



POLOKWANE MUNICIPALITY

BID NUMBER: PM18 - 25/26

TENDER DESCRIPTION: CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE
REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

NAME OF BIDDER:

CSD NUMBER:

CONTACT NUMBER

EMAIL ADDRESS:

TOTAL BID AMOUNT:

Document Prepared by: POLOKWANE MUNICIPALITY
Corner Landross Mare and Boddeinstein Street
POLOKWANE, Limpopo Province
0699

CLOSING DATE: 17 July 2026 @ 10H00

Documents must be deposited in the bid box not later than **10H00** on **17 July 2026**, when bids will be opened in public.

Bidders must contact the following officials for any enquiries:

- Supply chain enquiries: Mr. Tiro Pilusa: on tirop@polokwane.gov.za
- Bids will remain valid for 90 days after the closing date.

Bids received after the closing date and time will not be considered. Polokwane Municipality does not bind itself to accept the lowest or any other bid in whole or in part.

IMPORTANT NOTICE ON DISQUALIFICATIONS

A bid that does not comply with the peremptory requirements stated hereunder will be regarded as not being an “acceptable bid”, and such a bid will be rejected. An “acceptable bid” means any bid which, in all respects, complies with the conditions of the bid and the specifications as set out in the bid documents, including the conditions as specified in the preferential procurement policy framework Act and The Preferential Procurement Regulation, 2022 and related legislation, in terms of which provision is made for this policy.

1. If the bid document is completed using a pencil. Only black ink must be used to complete the bid document.
2. The bidder attempts to influence or has in fact influenced the evaluation and/or awarding of the contract.
3. The bid has been submitted after the stated closing date and time.
4. If any bidder who, during the last five years, has failed to perform satisfactorily on a previous contract with the municipality, municipal entity or any other organ of state after written notice was given to that bidder that performance was unsatisfactory.
5. The accounting officer must ensure that, irrespective of the procurement process followed, no award may be given to a person –
 - a. who is in the service of the state;
 - b. if that person is not a natural person, of which any director, manager, principal shareholder or stakeholder is a person in the service of the state; or
 - c. who is an advisor or consultant contracted to the municipality in respect of a contract that would cause a conflict of interest.
6. Bid offers will be rejected if the bidder or any of his/her directors are listed on the Register of Bid Defaulters in terms of the Prevention and Combating of Corrupt Activities Act, 2004 (Act 12 of 2004) as a person prohibited from doing business with the public sector.
7. Bid offers will be rejected if the bidder has abused the Polokwane Municipality supply chain management system.
8. Failure to complete and sign the certificate of independent determination or disclosure of wrong information.
9. Failed to pay municipal rates and taxes or municipal service charges and such rates, taxes and charges are in arrears for more than three months;

“Polokwane Municipality is committed to maintaining the highest standards of honesty, integrity and ethical conduct and has adopted a zero tolerance to fraud and corruption. Thus, Polokwane municipality urges all stakeholders and potential service providers to exercise extreme caution and be vigilant of imposters in the name of the Polokwane Municipality.

Service Providers are reminded of the importance of verifying the authenticity of any requests for personal information and avoid engaging with unsolicited communications, particularly those involving financial matters or the promise of tenders and jobs. Any suspicious activity, including fraudulent calls or messages, should be reported immediately to the relevant authorities and the police for investigation. Polokwane Municipality does not request potential service providers to pay any gratification to individual in any way whatsoever in exchange for the appointment to render services for the Municipality.”

.....

Signed by Bidder

TENDER NOTICE



PART A

INVITATION TO BID: MBD1

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF THE (POLOKWANE MUNICIPALITY)					
BID NUMBER:	PM18 - 25/26	CLOSING DATE:	17 July 2026	CLOSING TIME:	10H00
BID DESCRIPTION	CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B				
TOTAL BID PRICE (INCLUSIVE OF VAT 15%)					
THE CONTRACT SHALL BE THE "FIDIC YELLOW BOOK 2017 VERSION AND ANY OTHER SPECIAL CONDITIONS OF CONTRACT"					

BID RESPONSE DOCUMENTS MUST BE DEPOSITED IN THE BID BOX SITUATED AT (Polokwane Municipality, Civic Centre, corner, Bodenstein and Landdros Mare Street, Ground Floor) not later than 10H00 on 17 July 2026.

An official and compulsory site inspection will be held on **02 June 2026** at **10H00**. Bidders are requested to meet the New Peter Mokaba Stadium Complex, Executive Lounge, 1st Floor, Polokwane

Bid box is generally open 24 hours, 7 days a week.

Completed Bid document, fully priced and signed must be sealed in an envelope marked **"PM18 - 25/26: Construction, Operations and Maintenance of The Polokwane Regional Wastewater Treatment Works (PRWWTW): Phase 2B"**

Bids documents containing the Conditions of Bid and other requirements in terms of the Supply Chain Management Policy can be downloaded from e-tender Publication Portal at www.etenders.gov.za and www.polokwane.gov.za at no fee.

SUPPLIER INFORMATION

NAME OF BIDDER					
POSTAL ADDRESS					
STREET ADDRESS					
TELEPHONE NUMBER	CODE		NUMBER		
CELLPHONE NUMBER					
FACSIMILE NUMBER	CODE		NUMBER		
E-MAIL ADDRESS					
VAT REGISTRATION NUMBER					
TAX COMPLIANCE STATUS (TSC)	TCS PIN:		OR	CSD No:	

ARE YOU THE ACCREDITED REPRESENTATIVE IN SOUTH AFRICA FOR THE GOODS /SERVICES /WORKS OFFERED?	☐ Yes ☐ No [IF YES ENCLOSE PROOF]	ARE YOU A FOREIGN BASED SUPPLIER FOR THE GOODS /SERVICES /WORKS OFFERED?	☐ Yes ☐ No [IF YES, ANSWER PART B:3]
MINIMUM WORK OPPORTUNITIES TO BE CREATED	200	CIDB GRADING	9CE
TOTAL BID PRICE			
SIGNATURE OF BIDDER			
DATE			
CAPACITY UNDER WHICH THIS BID IS SIGNED			
BIDDING PROCEDURE ENQUIRIES MAY BE DIRECTED TO:			
SUPPLY CHAIN ENQUIRES			
MUNICIPALITY	POLOKWANE		
CONTACT PERSON	Mr. Tiro Pilusa		
TELEPHONE NUMBER	015 290 2212/2693		
E-MAIL ADDRESS	tirop@polokwane.gov.za		
TECHNICAL ENQUIRES			
MUNICIPALITY	POLOKWANE		
CONTACT PERSON	Mr. Ramaramela Sebaka		
TELEPHONE NUMBER	015 290 2335		
E-MAIL ADDRESS	ramaramelas@polokwane.gov.za		



EXPANDED PUBLIC WORKS PROGRAMME
Creating opportunities towards human fulfilment



water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

PART B

TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:										
1.1. Bids must be delivered by the stipulated time to the correct address. Late bids will not be accepted for consideration. 1.2. All bids must be submitted on the official forms provided (not to be re-typed) 1.3. THIS BID IS SUBJECT TO THE Preferential Procurement Policy Framework Act And The Preferential Procurement Regulations, 2022, FIDIC Yellow Book 2017 Version and, if applicable, any other special conditions of contract.										
2. TAX COMPLIANCE REQUIREMENTS										
2.1 Bidders must ensure compliance with their tax obligations. 2.2 Bidders are required to submit their unique personal identification number (PIN) issued by SARS to enable the organ of state to view the taxpayer's profile and tax status. 2.3 Application for the tax compliance status (TCS) certificate or pin may also be made via e-filing. In order to use this provision, taxpayers will need to register with SARS as e-filers through the website www.sars.gov.za. 2.4 Foreign suppliers must complete the pre-award questionnaire in part b:3. 2.5 Bidders may also submit a printed TCS certificate together with the bid. 2.6 In bids where consortia / joint ventures / sub-contractors are involved; each party must submit a separate TCS certificate / pin / CSD number. 2.7 Where no TCS is available, but the bidder is registered on the central supplier database (CSD), a CSD number must be provided.										
3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS										
<table style="width: 100%; border: none;"><tr><td style="width: 80%;">3.1. Is the entity a resident of the republic of South Africa (RSA)?</td><td style="width: 20%; text-align: right;">☐ YES ☐ NO</td></tr><tr><td>3.2. Does the entity have a branch in the RSA?</td><td style="text-align: right;">☐ YES ☐ NO</td></tr><tr><td>3.3. Does the entity have a permanent establishment in the RSA?</td><td style="text-align: right;">☐ YES ☐ NO</td></tr><tr><td>3.4. Does the entity have any source of income in the RSA?</td><td style="text-align: right;">☐ YES ☐ NO</td></tr><tr><td>3.5. Is the entity liable in the RSA for any form of taxation?</td><td style="text-align: right;">☐ YES ☐ NO</td></tr></table> If the answer is "no" to all of the above, then it is not a requirement to register for a tax compliance status system pin code from the South African Revenue Service (SARS) and if not register as per 2.3 above.	3.1. Is the entity a resident of the republic of South Africa (RSA)?	☐ YES ☐ NO	3.2. Does the entity have a branch in the RSA?	☐ YES ☐ NO	3.3. Does the entity have a permanent establishment in the RSA?	☐ YES ☐ NO	3.4. Does the entity have any source of income in the RSA?	☐ YES ☐ NO	3.5. Is the entity liable in the RSA for any form of taxation?	☐ YES ☐ NO
3.1. Is the entity a resident of the republic of South Africa (RSA)?	☐ YES ☐ NO									
3.2. Does the entity have a branch in the RSA?	☐ YES ☐ NO									
3.3. Does the entity have a permanent establishment in the RSA?	☐ YES ☐ NO									
3.4. Does the entity have any source of income in the RSA?	☐ YES ☐ NO									
3.5. Is the entity liable in the RSA for any form of taxation?	☐ YES ☐ NO									

**NB: FAILURE TO PROVIDE ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID.
NO BIDS WILL BE CONSIDERED FROM PERSONS IN THE SERVICE OF THE STATE.**

SIGNATURE OF BIDDER:

CAPACITY UNDER WHICH THIS BID IS SIGNED:

DATE:

POLOKWANE MUNICIPALITY

CONTENTS OF TENDER DOCUMENTATION

Volume 1: Tender requirements, Contract and Pricing Data	
Number	Heading
THE TENDER	
Part T1: Tendering procedures	
T1.1	Tender Notice and Invitation to Tender
T1.2	Tender Data
T1.3	Standard Conditions of Tender
Part T2: Returnable Documents	
T2.1	List of Returnable Documents
T2.2	Returnable Schedules
Part C1: Agreements and Contract Data	
C1.1	Form of Offer and Acceptance
C1.2	Contract Data
C1.3	Demand Guarantee and Retention Money Guarantee
C1.4	Occupational Health and Safety Agreement
C1.5	Agreement with Adjudicators
Part C2: Pricing Data	
C2.1	Pricing Instructions
C2.2	Bill of Quantities
Volume 2: Scope of Work, Site Information and associated annexures	
Part C3: Scope of Work	
C3.1	Description of The Works
C3.2	Standard Specifications
C3.3	Particular Specifications
Part C4: Site Information	
C4.1	Locality Map
C4.2	Geotechnical Investigations
C4.3	Geohydrological Status Report
Part C5: Annexures	
C5.1	Water Use Licence
C5.2	Environmental Management Plan
C5.3	OHS Specification
C5.4	Environmental Authorisation
C5.5	Mechanical Datasheets
C5.6	Electrical Datasheets
C5.7	Drawings

A. PART T1: TENDERING PROCEDURE

1. T1.1 TENDERING PROCEDURES

BID No.: PM18 - 25/26: **CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B**

DIRECTORATE: WATER AND SANITATION SERVICES

1.1 Tender Notice

- 1.1.1 Bids are hereby invited for the **Construction, Operations and Maintenance of The Polokwane Regional Wastewater Treatment Works (PRWWTW): Phase 2B**
- 1.1.2 Bidders should ensure that bids are delivered timeously to the correct address. If the bid is late, it will not be accepted for consideration. It is estimated that tenderers must have a CIDB contractor grading designation of 9CE
- 1.1.3 The CIDB Standard for Developing Skills through Infrastructure Contracts, published in Government Gazette 43495 dated 3 July 2020 and the CIDB Standard for Indirect Targeting for Enterprise Development through Construction works Contracts, published in Gazette Notice No.36190 of 25 February 2013 is applicable to this project
- 1.1.4 THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATION, 2022, AND THE "CONDITIONS OF CONTRACT FOR CONSTRUCTION FOR BUILDING AND ENGINEERING WORKS DESIGNED BY THE EMPLOYER" SECOND EDITION 2017 PUBLISHED BY THE FÉDÉRATION INTERNATIONALE DES INGÉNIEURS — CONSEILS (FIDIC) (FIDIC YELLOW BOOK) SECOND EDITION 2017.
- 1.1.5 The Municipality shall adjudicate and award bids in accordance with preference points of 90/10-point system, 90 points for the price and 10 points for specific goals. Prospective bidders must accept that the bid will be adjudicated, according to the said legislation. Bids will remain valid for 90 days. The Municipality also reserves the right to negotiate further conditions and requirements with the successful bidder.
- 1.1.6 All bids received shall be evaluated in terms of the Supply Chain Management Regulations, the Polokwane Municipality Supply Chain Management Policy (on request from the Municipality), and other applicable legislation.
- 1.1.7 The Municipality reserves the right to accept all, some, or none of the bids submitted – either wholly or in part – and it is not obliged to accept the lowest bid.
- 1.1.8 By submitting this bid, bidder authorizes the Municipality or its delegate(s) to carry out any investigation deemed necessary to verify the correctness of the statements and documents submitted and that such documents reasonably reflect the ability of the Bidder to provide the goods and services required by the Municipality.

THUSO NEMUGUMONI
CITY MANAGER
CIVIC CENTRE
LANDDROS MARE STREET
POLOKWANE, LIMPOPO
0699

T1.2

TENDER DATA

2.1 T1.2 Tender Data

1. CONDITIONS OF TENDER

The conditions of this tender are the Standard Conditions of Tender as contained in Annex C of the CIDB Standard for Uniformity in Engineering and Construction Works Contracts. Board Notice 423 of 2019 in Government Gazette No 42622 of 8 August 2019 (see www.cidb.org.za).

The Standard Conditions of Tender make several references to Tender data for details that apply specifically to this tender. The Tender Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender. See www.cidb.org.za.

Each Tenderer shall obtain its own copy of the Standard Conditions of Tender.

Each item of data given below is cross-referenced to the clause in the Standard Conditions of Tender to which it mainly applies.

The CIDB Standard for Developing Skills through Infrastructure Contracts, published in Government Gazette 43495 dated 3 July 2020 and the CIDB Standard for Indirect Targeting for Enterprise Development through Construction works Contracts, published in Gazette Notice No.36190 of 25 February 2013 is applicable to this project.

Clause Number	Tender Data
EMPLOYER C.1.1	The "Employer" is "Polokwane Municipality" The Employer's <i>domicilium citandi et executandi</i> (permanent physical business address) is: POLOKWANE MUNICIPALITY Civic Centre, Landdros Mare Street POLOKWANE, Limpopo 0699 The Employer's address for communication relating to this project is: POLOKWANE MUNICIPALITY PO Box 111, POLOKWANE, Limpopo 0700
TENDER DOCUMENTS C.1.2	"The following documents form part of this tender: THE TENDER Part T1 Tendering procedures T1.1 Tender Notice and Invitation to Tender T1.2 Tender data T1.3 Standard and Particular Conditions to Tender Part T2 Returnable Documents T2.1 List of Returnable Documents T2.2 Returnable Schedules Part C1 Agreements and Contract Data C1.1 Form of Offer and Acceptance C1.2 Contract Data C1.3 Demand Guarantee and Retention Money Guarantee C1.4 Occupational Health and Safety Agreement C1.5 Agreement with Adjudicators Part C2 Pricing Data C2.1 Pricing Instructions C2.2 Bill of Quantities Part C3 Scope of Work C3.1 Description of the Works

Clause Number	Tender Data
	C3.2 Standard Specifications C3.3 Particular Specifications Part C4 Site information C4.1 Locality Map C4.2 Geotechnical Investigations C4.3 Geohydrological Status Report Part C5: Annexures C5.1 Water Use Licence C5.2 Environmental Management Plan C5.3 OHS Specification C5.4 Environmental Authorisation C5.5 Mechanical Datasheets C5.6 Electrical Datasheets C5.7 Drawings
INTERPRETATION	For the purposes of these conditions of tender, the following definitions apply:
C.1.3	
C.1.3.3	bidder - The CIDB prescripts use the terms “tender” and “tenderer” in preference to “bid” and “bidder”. For ease of reference, the Municipality has kept the word “bid” in most sections of this document instead of “Tender”. In some parts, the term tender is used. The words tenderer and bidder are used inter-changeably. Similarly, the terms ‘bid’ and ‘tender’ or ‘tenderer’ and ‘bidder’ and their derivatives are meant to have the same meaning in the context they are used. targeted enterprise - sole trader, partnership or legal entity which is engaged in the performance of the contract and defined as the target group. Enterprises can be targeted upon the basis of a) locality (domicile), b) status as a small, medium, or micro enterprise, c) ownership, operational responsibilities and control, (or a combination thereof), by designated groups (, or d) a combination of (a), (b) and (c). Targeting can be either on a generic or an area-bound (localized) basis, for example women-owned business enterprises (generic), or business enterprises within a geographical region (area-bound). Professional registration categories and abbreviations: Pr. Eng stands for Professional Engineer. It is a recognized title given to engineers who are registered or licensed with a professional engineering regulatory body (Engineering Council of South Africa, commonly known as ECSA). Pr. Eng Tech stands Professional Engineering Technologist, which is different from a Professional Engineer (Pr. Eng) but still a recognized professional registration in engineering within ECSA. It is a mid-tier professional registration, sitting between Professional Engineer (Pr. Eng) and Engineering Technician (Eng Techni). Pr. Eng Techni stands for Professional Engineering Technician. It represents the entry-level professional registration in engineering, focusing on technical support and practical engineering tasks under supervision. Pr. CM stands for Professional Construction Manager. It is a professional designation given by SACPCMP for individuals who are registered or recognized in the field of construction management. A Pr CM generally oversees and manages construction projects from inception to completion. Pr. CPM stands for Professional Construction Project Manager. It is a professional registration within SACPCMP for individuals who are qualified to manage construction projects at a professional level, combining technical, managerial, and legal responsibilities. SACPCMP stands for the South African Council for the Project and Construction Management Professions. It is the statutory regulatory body in South Africa responsible for overseeing, regulating, and promoting the professions of project management, construction management, and related disciplines. Each tender offer shall be in the English Language. Documents written in other languages, such as Reference letters from previous clients, CVs and other supporting documents should be

Clause Number	Tender Data
	translated to the English language in a form that can be readily read, copied and recorded prior submission for ease of understanding and for evaluation processes.
EMPLOYER'S AGENT C.1.4	The Employer's agents are: a) Principal Agent ZAKUMI Consulting Engineers (Pty) Ltd Contact Person: Dr. Talent Diotrefe Banda Physical Address: ZCE House 21 Compensatie Street, CBD POLOKWANE, Limpopo Province South Africa, 0699 Postal Address: PO Box 3154, POLOKWANE, 0700 Telephone: (015) 291 1776 Facsimile: (015) 291 1993 E-mail: admin@zce.co.za
5. TENDERER'S OBLIGATIONS	
ELIGIBILITY C.2.1	The following Eligibility Criteria apply to this tender: 1. Responsiveness 1.1 It is an Eligibility Criteria requirement that Tenderers complete and submit all Returnable Schedules and Documentation as described in the TENDER and as listed in T2.1, and in accordance with the submission requirements set out in Table A1 of the tender data 1.2 A tender offer may only be submitted if the Tenderer satisfies the criteria stated in the Tender Data and if the Tenderer, or any of his principals, is not under any restriction to do business with the Employer. 2. Step 1 – Compulsory clarification meeting attendance 2.1 An authorised representative of the tendering entity or a representative of a tendering entity that intends to form a Joint Venture (JV) must attend the compulsory clarification meeting in terms C2.7 3. Eligibility in terms of the Construction Industry Development Board: 3.1 This tender applies CIDB Regulation(s) 25(1B), or 25(7A) issued in terms of the CIDB Act. 3.2 The Tenderer must demonstrate a CIDB grading of 9CE or higher within its Consortium or Joint Venture. Tenderers are required to submit proof of CIDB grading with their Tender Offer. Tenderers who do not comply with this requirement will be declared non-responsive. 3.3 Potentially emerging enterprise (PE) status in terms of CIDB grading will not be applicable to the tenderer and it therefore will be a requirement to hold to requisite CIDB grading without reference to PE status. Members, Subcontractors and any other party carrying out the Works must have necessary CIDB grading for the value and complexity of Works they are undertaking. 4. Requirements for Joint Ventures, Consortia 4.1 The Tenderer, if comprising Members of an unincorporated joint venture or consortium, shall submit a Member organogram in its Tender Offer. 4.2 Where the Tenderer is an unincorporated joint venture or consortium, the Tenderer shall submit a signed Joint Venture Agreement or Consortium Agreement signed by each Member of the joint venture or consortium. 4.3 The Joint Venture Agreement or Consortium Agreement shall specify the proportional participation or share of each Member in the contracting party. The Contractor will be responsible for ensuring that such proportional participation or share is adhered to for the Time for Completion, which will be monitored in terms of the Contract.

Clause Number	Tender Data
	4.4 Each member, if not a natural person, shall be duly authorised to enter into the Joint Venture Agreement or Consortium Agreement by its board of directors by way of a signed letter of authority. Original or original certified copies of the letters of authority shall be appended to the Joint Venture Agreement or Consortium Agreement. 4.5 Each Member shall, as an express term in the joint venture or consortium agreement, authorise the lead Member acting on behalf of the Tenderer to submit a Tender Offer. 4.6 Each Member to a joint venture or consortium shall be held jointly and severally liable under the Contract. The Tenderer shall declare in the Joint Venture or Consortium Agreement, the indemnities which are agreed between the Joint Venture or Consortium Members. 4.7 Members may not participate in the Tender Offer of more than one Tenderer including Members that are Subcontractors. Subcontractors that are not Members of a Tenderer may participate in the Tender Offer of more than one Tenderer, provided that: 4.7.1 Such Subcontractors shall not be involved in the determination of Financial Offers. 4.7.2 Key Persons of such Subcontractors may not participate in the Tender Offer of more than one Tenderer. 4.8 every member of the joint venture is registered with the CIDB; 4.9 the lead partner has a contractor grading designation of not lower than one level below the required class of construction works under consideration and possesses the required recognition status; 4.10 the combined Contractor grading designation calculated in accordance with the Construction Industry Development Regulations is equal to or higher than a Contractor grading designation determined in accordance with the sum tendered for a 9CE or higher class of construction work or a value determined in accordance with Regulation(s) 25(1B), or 25(7A) of the Construction Industry Development Regulations; and 5 National Treasury Central Supplier Database (CSD) Registration 5.1 Each Member and declared Subcontractor of the Tenderer shall be registered on the National Treasury Central Supplier Database at the closing date for TENDER submissions 5.2 The Tenderer shall submit a CSD Summary Report for each Member and declared Subcontractor of the Tenderer 6 Submission of four (4) Skilled and Qualified individuals with extensive experience in the water and/or wastewater treatment works projects (Design Support Team): 6.1 Civil Design Engineer shall be responsible for the civil design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following: • A minimum of 15 years' relevant post-graduate experience in Civil Engineering design within the built environment; • Have demonstrated experience in water and/or wastewater treatment projects; • Hold a minimum a minimum of BSc, BEng or B Tech in Civil Engineering or the Built Environment. • Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA) 6.2 Mechanical Design Engineer shall be responsible for the mechanical design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following: • a minimum of 15 years' relevant post-graduate experience in Mechanical Engineering design within the built environment; • Have demonstrated experience in water and/or wastewater treatment projects, having successfully completed a minimum of two (2) projects; • Hold a minimum a minimum of BSc, BEng or B Tech in Mechanical Engineering or the Built Environment.

Clause Number	Tender Data
	- Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA) 6.3 Electrical Design Engineer shall be responsible for the electrical design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following: - A minimum of 15 years' relevant post-graduate experience in Electrical Engineering design within the built environment; - Have demonstrated experience in water and/or wastewater treatment projects; - Hold a minimum a minimum of BSc, BEng or B Tech in Electrical Engineering or the Built Environment; and - Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA). 6.4 The WWTW Operations (Plant) Manager shall be responsible for the overall operation, performance, compliance and maintenance management of the wastewater treatment works, ensuring that all treatment processes, assets and systems function safely, reliably and in accordance with regulatory requirements. The role includes oversight of operations staff, coordination of maintenance activities, performance monitoring, incident management, and skills transfer to City personnel to enable sustainable handover at the end of the operating period. The Plant Manager shall have the following: - Minimum 8 years' experience in WWTW operations with demonstrated experience with biological treatment processes; - Have demonstrated experience in managing wastewater treatment projects; and - Hold a minimum a minimum of BSc, BEng or B Tech in Water/Wastewater Treatment, Chemical Engineering, Civil Engineering, or Process Engineering; and - Experience with regulatory compliance (e.g. Green Drop or equivalent). Attach a detailed CV indicating detailed and traceable experience relevant to the works, contactable references, evidence of academic qualifications and professional registration (<i>Use Table J1 CV Template a guide</i>). NB: Foreign Qualifications to be accompanied by SAQA verification. 7 Administrative and substantive compliance 7.1 Bid documents are completed using black ink; 7.2 Pricing schedule (BoQ) in its entirety in black ink; 7.3 Form of offer and Acceptance filled in full; and 7.4 Submission of audited or reviewed annual financial statement for the past three years. <i>Any tenderer that fails to meet the stipulated eligibility criteria will be regarded as an unacceptable tender.</i>
SITE VISIT AND BRIEFING SESSION C.2.7	The arrangements for a compulsory site briefing session are as follows: Location: New Peter Mokaba Stadium Complex, Executive Lounge 1st floor Date and Time: 02 June 2026 at 10H00 - After we proceed to the project site which lies behind the Polokwane International Airport approximately 18.50 km northwest of Polokwane Central Business District (CBD). The project site is accessible through Landdros Mare Street or Regional Road R101 - Project Site Central coordinates: S 23° 47' 42.42" and E 029° 27' 19.27". - The onus rests with the tenderer to ensure that the person attending the clarification meeting on his behalf is appropriately qualified to understand all directives and clarifications given at that meeting. - Tenderers shall sign the attendance list in the name of the tendering entity. Addenda will be issued to, and tenders will be received only from those tendering entities appearing on the attendance list. It is the responsibility of the tenderer to ensure that the names of the tenderer, representatives and contact details (emails and contact numbers) are written down in a legible form. - The tenderer shall bear all costs associated with his visit or visits to the site and his attendance at the compulsory briefing session.

Clause Number	Tender Data
	Requests for further clarifications are to be submitted no later than 5 working days before the closing time.
INSURANCE C.2.9	No insurance cover will be provided by the Employer. The tenderer is advised to seek qualified advice regarding insurances stipulated in the Contract Data.
PRICING THE TENDER OFFER C.2.10	Include in the rates, prices, and the tendered total of the prices (if any) all duties, taxes except Value Added Tax (VAT), and other levies payable by the successful tenderer, such duties, taxes and levies being those applicable fourteen (14) days before the closing time stated in the tender data. Show VAT payable by the employer separately as an addition to the tendered total of the prices. Provide rates and prices that are fixed for the duration of the contract and not subject to adjustment except as provided for in the conditions of contract identified in the contract data. State the rates and prices in ZAR (Rand) unless instructed otherwise in the tender data. The conditions of contract identified in the contract data may provide for part payment in other currencies.
ALTERATIONS TO DOCUMENTS C.2.11	No alterations or additions to the tender documents will be permitted or accepted, except to comply with instructions issued by the employer, or necessary to correct errors made by the tenderer. All signatories to the tender offer shall initial all such alterations.
ALTERNATIVE TENDER OFFERS C.2.12.	Unless anything to the contrary has been determined in the Contract Data, a Tenderer may, together with his tender for the original designs contained in the contract documents, submit alternative designs and tender offers for consideration. All designs, calculations, drawings and Operation and Maintenance manuals shall be fully endorsed by a third-party registered engineer, accomplished in such specific field of practice and the cost thereof shall be borne solely by the Contractor. Such alternative designs and offers shall be subject to the following conditions and requirements: Tenders - An alternative offer or design will be considered only if the tender for the original items has been fully priced and completed. The alternative tender offer is to be submitted in the same envelope as the main tender offer, together with a schedule that compares the requirements of the tender documents with the alternative requirements the Tenderer proposes. No alternative tender will be considered unless a tender free from qualifications is also submitted. - Unless the alternative offer stipulates to the contrary, it shall be assumed that the period for completion of the Works shall be the same as for the original design. Preliminary calculations Preliminary calculations for an alternative design shall be submitted with the tender. Such calculations shall give adequate details so as to enable an assessment to be made of the general efficacy of the design and of its principal elements, also of the degree to which the design prescriptions and codes of the Employer are being complied with. The calculations shall be clear and in a logical sequence and shall clearly reflect all the design assumptions. Preliminary drawings Preliminary drawings of the alternative designs shall also be submitted with the tender. These drawings shall comprise adequate layout plans, elevations and sections and shall clearly illustrate the general efficacy of the design and its principal elements. Quantities Each alternative offer shall be accompanied by a modified priced schedule of quantities compiled in accordance with the specifications, in so far as it is applicable, which clearly shows how the price for the alternative offer has been determined and the items in the original schedule of

Clause Number	Tender Data
	quantities which fall away or are being changed. In addition to the schedule of quantities, a set of calculations shall be supplied to show how the quantities have been determined. All assumptions in regard to factors which will determine quantities shall be clearly and conspicuously marked by underlining or colouring and shall indicate whether or not the assumptions have been based on information furnished in the Contract Data (with the necessary references). Further details Should the Employer's Agent find that the calculations and drawings submitted for alternative designs are not complete enough for proper adjudication of the alternative designs, the Employer reserves to itself the right to call on the Tenderer to submit such further calculations and drawings as may be required. If such further details are not submitted within ten days of having been requested, the alternative designs will not be given further consideration. Preliminary adjudication of alternative designs The Employer's Agent will undertake a preliminary scrutiny of any alternative designs for compliance with the specified requirements of the Employer. Should he find any mistakes or unsatisfactory aspects, he may afford the Bidder the opportunity to rectify them within a period to be determined by the Employer's Agent. However, it is emphasized that the preliminary scrutiny of the design and tender by the Employer's Agent, by its very nature, cannot be comprehensive, and no guarantee can be given in this regard that all the mistakes made by the Bidder will in fact be detected. Any correction of such mistakes shall be made with the tender price of the bidder being retained, and, wherever necessary, the priced schedule of quantities for the alternative design shall be adjusted accordingly. Acceptance of alternative design The Bidder shall note that the acceptance of a tender which includes alternative designs shall mean that the alternative designs have been approved in principle only. If the final calculations, drawings and details do not comply with the specified requirements, such alternative designs may be rejected, unless they are suitably amended by the Bidder so as to be acceptable to the Employer. Final drawings and calculations and the priced schedule of quantities Where a tender with an alternative design has been accepted, the Contractor shall, not less than two months before he intends starting with the construction of such design, submit to the Employer's Agent a complete set of working drawings, detailed calculations and a complete schedule of quantities, for approval. The schedule of quantities shall be based on the preliminary schedule of quantities, but with the necessary adjustments in quantities and prices and with the tendered price for the alternative design being retained. Within three weeks of having received the above, the Employer's Agent will indicate which drawings, calculations, quantities, prices and other particulars are acceptable to him and which not, with reasons furnished. The Contractor shall then submit to the Employer's Agent in good time any modified drawings and other particulars for approval, for which he will require two weeks. Any delay arising from the fact that the amended particulars do not meet the requirements shall be the responsibility of the Contractor. No work which will be affected by an alternative design may be commenced, unless the drawings, schedule of quantities and prices for such alternative design have been approved. Should the Contractor fail to modify any drawings, calculations, quantities, prices or any other particulars to the satisfaction of the Employer's Agent, the alternative design will be rejected and the original design shall be constructed for the same amount as has been tendered for the alternative design. Responsibility for alternative design The approval of a design by the Employer's Agent shall not in any way relieve the Bidder of his responsibility to produce a design which conforms in all respects to all the specified requirements,

Clause Number	Tender Data
	and which will be suitable for the purpose envisaged. Should it appear later during construction or during the maintenance period that the design does not conform to the specified requirements, the Contractor only, shall be liable for any damage arising there from and he shall, at his own expense, do all the necessary work to ensure that the Works conforms to all the specified requirements. Indemnity Once the alternative design has been approved, the Contractor shall indemnify and hold harmless the Employer, its agents and assigns, against all claims howsoever arising out of the said design whether in contract or delict.
SUBMITTING A TENDER OFFER C.2.13	Whole of the Works (C.2.13.1) Tenderers shall offer to provide for the whole of the Works identified. Original tender documents (C.2.13.2) The original tender document, issued to the bidder, shall be completed by writing legibly in non-erasable ink and be submitted in its entirety. The Tenderer shall respond in full to each item as contained in the List of Returnable Schedules and Documents. The Tender Offer and each Bid shall be in the same chronological order as the List of Returnable Schedules and Documents. The pages of Tender Offer and each Bid shall be logically titled, numbered and/or otherwise marked to ensure that the position of each page in the Tender Offer can be uniquely traced to the Tender Offer and Returnable Schedules and/or Documents in the same chronological order as submitted. • Tenderers are not required to number their Tender Offers or Bids sequentially from beginning to end, provided it is logically traceable. • Where prescribed, the Tenderer shall use the format of the Returnable Schedules to compile the relevant part of its Tender Offer and Bids. Marking of Tender Submissions (C.2.13.3) The complete tender documents shall be enclosed and sealed in a single envelope, marked together with a soft copy (USB) “BID No.: PM18 - 25/26 - CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B Submit the parts of the tender offer communicated on paper as an original plus the number of copies stated in the tender data, with an English translation of any documentation in a language other than English and also print out the parts communicated electronically in the same format as they were issued by the employer. The Employer’s address for delivery of tender offers to be shown on each tender submission package is the Tender Box located at: POLOKWANE MUNICIPALITY Civic Centre Landdros Mare Street POLOKWANE, Limpopo 0699 Two envelope system (C.2.13.6) A two-envelope procedure will not be followed.
CLOSING TIME AND PLACE C.2.15	The Employer’s address for delivery of tender offers to be shown on each tender submission package is the Tender Box located at: POLOKWANE MUNICIPALITY Civic Centre Landdros Mare Street

Clause Number	Tender Data
	POLOKWANE, Limpopo 0699 Closing time (C.2.15) The closing time for submission of tender offers is: 10H00 (Municipality time) NO LATE TENDERS WILL BE ACCEPTED It is the responsibility of the tenderer(s) to ensure that tender documents are submitted on or before closing time and at the correct location. The municipality will not take responsibility for wrong delivery of the documents. Tenderers making use of courier services for delivery of their tender documents must ensure the delivery is sent to the correct place/location and time, as the municipality will not be held responsible for wrong or late delivery. Tenderers are not to be delivered to municipal officials. The municipality will not accept responsibility of tenders received by security officials or municipal officials, if they are not timely been deposited in the Tender Box. Tenders may only be submitted on the Tender Documentation that is issued. Tenderers must be registered on the National Treasury Central Supplier Data Base and proof of registration must be submitted with the bid (https://secure.csd.gov.za). Requirements for sealing, addressing, delivery, opening and assessment of tenders are stated in the Tender Data (C.2.13) and Invitation to Tender.
TENDER OFFER VALIDITY C.2.16	The tender offer validity period is 90 days after the closing date. Tenderers are to note that they may be requested to extend the validity period of their tender, on the same terms and conditions, if the City's internal evaluation and governance approval processes has not been finalised within the validity period.
CLARIFICATION OF TENDER OFFER AFTER SUBMISSION C.2.17	The tenderer may be requested to provide clarification of a tender offer in response to a request to do so from the employer during the evaluation of tender offers. This may include providing a breakdown of rates or prices and correction of arithmetical errors by the adjustment of certain rates or item prices (or both). No change in the competitive position of tenderers or substance of the tender offer is sought, offered, or permitted.
PROVIDE OTHER MATERIAL C.2.18	Upon request by the Employer, the tenderer shall promptly supply any other material that has a bearing on the tender offer, the bidder's commercial position (including, where applicable, notarized joint venture agreements), preferencing arrangements, or samples of materials, considered necessary by the Employer for the purpose of a full and fair assessment. Should the tenderer not provide the information or material called for, by the time for submission stated in the Employer's request, the Employer will regard the tender offer as being non-responsive.
SUBMIT SECURITIES, BONDS AND POLICIES C.2.20	If requested, submit for the employer's acceptance before formation of the contract, all securities, bonds, guarantees, policies and certificates of insurance required in terms of the conditions of contract identified in the contract data.
CERTIFICATES C.2.23	The following certificates are to be provided with this tender: a) Tax Pin Certificate b) Vaid Letter of Good Standing with Workmen's Compensation Fund (COIDA). c) Certificate of Contractor Registration issued by the Construction Industry Development Board or a copy of the application Form for registration in terms of the Construction Industry Development Board Act (Form F006) or a CIDB Registration number (i.e. CRS number). A minimum grading of 9CE is required. d) Proof of registration on the Central Supplier Database; Important Note: Failure to provide the required particulars as per the above-listed certificates may lead to a tenderer being considered a non-responsive tender.

Clause Number	Tender Data
BID GUARANTEE	Each Tenderer shall submit an original, unconditional and irrevocable guarantee in the form set out in Returnable Schedule C1.3 of this TENDER. If a Tenderer fails to lodge such Bid Guarantee, the Tender Offer will be declared non-responsive and the Tenderer will be eliminated. The bid guarantee shall be: - issued by a bank which is licensed to conduct banking business in South Africa under the Banks Act No. 94 of 1990 or a licensed short-term insurer as contemplated in the Short-Term Insurance Act No. 53 of 1998 and which has a South African rating of BBB or better by Standard & Poor's or equivalent; and - be valid and effective for the period from the date of its issue until the earlier of the expiry of 365 (three hundred and sixty five) days from the Bid Submission Date and:- - in the case of an unsuccessful Tenderer, either (i) 30 (thirty) days after the Tenderer is notified that it has submitted a Tender Offer that is non-responsive; or (ii) the date that such Tenderer is notified that notwithstanding that its Tender Offer was responsive, it has not been successful; and - in the case of a successful Tenderer, the date on which the Contract is entered into between the Contractor and the Employer, - and shall remain valid during that period notwithstanding the insolvency, winding up, liquidation, judicial management, dissolution, business rescue or de-registration, whether provisionally or finally, of any Member of the Tenderer or the Tenderer itself (if it is a legal entity) or any other person.
	The Tenderer shall submit the following prior to formation of the Contract: - Advance Payment Bond - Performance Bond - Retention Bond (if the Tenderer in its Tender Offer proposes the use of a Retention Bond)
5. EMPLOYER'S UNDERTAKING	
ISSUE ADDENDA C.3.2	If necessary, issue addenda that may amend or amplify the tender documents to each tenderer during the period from the date that tender documents are available until three (3) working days before the tender closing time stated in the Tender Data (clause C.2.15). If, as a result a tenderer applies for an extension to the closing time stated in the Tender Data, the Employer may grant such extension and, shall then notify all tenderers who collected tender documents.
OPENING OF TENDER SUBMISSIONS C.3.4	The time and location for opening of the tender offers are: Time: 10H00 on 17 July 2026 Location: Tender Box, Polokwane Municipality, Civic Centre, Landdros Mare Street, Polokwane
ARITHMETICAL ERRORS C.3.9	Arithmetical errors, omissions and discrepancies shall be treated as per clause 3.9 of the Annexure C of the Standard Conditions of Tender (SFU August 2019). The Contract Price for the completed Contract shall be computed from the actual quantities of authorised work done and compliant with the Contract Data, valued at rates contracted against the respective items in the bill of quantities, schedule of Quantities or schedule of rates and shall include such authorised Provisional Sums and items of extra work as have become payable in terms of the Contract Data.
EVALUATION OF TENDER OFFERS C.3.11	Phase One – Administrative and Eligibility compliance Phase Two – Functionality criteria (a minimum of 80 points) Phase Three – Price and Preference Refer to Annexure A for the detailed evaluation criteria.

Clause Number	Tender Data
ACCEPTANCE OF TENDER OFFER C.3.13	Tender offers will only be accepted if: a) is not under restrictions, or has principals who are under restrictions, preventing participating in the employer's procurement; b) can, as necessary and in relation to the proposed contract, demonstrate that he or she possesses the professional and technical qualifications, professional and technical competence, financial resources, equipment and other physical facilities, managerial capability, reliability, experience and reputation, expertise and the personnel, to perform the contract; c) has the legal capacity to enter into the contract; d) is not; insolvent, in receivership, under Business Rescue as provided for in chapter 6 of the Companies Act No. 2008, bankrupt or being wound up, has his/her affairs administered by a court or a judicial officer, has suspended his/her business activities or is subject to legal proceedings in respect of any of the foregoing; e) complies with the legal requirements, if any, stated in the tender data; f) is able, in the opinion of the employer, to perform the contract free of conflicts of interest. g) Is in his or her possession of a valid Tax Pin issued by the South Africa Revenue Services; h) is registered with the Construction Industry Development Board in an appropriate contractor grading designation. A minimum grading of 9CE is required for the main contractor; i) has submitted four (4) experienced Professionally registered Engineers (ECSA): 1 x Civil Engineering discipline, 1 x Mechanical Engineering discipline and 1 x Electrical Engineering discipline and 1 x Operations (Plant) Manager. All individuals must have extensive experience in the design and management of Water and Wastewater projects; j) any or all its principals is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; k) has not abused the Employer's Supply Chain Management System. l) can, as necessary and in relation to the proposed contract, demonstrate that he or she possesses the professional and technical qualifications, professional and technical competence, financial resources, equipment and other physical facilities, managerial capability, reliability, experience and reputation, expertise and the personnel, to perform the contract; m) is able, in the opinion of the employer, to perform the contract free of conflicts of interest; n) has completed the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the bidder's ability to perform the contract in the best interests of the employer or potentially compromise the tender process.
PROVIDE COPIES OF THE CONTRACT DOCUMENT C.3.17	The number of paper copies of the signed Contract to be provided by the Employer to the successful bidder is one

ANNEXURE A

SUPPLY CHAIN MANAGEMENT

EVALUATION PROCESS AND CRITERIA

The following evaluation process and criteria will be used to evaluate all bids submitted:

1. Administrative and Eligibility Compliance – Phase One

- 1.1 All bids duly lodged will be examined to determine compliance with bidding requirements and conditions. Bids with obvious deviations from the requirements/conditions, will be eliminated from further evaluation.

CRITICAL CRITERIA:

- A. The following information is expected to be submitted in full. Bidders who do not adhere to those criteria listed as PRE-QUALIFIER (Table A1), will be disqualified immediately:

Table A1

No	Responsiveness Criteria	Applicable to this Tender (Y/N)
1.	Attendance of a Compulsory briefing session and the attendance register duly completed and signed.	Y
2.	Bid documents are completed using black ink	Y
3.	Pricing schedule (BoQ) in its entirety and in black ink	Y
4.	Signed by a black pen all changes or alterations to written numbers in the pricing schedule (BOQ)	Y
5.	Form of offer and Acceptance filled in full	Y
6.	Valid proof of registration with CIDB attached. The registration in a correct class and grade level	Y
7.	Civil Design Engineer shall be responsible for the civil design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following: - A minimum of 15 years' relevant post-graduate experience in Civil Engineering design within the built environment; - Have demonstrated experience in water and/or wastewater treatment projects, having successfully completed a minimum of two (2) projects of an average capacity of 20 ML/day and/or a minimum project value of R100 million per project, escalated to the date of tender closure by the Employer or Employer's Agent using an escalation factor of 7.5% per annum; - Hold a minimum a minimum of BSc, BEng or B Tech in Civil Engineering or the Built Environment. - Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA)	Y
8.	Mechanical Design Engineer shall be responsible for the mechanical design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following: a minimum of 15 years' relevant post-graduate experience in Mechanical Engineering design within the built environment;	Y

	- Have demonstrated experience in water and/or wastewater treatment projects, having successfully completed a minimum of two (2) projects of an average capacity of 20 ML/day and/or a minimum project value of R100 million per project, escalated to the date of tender closure by the Employer or Employer's Agent using an escalation factor of 7.5% per annum; - Hold a minimum a minimum of BSc, BEng or B Tech in Mechanical Engineering or the Built Environment. - Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA)	
9.	Electrical Design Engineer shall be responsible for the electrical design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following: - A minimum of 15 years' relevant post-graduate experience in Electrical Engineering design within the built environment; - Have demonstrated experience in water and/or wastewater treatment projects, having successfully completed a minimum of two (2) projects of an average capacity of 20 ML/day and/or a minimum project value of R100 million per project, escalated to the date of tender closure by the Employer or Employer's Agent using an escalation factor of 7.5% per annum; - Hold a minimum a minimum of BSc, BEng or B Tech in Electrical Engineering or the Built Environment. - Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA)	Y
10.	The WWTW Operations (Plant) Manager shall be responsible for the overall operation, performance, compliance and maintenance management of the wastewater treatment works, ensuring that all treatment processes, assets and systems function safely, reliably and in accordance with regulatory requirements. The role includes oversight of operations staff, coordination of maintenance activities, performance monitoring, incident management, and skills transfer to City personnel to enable sustainable handover at the end of the operating period. The Plant Manager shall have the following: - Minimum 8 years' experience in WWTW operations with demonstrated experience with biological treatment processes; - Have demonstrated experience in managing wastewater treatment projects, having successfully operated a minimum of two (2) projects of minimum capacity of 20 ML/day - Hold a minimum a minimum of BSc, BEng or B Tech in Water/Wastewater Treatment, Chemical Engineering, Civil Engineering, or Process Engineering; and - Experience with regulatory compliance (e.g. Green Drop or equivalent);	
11.	Director(s) of the tenderer in the service of the State. Tender will be disqualified	Y
12.	Director(s) convicted of fraud or corruption during the past five years. Tender will be disqualified	Y
13.	Tenderer or director(s) has been listed in the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No. 12 of 2004) or has been listed on National Treasury's database as a person prohibited from doing business with public sector. Tender will be disqualified	Y
14.	Valid Tax Pin Certificate showing compliance status (If JV, submit for Both	Y
15.	Authority to sign filled in full	Y
16.	All pages initialed	Y
17.	Certified ID Copies of All Directors/Members/Shareholders of The Company/Business (If JV, For Both)	Y
18.	Signed J/V agreement must be attached (Where applicable).	Y

19.	Company registration certificates	Y
20.	Compulsory enterprise questionnaire completed.	Y
21.	Completed and signed Invitation to bid (MBD1)	Y
22.	Completed and signed Bidder's disclosure/ declaration (MBD4)	Y
23.	Completed and signed preference points claim form (MBD6.1)	Y
24.	Complete MBD5 and submit Audited or Reviewed Financial Statements (AFS) for the last three (03) years - Only where the tender exceeds R10mil - including VAT	Y
25.	Tenderer or its directors failed to pay municipal rates and taxes or municipal service charges, and such rates, taxes and charges are in arrears for more than three months; Tender will be disqualified.	Y
26.	Proof of Municipal Rates and Taxes statement of account for the company and all the directors which are not older than three (3) months or signed lease agreement for service providers who are renting or letter from tribal authority not older than 3 months	Y

2. Functionality – Phase Two (100 points allocation)

The bidders who complied with Phase One of administrative and eligibility Compliance are then considered for further evaluation on ability to execute the project.

The assessment of functionality will be done in terms of the evaluation criteria, and a minimum threshold of **80 points** must be obtained by a bidder. A bidder will be disqualified if it fails to meet the minimum threshold of 80 points for functionality and not proceed to the next stage.

TABLE A1: Points Allocation Breakdown

FUNCTIONALITY ASSESSMENT CRITERIA	
Criteria	Weight
1. Key Personnel (Site Support Team): Experience and Qualifications	35
2. Relevant Experience of a Tenderer	40
3. Tenderers Project Execution Plan	10
4. Tenderers Financial Position	5
5. Plant and Equipment	10
Overall Evaluation Score	100

2.1. CRITERIA 1: KEY PERSONNEL (SITE SUPPORT TEAM): EXPERIENCE AND QUALIFICATIONS (35 POINTS)

The Tenderer provides CVs for the following **Key Persons**, using the Returnable Schedule J provided and appending the relevant proofs requested in the template (Table J1), as well as an organisational structure or organogram demonstrating the Tenderer's Key Personnel:

- a. Contracts Manager/Director – 8 points
- b. Construction Manager– 7 points
- c. Control & Instrumentation (C&I / SCADA) Design Engineer – 5 points
- d. Quantity Surveyor (or Cost Engineer) – 5 points
- e. Construction Health and Safety Practitioner – 5 points
- f. Environmental Practitioner – 5 points

All the copies of qualifications, attachments and supporting documents should be certified, and the certified copies should not be older than 6 months from the date of tender closing.

TABLE A2: Key Personnel: Experience and Qualifications [35 POINTS]

Key Person	Minimum Qualification	Points	Minimum Professional Registration	Points	Minimum relevant Experience in the field and similar project roles:	Points	Max Points
Contracts Manager/Director The Contractor shall appoint a Contract Manager / Contracts Director with a minimum of 15 years' post-graduate experience in the Civil construction industry and a minimum three-year Diploma in the Built Environment and be professionally registered with the relevant statutory body The Contract Manager / Contracts Director shall be responsible for the overall management of the project on behalf of the Contractor, including project management, financial management, and contractual administration. Responsibilities include the preparation and control of construction programmes, cash flows, and budgets, as well as the management of all contractor personnel assigned to the project. The Contract Manager / Contracts Director shall serve as the primary point of contact for the Employer and the Employer's Agent, attend all contract site meetings, and be accountable for health and safety compliance and overall quality management for the project.	Points for Contracts Manager/Director will be allocated as follows:						
	Four (4) Year Degree in Built Environments	1	ECSA Pr. Eng	1	≥ 25 Year's relevant experience	6	8
	Three (3) Year Diploma /Degree in Built Environments	0.5	ECSA Pr. Tech or Pr. Techni	0.5	≥ 15 to < 25 Year's relevant experience	4	
					< 15 Year's relevant experience	0	
Points for Construction Manager will be allocated as follows:							
Construction Manager The Contractor shall appoint a Construction Manager with demonstrated experience in wastewater treatment projects with a minimum of 10 years' post-graduate experience in the Civil construction industry. Minimum three-year Diploma in the Built	Four (4) Year Degree in Built Environments	1	SACPCMP Pr.CM /Pr. CPM	1	≥ 15 Year's relevant experience	5	7
	Three (3) Year diploma/Degree in Built Environments	0.5			≥ 10 to < 15 Year's relevant experience	4	

Environment and professional registration with the statutory body The Construction Manager shall be full-time on site for the duration of the construction period and construction programme, particularly when construction activities are underway or when reasonably required by the Employer's Agent. The Construction Manager shall be delegated appropriate authority by the Contractor and shall be authorised to receive, on behalf of the Contractor, all oral and written instructions and communications from the Employer's Agent, the Employer's Agent's Representative, or any other duly authorised person.					< 10 Year's relevant experience	0	
Control & Instrumentation (C&I) Design Engineer The Contractor shall appoint a C&I Design Engineer with demonstrated experience in water and/or wastewater treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry. The C&I Design Engineer shall hold a minimum three-year Diploma or Degree in C&I or the Built Environment and be professionally registered with the relevant statutory body The C&I Design Engineer shall be responsible for the C&I design, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements.	Points for C&I Design Engineer will be allocated as follows:						
	Four (4) Year Degree in Built Environments	1	ECSA Pr. Eng	1	≥ 15 Year's relevant experience	3	5
	Three (3) Year Diploma/Degree in Built Environments	0.5	ECSA Pr. Tech or Pr. Techni	0.5	≥ 10 to < 15 Year's relevant experience	2	
					< 10 Year's relevant experience	0	
Quantity Surveyor The Contractor shall appoint a Quantity Surveyor with demonstrated experience in water and/or wastewater treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry.	Points for Quantity Surveyor will be allocated as follows:						
	Four (4) Year Degree in QS	1	SACQSP PrQS	1	≥ 15 Year's relevant experience	3	5
	Three (3) Year Degree in QS	0.5	Candidate QS	0.5	≥ 10 to < 15 Year's relevant experience	2	

The Quantity Surveyor hold a relevant three-year Diploma or Degree in Quantity Surveying or the Built Environment and be professionally registered with the relevant statutory body. The Quantity Surveyor shall be responsible for cost control, measurement, valuation, and financial reporting, including the preparation and assessment of payment certificates, variations, and final accounts, in accordance with the contract and applicable standards.					< 10 Year's relevant experience	0	
Construction Health & Safety Officer The Contractor shall appoint a Construction Health & Safety Officer with demonstrated experience in water and/or wastewater treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry. The Construction Health & Safety Officer shall hold a relevant three-year Diploma or Degree in Occupational Health and Safety, Construction Management, or a related field and be professionally registered with the relevant statutory body. Registration as Professional registration as Construction H&S Officer (CHSO) (SACPCMP) is a minimum requirement. Without registration, qualification and experience will also score a zero (0). The Construction Health & Safety Officer shall be responsible for ensuring compliance with the Occupational Health and Safety Act, Construction Regulations, and the project-specific Health and Safety Plan, including monitoring, reporting, incident management, and coordination with the Employer's Agent for the duration of the works.	Points for Health & Safety Officer will be allocated as follows:						
	Three (3) year university diploma or degree in Safety Management, Health or Built environment or relevant	1	Construction H&S Officer (CHSO) (SACPCMP)	1	≥ 15 Year's relevant experience	3	5
	Any other qualification / certificate in Safety Management, Health or Built environment or relevant	0.5		0.5	≥ 10 to < 15 Year's relevant experience	2	
					< 10 Year's relevant experience	0	
	Environmental Officer The Contractor shall appoint an Environmental Officer with demonstrated experience in water and/or wastewater	Points for Environmental Officer will be allocated as follows:					
Four (4) Year Science degree with honours		1	SACNASP Pr Sci Nat	1	≥ 15 Year's relevant experience	3	5

treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry. The Environmental Officer shall hold a relevant three-year Diploma or Degree in Environmental Management, Environmental Science, or a related field and be professionally registered with the relevant statutory body The Environmental Officer shall be responsible for ensuring compliance with environmental legislation, approval conditions, and the Environmental Management Programme (EMPr), including monitoring, reporting, and liaison with the Employer's Agent and relevant authorities for the duration of the construction works.	Three (3) Year Science degree/Diploma/Btech	0.5	SACNASP Certified Sci Nat	0.5	≥ 10 to < 15 Year's relevant experience	2	
					< 10 Year's relevant experience	0	

NB. Failure to provide proof of relevant experience, projects, academic qualifications and professional registration in the resources mentioned above will result in the disqualification of points. The Bidder has the opportunity to accumulate points to a maximum of 35 points on this criteria. All the copies of qualifications should be certified, and the certified copies should not be older than 6 months from the date of tender closing.

2.2. CRITERIA 2: RELEVANT EXPERIENCE OF COMPANY (40 POINTS)

The Tenderer's Experience may include the experience of Members and Subcontractors.

The Tenderer shall provide no more than four (4) project references per discipline (Civil, Mechanical, and Electrical) for projects completed within the last fifteen (15) years, using the template provided in the Returnable Schedules. Where a project included multiple disciplines under a single contract, the Tenderer may cross-reference the same project under each applicable discipline, provided that the Tenderer clearly indicates the scope performed per discipline.

Project References and append supporting information where prescribed in the template. As part of the Returnable Schedule for Project References, the Project Reference checklist must be completed.

If the Tenderer provides more than four (4) project references, only the first four (4) project references as they are ordered in the Tenderer's Response will be selected for evaluation.

The maximum score under Tenderer's Experience is 40 points.

The Tenderer shall substantiate its experience by submitting the following:

- A reference letter, appointment letter and completion certificate in the letterhead of the client shall include: The name of the client, the tenderer's names, project amount, the scope of work/nature of works, the duration of the project (the start and end date), confirmation that the work was successfully completed, signature of client representative, contactable references (email and phone numbers). If the reference is in the tenderer's template, the stamp in the letter, contacts and signatures should be those of the previous client;
- For Mechanical, Electrical and/or Operations & Maintenance works: if the scope of works formed part of an overall water treatment plant and/or wastewater treatment plant project that included other classes of works, a detailed breakdown of the works shall be provided. This breakdown must clearly identify the scope and value attributable to any of the three disciplines, classes, works or components and shall be submitted as supporting evidential material. Acceptable forms of evidence include extracts from the signed Final Account, signed Final payment, signed reference letters, or approved Bills of Quantities.

Only completed projects/contracts will be considered for evaluation, and points will be awarded accordingly. Failure to submit the required project information may negatively affect the Tenderer's score.

In the case of a Joint Venture, qualifying projects undertaken by any member of the Joint Venture may be submitted. For each project, the scope of work performed shall be clearly stated.

Schedule J (Tables J2, J3, J4 and J5) should be completed

NOTE:

- **Mechanical works** is described as designing, installing, and maintaining physical equipment for preliminary (screening, grit removal, sedimentation), secondary (pumps, clarifier scrapers, blowers), and tertiary (filtration systems, chemical feeders) treatment stages, focusing on solid/liquid separation, fluid movement, and process automation to remove solids and prepare water for final disinfection. Key tasks include managing pumps (raw sewage pumping system, biofilter pumping system, sludge pumping systems, supernatant pumping system, effluent and irrigation pumping system, chlorination motive system), valves, conveyors, clarifier mechanisms, aeration systems and sludge handling equipment, effluent discharge systems, amongst others.
- **Electrical works** is described as designing and installing various electrical systems, including building or industrial wiring, motor control, and/or lighting systems related to wastewater treatment plants, in order to maintain electrical operation of electrical equipment. It also involves installing various generators and transformers, such as medium voltage gas turbine generators and medium and high voltage steam turbine generators, in order to supply voltage to plant electrical equipment. It also further includes installing and inspecting various equipment, including circuit breakers, meters, conventional controls, electronic control systems, instrumentation installations, programmable controls, relays, protective devices, motors, motor protection sensors, public address systems and other communications and surveillance systems, logic circuits, and uninterruptible power supplies, in order to maintain effective operation of wastewater treatment electrical systems. Also performing preventative maintenance on wastewater treatment electrical equipment, such as electrical motors, ventilation systems, and lighting systems, sufficient to ensure the effective operation of equipment and prevent equipment failure.
- **Operations and Maintenance** is described as producing Operations and Maintenance manuals, As-Built drawings for electrical and/or mechanical systems, equipment, plants and operating, maintaining, refurbishing and replacing any of the equipment, systems, plant, components and parts described above. It also involves continuous operation, monitoring, control, maintenance, repair, refurbishment and optimisation of all process, mechanical, electrical, instrumentation, control and civil infrastructure associated with the treatment of wastewater and sludge. Experience limited to preparation of O&M manuals or as-built documentation, without responsibility for active plant operation and maintenance, will not be considered as qualifying O&M experience.

TABLE A3: Relevant Experience of a Tenderer

#	Description of Functional Criteria	Points Allocated	Maximum Points
1	Civil Contractor Wastewater treatment and/or water treatment related projects (local or international) with a construction value greater than R 350 million (per individual project) excluding VAT successfully completed within the past fifteen (15) years.	Points for Civil Contractor will be allocated as follows: - Four (4) projects with wastewater treatment and/or water treatment scope and minimum value of R 350 million = 10 points - Three (3) projects with wastewater treatment and/or water treatment scope and minimum value of R 350 million = 7 points - Two (2) projects with wastewater treatment and/or water treatment scope and minimum value of R 350 million = 5 points - One (1) project with wastewater treatment and/or water treatment scope and minimum value of R 350 million = 1 point - No (0) projects listed and/or project is incomplete or information not as per requirements = 0 points	10
2	Mechanical Contractor Wastewater treatment and/or water treatment related projects (local or international) with a construction value greater than R 200 million (per individual project) excluding VAT successfully completed within the past fifteen (15) years.	Points for Mechanical Contractor will be allocated as follows: - Four (4) projects with wastewater treatment and/or water treatment scope and minimum value of R 200 million = 10 points - Three (3) projects with wastewater treatment and/or water treatment scope and minimum value of R 200 million = 7 points - Two (2) projects with wastewater treatment and/or water treatment scope and minimum value of R 200 million = 5 points - One (1) project with wastewater treatment and/or water treatment scope and minimum value of R 200 million = 1 point - No (0) projects listed and/or project is incomplete or information not as per requirements = 0 points	10

3	Electrical Contractor Wastewater treatment and/or water treatment related projects (local or international) with a construction value greater than R100 million (per individual project) excluding VAT successfully completed within the past fifteen (15) years.	Points for Electrical Contractor will be allocated as follows: • Four (4) projects with wastewater treatment and/or water treatment scope and minimum value of R 100 million = 10 points • Three (3) projects with wastewater treatment and/or water treatment scope and minimum value of R 100 million = 7 points • Two (2) projects with wastewater treatment and/or water treatment scope and minimum value of R 100 million = 5 points • One (1) project with wastewater treatment and/or water treatment scope and minimum value of R 100 million = 1 points • No (0) projects listed and/or project is incomplete or information not as per requirements = 0 points	10
4	Operations & Maintenance Operation and maintenance of wastewater treatment works (local or international) with an average treatment capacity of not less than 10 ML/day per facility, successfully operated and maintained for a minimum continuous period of one (1) year per facility, within the past fifteen (15) years. Where required for valuation consistency, the O&M experience may alternatively be demonstrated by wastewater treatment facilities with an annual O&M contract value of not less than R 30 million per annum.	Points for Operations and Maintenance will be allocated as follows: • Four (4) projects with wastewater treatment scope and minimum annual O&M value of R 30 million = 10 points • Three (3) projects with wastewater treatment scope and minimum annual O&M value of R 30 million = 7 points • Two (2) projects with wastewater treatment scope and minimum annual O&M value of R 30 million = 5 points • One (1) project with wastewater treatment scope and minimum annual O&M value of R 30 million = 1 points • No (0) projects listed and/or project is incomplete or information not as per requirements = 0 points	10

Failure to provide proof of relevant completed projects (as per Table J2, Table J3, Table J4 and Table J5 templates) will result in the disqualification of points. The Bidder could accumulate points to a maximum of 40 points on this criteria.

CRITERIA 3: PROJECT EXECUTION PLAN [10 POINTS]

The maximum total that can be scored under Project Execution Plan is 10 points.

Each criterion of the Project Execution Plan will be evaluated, scored and weighted, the total of which is a maximum of 100%.

1. An organogram to indicate members of the contractor – 4 points
2. Tenderer's understanding of the scope – Methodology or approach paper – 4
3. Preliminary Programme – 2 points

Scoring of each aspect will be undertaken as follows:-

	Project Execution Plan evaluation criteria	Points Allocated	Weighting															
1	The Tenderer shall submit a project specific organogram clearly illustrating the Organisational structure for the execution of the Works and the provision of Operations and Maintenance (O&M) services.. Organogram Requirements: The organogram must: - Clearly distinguish between the Contractor, Joint Venture partners (if applicable), and all Subcontractors; - Identify all key personnel assigned to the project, including both construction-phase and O&M-phase resources; - Explicitly reflect O&M resources, including operational, maintenance, and supervisory roles responsible for the operation and maintenance of the wastewater treatment works; - Show clear reporting lines and interfaces between construction, commissioning, and O&M functions; - Reflect each key person under the correct contracting entity (i.e. main contractor, JV partner, or subcontractor), with no ambiguity regarding contractual responsibility; and - Key personnel reflected in the organogram must be consistent with the personnel schedules and CVs submitted elsewhere in the tender submission.	Points for 1 are allocated as follows: Points Allocation <table><tr><td>A project-specific organogram is provided that fully complies with all the requirements and elements listed under “Organogram Requirements”, including clear identification of contracting entities, key personnel, O&M resources, reporting lines, and consistency with submitted CVs and personnel schedules</td><td>4</td></tr><tr><td>A project-specific organogram is provided but partially complies with the listed requirements and elements (e.g. some elements are omitted, unclear, or insufficiently detailed).</td><td>2</td></tr><tr><td>No organogram is submitted, or the organogram is generic, not project-specific, or does not meaningfully address the listed requirement</td><td>0</td></tr></table>	A project-specific organogram is provided that fully complies with all the requirements and elements listed under “Organogram Requirements”, including clear identification of contracting entities, key personnel, O&M resources, reporting lines, and consistency with submitted CVs and personnel schedules	4	A project-specific organogram is provided but partially complies with the listed requirements and elements (e.g. some elements are omitted, unclear, or insufficiently detailed).	2	No organogram is submitted, or the organogram is generic, not project-specific, or does not meaningfully address the listed requirement	0	4									
A project-specific organogram is provided that fully complies with all the requirements and elements listed under “Organogram Requirements”, including clear identification of contracting entities, key personnel, O&M resources, reporting lines, and consistency with submitted CVs and personnel schedules	4																	
A project-specific organogram is provided but partially complies with the listed requirements and elements (e.g. some elements are omitted, unclear, or insufficiently detailed).	2																	
No organogram is submitted, or the organogram is generic, not project-specific, or does not meaningfully address the listed requirement	0																	
2	The Tenderer shall submit a Methodology / Approach Papers: A. Approach to Design, Construction, Testing and Commissioning The Tenderer shall submit a Methodology or Approach Paper demonstrating a clear understanding of the requirements for the design, construction, testing and commissioning of the Works. The Approach Paper must address, at a minimum: - The approach to fulfilling the design obligations for mechanical, electrical, control and instrumentation, and building works components; - Design coordination, reviews, approvals and integration across disciplines; - The construction methodology, sequencing and quality management approach; - The approach to testing, commissioning and performance verification of all systems and plant; - The methodology for identifying, managing and resolving defects during commissioning and the defects liability period; and	Points Allocation <table><tr><td>Excellent:</td><td>Comprehensive, innovative, clearly implementable</td><td>4</td></tr><tr><td>Very Good:</td><td>Well structured, project specific, risk aware</td><td>3</td></tr><tr><td>Good:</td><td>Adequate, logical, meets minimum requirements</td><td>2</td></tr><tr><td>Poor:</td><td>Superficial, generic, unclear, and approaches not separated</td><td>1</td></tr><tr><td>Not addressed:</td><td>No submission or irrelevant content</td><td>0</td></tr></table>	Excellent:	Comprehensive, innovative, clearly implementable	4	Very Good:	Well structured, project specific, risk aware	3	Good:	Adequate, logical, meets minimum requirements	2	Poor:	Superficial, generic, unclear, and approaches not separated	1	Not addressed:	No submission or irrelevant content	0	4
Excellent:	Comprehensive, innovative, clearly implementable	4																
Very Good:	Well structured, project specific, risk aware	3																
Good:	Adequate, logical, meets minimum requirements	2																
Poor:	Superficial, generic, unclear, and approaches not separated	1																
Not addressed:	No submission or irrelevant content	0																

	Project Execution Plan evaluation criteria	Points Allocated	Weighting									
	- Key success factors and risk mitigation measures for achieving a fully functional and compliant facility B. Approach to Operations & Maintenance and Skills Transfer The Tenderer shall submit a separate Methodology or Approach Paper demonstrating a clear and comprehensive understanding of the requirements for Operations and Maintenance (O&M) of the wastewater treatment works, including skills transfer and capacity building for the City. The O&M and Skills Transfer Approach Paper must address, at a minimum: - The proposed approach to day-to-day operation and maintenance of the wastewater treatment works over the two (2) year operating period; - The approach to ensuring operational performance, reliability, regulatory compliance and environmental management; - Preventive, corrective and reactive maintenance strategies and asset management practices; - The approach to O&M readiness, including staffing, systems, procedures and reporting; - The Skills Transfer and Capacity Building Plan, including on-the-job training, mentoring, shadowing and progressive handover of operational responsibilities to City personnel; - A phased handover strategy demonstrating how the City will be capacitated to assume full operational responsibility at the end of the Contract period; and - Key success factors and measurable outcomes for skills transfer and handover readiness											
4	The Tenderer shall submit a Preliminary Programme for the execution of the Works. The Programme will be evaluated based on the following: - Inclusion of all major activities and deliverables across the project lifecycle, including design development, procurement, construction, testing, commissioning and O&M mobilisation; - Logical sequencing of activities and realistic identification of dependencies and interfaces between disciplines; - Identification of the critical path and key programme drivers; - Clearly defined milestones, including design completion, commencement of construction, commissioning, practical completion and handover	Points Allocation <table><tr><td>Excellent:</td><td>Comprehensive, well-structured, clearly reasoned and realistic, fully integrated and risk aware programme</td><td>2</td></tr><tr><td>Good:</td><td>Complete, logical and compliant programme</td><td>1</td></tr><tr><td>Poor:</td><td>Incomplete, illogical</td><td>0</td></tr></table>	Excellent:	Comprehensive, well-structured, clearly reasoned and realistic, fully integrated and risk aware programme	2	Good:	Complete, logical and compliant programme	1	Poor:	Incomplete, illogical	0	2
Excellent:	Comprehensive, well-structured, clearly reasoned and realistic, fully integrated and risk aware programme	2										
Good:	Complete, logical and compliant programme	1										
Poor:	Incomplete, illogical	0										

	Project Execution Plan evaluation criteria	Points Allocated	Weighting
	- Realism and feasibility of activity durations, taking into account the nature, scale and complexity of the Works; and - The Preliminary Programme should demonstrate that the Tenderer has a clear, logical and achievable plan for delivering the Works in accordance with the Contract requirements.		
	TOTAL		100%

2.3. CRITERIA 4: FINANCIAL STATUS (5 POINTS)**TABLE A7: Financial References**

Bidder Evaluation Criteria for Functionality	Weight	Scores	Maximum Points						
Financial standing/Ability to execute the project • NB: Bidders are required to attach the most recent proof of funding from Registered Financial Institutions (Funding letter, credit facility letter or bank statement not older than 60 days) Failure to do so will result in loss of points. • Proof of funding must be verifiable, and clearly indicate the name of the Tenderer and the available balance or facility amount	5	Points Allocation <table><tr><td>Proof of funding in the form of a bank statement, confirmed credit facility, issued by an Authorised Financial Service Provider, demonstrating available funds of more than R50 000 000</td><td>5</td></tr><tr><td>Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of not less than R20 000 000.00 and not more than R50 000 000.00</td><td>3</td></tr><tr><td>Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of less than R20 000 000.00</td><td>0</td></tr></table>	Proof of funding in the form of a bank statement, confirmed credit facility, issued by an Authorised Financial Service Provider, demonstrating available funds of more than R50 000 000	5	Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of not less than R20 000 000.00 and not more than R50 000 000.00	3	Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of less than R20 000 000.00	0	5
Proof of funding in the form of a bank statement, confirmed credit facility, issued by an Authorised Financial Service Provider, demonstrating available funds of more than R50 000 000	5								
Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of not less than R20 000 000.00 and not more than R50 000 000.00	3								
Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of less than R20 000 000.00	0								

2.4. CRITERIA 5: PLANT AND EQUIPMENT (10 POINTS)**TABLE A8: Plant and Equipment**

Bidder Evaluation Criteria for Functionality	Weight	Scores	Maximum Points												
Plant and Equipment NB: Proof of the bidder's ownership of the plant is to be submitted with the tender. The proof of ownership for the plant should be accompanied by a copy of the traffic department's annual renewal certificate, with the disc for the tenderer to score points. If a plant is hired, a signed letter from the plant Hire Company confirming availability to the service provider for this particular contract. Furthermore, maximum points will be allocated to the plants owned by the tenderer, and half of the maximum points will be allocated to the plant being hired.	10	Points Allocation <table><tr><td>Grader (140G or equivalent) with 1 unit required and 2 points per grader</td><td>2</td></tr><tr><td>Tipper Truck (10m³) with 2 units required and 1 point per tipper truck</td><td>2</td></tr><tr><td>Excavator (20 ton minimum) with 1 unit required and 2 point per Excavator</td><td>2</td></tr><tr><td>TLB (4X4) with 2 unit required and 1 points per TLB with 4x4 capabilities</td><td>2</td></tr><tr><td>Water tanker with 12,000 litres (12m³) minimum size with 1 unit required and 1 points per water tanker</td><td>1</td></tr><tr><td>Drop-side or flat-deck truck with minimum payload of 4 ton or higher with 1 unit required and 1 points per truck</td><td>1</td></tr></table>	Grader (140G or equivalent) with 1 unit required and 2 points per grader	2	Tipper Truck (10m³) with 2 units required and 1 point per tipper truck	2	Excavator (20 ton minimum) with 1 unit required and 2 point per Excavator	2	TLB (4X4) with 2 unit required and 1 points per TLB with 4x4 capabilities	2	Water tanker with 12,000 litres (12m³) minimum size with 1 unit required and 1 points per water tanker	1	Drop-side or flat-deck truck with minimum payload of 4 ton or higher with 1 unit required and 1 points per truck	1	10
Grader (140G or equivalent) with 1 unit required and 2 points per grader	2														
Tipper Truck (10m³) with 2 units required and 1 point per tipper truck	2														
Excavator (20 ton minimum) with 1 unit required and 2 point per Excavator	2														
TLB (4X4) with 2 unit required and 1 points per TLB with 4x4 capabilities	2														
Water tanker with 12,000 litres (12m³) minimum size with 1 unit required and 1 points per water tanker	1														
Drop-side or flat-deck truck with minimum payload of 4 ton or higher with 1 unit required and 1 points per truck	1														

3. Price and Specific goals– Phase Three

Only tenders that achieve the minimum qualifying score of **80 points** for functionality will be evaluated further in accordance with the 90/10 preference points systems as described in Preferential Procurement Regulations.

The evaluation will be done by using **90/10-point system** as indicated below:

Preference point system	Points
Price	90
Specific Goals	10
Total Maximum Score	100

Up to 10 tender evaluation preference points will be awarded to tenderers who complete the preferencing schedule and who are found to be eligible for the preference claimed.

NOTE: Bidders must note that points for specific goals must be claimed in terms with the percentage of ownership within their business entity. The tenderer must indicate how they claim points.)

SPECIFIC GOALS	MEANS OF VERIFICATION DOCUMENTS REQUIRED	Number of points for each specific goal
Ownership of 51% or more by persons who are black	CSD/Company registration copy and ID Copies of directors	3
Ownership of 51% or more by persons who are woman	CSD/Company registration copy and ID Copies of directors	3
Ownership of 51% or more by persons who are disabled	Medical report indicating disability	2
Ownership of 51% or more by persons who are youth	CSD/Company registration copy and ID Copies of directors	1
Ownership by persons who are residing within jurisdiction of Polokwane Municipality	Municipal rates and taxes statement of account/ signed valid leasing agreement/Letter from tribal authority	1
TOTAL		10

Should the evidence required for any of the Specific Goals applicable in this tender not be provided, a tenderer will score zero preference points for that particular “Specific Goal”.

In case ownership of specific goals is below 51% points will be claimed in terms with the percentage of ownership within their business entity. For example:

An Entity that has 35% shareholding of able black man who is below age of 35 and residing outside the jurisdiction of Polokwane Municipality. Points will be claimed as follows:

$$\begin{aligned}
 \text{Calculation} &= \frac{\text{Black Ownership}}{100} \times \text{Total number of allocated points} \\
 &= \frac{35}{100} \times 3 \\
 &= 1.05
 \end{aligned}$$

Points to be score for ownership of black person will be **1.05**

2.5. Criteria for breaking deadlock

If two or more tenders score the same number of points and these tenders are also the highest ranked tenders, the tender with the highest preference points will be recommended for award.

If functionality is part of the evaluation process and two or more tenders score equal total points and equal preference points, the tender that scored the highest points for functionality will be recommended for award.

If two or more tenders score the same number of financial points and preference points and these tenders are also the highest ranked tenders, the tenderer to be recommended for award will be decided by the drawing of lots.

2.6. Commercial Risk Analysis

Prior to being recommended for further evaluation, a bid will be subjected to risk analysis to ensure that it would, if accepted, not place the Municipality or the bidder, at undue risk.

A risk analysis will be performed to ascertain if any of the following might present an unacceptable commercial risk to the Municipality:

- Unduly low tendered sums
- Unduly high individual rates
- Unduly low rates
- Imbalances in pricing

It is in the best interests of the Municipality to amend an error, if identified and brought to tenderer's attention, which will cause the bid to be rejected on the basis of it presenting an unacceptable commercial risk.

2.7. Tendered rates

Rates for all the bids which have complied with the bid conditions will be assessed for the following:

- Comparison of rates and amounts with the average tendered amount.
- Sensitivity Analysis of Rates (i.e. whether the rates are balanced, acceptable, etc).
- Expected cash flows requirements.

NB. The procedure to deal with the above is stipulated in C.3.9 of the Standard Conditions of Tender (SFU August 2019). If the tenderer refuses to follow instructions as directed by the employer, the employer reserves the right to disqualify the tender from further evaluation.

3. Business Registration

Prospective bidders shall be registered:

- (a) With the South African Revenue Services for all categories of taxes applicable to it. International firms must complete MBD 1 form Questionnaire
- (b) With the Compensation Commissioner.
- (c) With the Construction Industry Development Board. A minimum grading of **9CE** is required.

4. Acceptance of Tender Offer (Cl. C.3.9)

Tender offers will only be accepted if:

- a) The bidder has in his or her possession an original valid Tax Pin Certificate issued by the South Africa Revenue Services;
- b) The bidder is registered with the Construction Industry Development Board in an appropriate contractor grading designation. A minimum grading of **9CE** is required;
- c) the bidder or any of its principals is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; and
- d) is not; insolvent, in receivership, under Business Rescue as provided for in chapter 6 of the Companies Act No. 2008, bankrupt or being wound up, has his/her affairs administered by a court or a judicial officer, has suspended his/her business activities or is subject to legal proceedings in respect of any of the foregoing
- e) The bidder has not abused the Employer's Supply Chain Management System.
- f) The bidder can, as necessary and in relation to the proposed contract, demonstrate that he or she possesses the professional and technical qualifications, professional and technical competence, financial resources, equipment and other physical facilities, managerial capability, reliability, experience and reputation, expertise and the personnel, to perform the contract;

- g) The bidder complies with the legal requirements, if any, stated in the tender data; and
- h) The bidder is able, in the opinion of the employer, to perform the contract free of conflicts of interest
- i) The bidder has completed the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the bidder's ability to perform the contract in the best interests of the employer or potentially compromise the tender process.
- j) **Price negotiations**
 - a. If the price offered by a tenderer scoring the highest points is not market related, the Municipality may not award the tender to that tenderer.
 - b. The Municipality may –
 - i. Negotiate a market related price with the tenderer scoring the highest points or cancel the tender.
 - ii. If the tenderer does not agree to a market related price, negotiate a market related price with the tenderer scoring the second highest points or cancel the tender.
 - iii. If the tenderer scoring the second highest points does not agree to a market-related price, negotiate a market-related price with the tenderer scoring the third highest points or cancel the tender.
 - iv. If a market related price is not agreed as envisaged in sub paragraph (iii) above, the municipality may cancel the tender.
- k) The bidder has the legal capacity to enter into the contract;

5. Provide copies of the Contract Document (Cl. C.3.17)

The number of paper copies of the signed Contract to be provided by the Employer to the successful bidder is **one**.

6. Notification of award (Cl. C.3.18)

- a. The Municipality will publish the winning the details of tender in the relevant platforms where the tender was advertised.

T1.3 STANDARD CONDITIONS OF TENDER

Standard Conditions of Tender

C.1 General

C.1.1 Actions

C.1.1.1 The employer and each tenderer submitting a tender offer shall comply with these conditions of tender. In their dealings with each other, they shall discharge their duties and obligations as set out in C.2 and C.3, timeously and with integrity, and behave equitably, honestly and transparently, comply with all legal obligations and not engage in anticompetitive practices.

C.1.1.2 The employer and the tenderer and all their agents and employees involved in the tender process shall avoid conflicts of interest and where a conflict of interest is perceived or known, declare any such conflict of interest, indicating the nature of such conflict. Tenderers shall declare any potential conflict of interest in their tender submissions. Employees, agents and advisors of the employer shall declare any conflict of interest to whoever is responsible for overseeing the procurement process at the start of any deliberations relating to the procurement process or as soon as they become aware of such conflict and abstain from any decisions where such conflict exists or recuse themselves from the procurement process, as appropriate.

Note: 1) A conflict of interest may arise due to a conflict of roles which might provide an incentive for improper acts in some circumstances. A conflict of interest can create an appearance of impropriety that can undermine confidence in the ability of that person to act properly in his or her position even if no improper acts result.

2) Conflicts of interest in respect of those engaged in the procurement process include direct, indirect or family interests in the tender or outcome of the procurement process and any personal bias, inclination, obligation, allegiance or loyalty which would in any way affect any decisions taken.

C.1.1.3 The employer shall not seek and a tenderer shall not submit a tender without having a firm intention and the capacity to proceed with the contract.

C.1.2 Tender Documents

The documents issued by the employer for the purpose of a tender offer are listed in the tender data.

C.1.3 Interpretation

C.1.3.1 The tender data and additional requirements contained in the tender schedules that are included in the returnable documents are deemed to be part of these conditions of tender.

C.1.3.2 These conditions of tender, the tender data and tender schedules which are required for tender evaluation purposes, shall form part of any contract arising from the invitation to tender.

C.1.3.3 For the purposes of these conditions of tender, the following definitions apply:

a) **conflict of interest** means any situation in which:

- i) someone in a position of trust has competing professional or personal interests which make it difficult to fulfill his or her duties impartially;
- ii) an individual or tenderer is in a position to exploit a professional or official capacity in some way for their personal or corporate benefit; or
- iii) incompatibility or contradictory interests exist between an employee and the tenderer who employs that employee.

b) **comparative offer** means the price after the factors of a non-firm price and all

unconditional discounts it can be utilised to have been taken into consideration;

- c) **corrupt practice** means the offering, giving, receiving or soliciting of anything of value to influence the action of the employer or his staff or agents in the tender process;
- d) **fraudulent practice** means the misrepresentation of the facts in order to influence the tender process or the award of a contract arising from a tender offer to the detriment of the employer, including collusive practices intended to establish prices at artificial levels;

C.1.4 Communication and employer's agent

Each communication between the employer and a tenderer shall be to or from the employer's agent only, and in a form that can be readily read, copied and recorded. Communications shall be in the English language. The employer shall not take any responsibility for non-receipt of communications from or by a tenderer. The name and contact details of the employer's agent are stated in the tender data.

C.1.5 Cancellation and Re-Invitation of Tenders

C.1.5.1 An employer may, prior to the award of the tender, cancel a tender if-

- a) due to changed circumstances, there is no longer a need for the engineering and construction works specified in the invitation;
- b) funds are no longer available to cover the total envisaged expenditure; or
- c) no acceptable tenders are received.
- d) there is a material irregularity in the tender process.

C.1.5.2 The decision to cancel a tender invitation must be published in the same manner in which the original tender invitation was advertised

C.1.5.3 An employer may only with the prior approval of the relevant treasury cancel a tender invitation for the second time.

C.1.6 Procurement procedures

C.1.6.1 General

Unless otherwise stated in the tender data, a contract will, subject to C.3.13, be concluded with the tenderer who in terms of C.3.11 is the highest ranked or the tenderer scoring the highest number of tender evaluation points, as relevant, based on the tender submissions that are received at the closing time for tenders.

C.1.6.2 Competitive negotiation procedure

C.1.6.2.1 Where the tender data require that the competitive negotiation procedure is to be followed, tenderers shall submit tender offers in response to the proposed contract in the first round of submissions. Notwithstanding the requirements of C.3.4, the employer shall announce only the names of the tenderers who make a submission. The requirements of C.8 relating to the material deviations or qualifications which affect the competitive position of tenderers shall not apply.

C.1.6.2.2 All responsive tenderers or at least a minimum of not less than three responsive tenderers that are highest ranked in terms of the evaluation criteria stated in the tender data shall be invited to enter into competitive negotiations based on the principle of equal treatment, keeping confidential the proposed solutions and associated information.

Notwithstanding the provisions of C.2.17, the employer may request that tenders be clarified, specified and fine-tuned in order to improve a tenderer's competitive position provided that such clarification, specification, fine-tuning or additional information does not alter any fundamental aspects of the offers or impose substantial new requirements which restrict or distort competition or have a discriminatory effect.

C.1.6.2.3 At the conclusion of each round of negotiations, tenderers shall be invited by the employer to revise their tender offer based on the same evaluation criteria, with or without adjusted weightings.

Tenderers shall be advised when they are to submit their best and final offer.

C.1.6.2.4 The contract shall be awarded in accordance with the provisions of C.3.11 and C.3.13 after tenderers have been requested to submit their best and final offer.

C.1.6.3 Bid procedure using the two stage-system

C.1.6.3.1 Option 1

Tenderers shall, in the first stage, submit bids and, if required, cost parameters around which a contract may be negotiated. The employer shall evaluate each responsive submission in terms of the method of evaluation stated in the tender data, and in the second stage, negotiate a contract with the tenderer scoring the highest number of evaluation points and award the contract in terms of these conditions of tender.

C.1.6.3.2 Option 2

C.1.6.3.2.1 Tenderers shall submit in the first stage only bids. The employer shall invite all responsive tenderers to submit tender offers in the second stage, following the issuing of procurement documents.

C.1.6.3.2.2 The employer shall evaluate tenders received during the second stage in terms of the method of evaluation stated in the tender data, and award the contract in terms of these conditions of tender.

C.2 Tenderer's obligations

C.2.1 Eligibility

C.2.1.1 Submit a tender offer only if the tenderer satisfies the criteria stated in the tender data and the tenderer, or any of his principals, is not under any restriction to do business with employer.

C.2.1.2 Notify the employer of any proposed material change in the capabilities or formation of the tendering entity (or both) or any other criteria which formed part of the qualifying requirements used by the employer as the basis in a prior process to invite the tenderer to submit a tender offer and obtain the employer's written approval to do so prior to the closing time for tenders.

C.2.2 Cost of tendering

C.2.2.1 Accept that, unless otherwise stated in the tender data, the employer will not compensate the tenderer for any costs incurred in the preparation and submission of a tender offer, including the costs of any testing necessary to demonstrate that aspects of the offer complies with requirements.

C.2.2.2 The cost of the tender documents charged by the employer shall be limited to the actual cost incurred by the employer for printing the documents. Employers must attempt to make available the tender documents on its website so as not to incur any costs pertaining to the printing of the tender documents.

C.2.3 Check documents

Check the tender documents on receipt for completeness and notify the employer of any discrepancy or omission.

C.2.4 Confidentiality and copyright of documents

Treat as confidential all matters arising in connection with the tender. Use and copy the documents issued by the employer only for the purpose of preparing and submitting a tender offer in response to the invitation.

C.2.5 Reference documents

Obtain, as necessary for submitting a tender offer, copies of the latest versions of standards, specifications, conditions of contract and other publications, which are not attached but which are incorporated into the tender documents by reference.

C.2.6 Acknowledge addenda

Acknowledge receipt of addenda to the tender documents, which the employer may issue, and if necessary apply for an extension to the closing time stated in the tender data, in order to take the addenda into account.

C.2.7 Clarification meeting

Attend, where required, a clarification meeting at which tenderers may familiarize themselves with aspects of the proposed work, services or supply and raise questions. Details of the meeting(s) are stated in the tender data.

C.2.8 Seek clarification

Request clarification of the tender documents, if necessary, by notifying the employer at least five (5) working days before the closing time stated in the tender data.

C.2.9 Insurance

Be aware that the extent of insurance to be provided by the employer (if any) might not be for the full cover required in terms of the conditions of contract identified in the contract data. The tenderer is advised to seek qualified advice regarding insurance.

C.2.10 Pricing the tender offer

C.2.10.1 Include in the rates, prices, and the tendered total of the prices (if any) all duties, taxes except Value Added Tax (VAT), and other levies payable by the successful tenderer, such duties, taxes and levies being those applicable fourteen (14) days before the closing time stated in the tender data.

C.2.10.2 Show VAT payable by the employer separately as an addition to the tendered total of the prices.

C.2.10.3 Provide rates and prices that are fixed for the duration of the contract and not subject to adjustment except as provided for in the conditions of contract identified in the contract data.

C.2.10.4 State the rates and prices in Rand unless instructed otherwise in the tender data. The conditions of contract identified in the contract data may provide for part payment in other currencies.

C.2.11 Alterations to documents

Do not make any alterations or additions to the tender documents, except to comply with instructions issued by the employer, or necessary to correct errors made by the tenderer. All signatories to the tender offer shall initial all such alterations.

C.2.12 Alternative tender offers

C.2.12.1 Unless otherwise stated in the tender data, submit alternative tender offers only if a main tender offer, strictly in accordance with all the requirements of the tender documents, is also submitted as well as a schedule that compares the requirements of the tender documents with the alternative requirements that are proposed.

C.2.12.2 Accept that an alternative tender offer must be based only on the criteria stated in the tender data or criteria otherwise acceptable to the employer.

C.2.12.3 An alternative tender offer must only be considered if the main tender offer is the winning tender.

C.2.13 Submitting a tender offer

C.2.13.1 Submit one tender offer only, either as a single tendering entity or as a member in a joint venture to provide the whole of the works identified in the contract data and described in the scope of works, unless stated otherwise in the tender data.

C.2.13.2 Return all returnable documents to the employer after completing them in their entirety, either electronically (if they were issued in electronic format) or by writing legibly in non-erasable ink.

C.2.13.3 Submit the parts of the tender offer communicated on paper as an original plus the number of copies stated in the tender data, with an English translation of any documentation in a language other than English, and the parts communicated electronically in the same format as they were issued by the employer.

C.2.13.4 Sign the original and all copies of the tender offer where required in terms of the tender data. The employer will hold all authorized signatories liable on behalf of the tenderer. Signatories for tenderers proposing to contract as joint ventures shall state which of the signatories is the lead partner whom the employer shall hold liable for the purpose of the tender offer.

C.2.13.5 Seal the original and each copy of the tender offer as separate packages marking the packages as "ORIGINAL". Each package shall state on the outside the employer's address and identification details stated in the tender data, as well as the tenderer's name and contact address.

C.2.13.6 Where a two-envelope system is required in terms of the tender data, place and seal the returnable documents listed in the tender data in an envelope marked "financial bid" and place the remaining returnable documents in an envelope marked "tender document". Each envelope shall state on the outside the employer's address and identification details stated in the tender data, as well as the tenderer's name and contact address.

C.2.13.7 Seal the original tender offer and copy packages together in an outer package that states on the outside only the employer's address and identification details as stated in the tender data.

C.2.13.8 Accept that the employer will not assume any responsibility for the misplacement or premature opening of the tender offer if the outer package is not sealed and marked as stated.

C.2.13.9 Accept that tender offers submitted by facsimile or e-mail will be rejected by the employer, unless stated otherwise in the tender data.

C.2.14 Information and data to be completed in all respects

Accept that tender offers, which do not provide all the data or information requested completely and in the form required, may be regarded by the employer as non-responsive.

C.2.15 Closing time

C.2.15.1 Ensure that the employer receives the tender offer at the address specified in the tender data not later than the closing time stated in the tender data. Accept that proof of posting shall not be accepted as proof of delivery.

C.2.15.2 Accept that, if the employer extends the closing time stated in the tender data for any reason, the requirements of these conditions of tender apply equally to the extended deadline.

C.2.16 Tender offer validity

C.2.16.1 Hold the tender offer(s) valid for acceptance by the employer at any time during the validity period stated in the tender data after the closing time stated in the tender data.

C.2.16.2 If requested by the employer, consider extending the validity period stated in the tender data for an agreed additional period with or without any conditions attached to such extension.

C.2.16.3 Accept that a tender submission that has been submitted to the employer may only be withdrawn or substituted by giving the employer's agent written notice before the closing time for tenders that a tender is to be withdrawn or substituted. If the validity period stated in C.2.16 lapses before the employer evaluating tender, the contractor reserves the right to review the price based on Consumer Price Index (CPI).

C.2.16.4 Where a tender submission is to be substituted, a tenderer must submit a substitute tender in accordance with the requirements of C.2.13 with the packages clearly marked as "SUBSTITUTE".

C.2.17 Clarification of tender offer after submission

Provide clarification of a tender offer in response to a request to do so from the employer during the evaluation of tender offers. This may include providing a breakdown of rates or prices and correction of arithmetical errors by the adjustment of certain rates or item prices (or both). No change in the competitive position of tenderers or substance of the tender offer is sought, offered, or permitted.

Note: *Sub-clause C.2.17 does not preclude the negotiation of the final terms of the contract with a preferred tenderer following a competitive selection process, should the Employer elect to do so.*

C.2.18 Provide other material

C.2.18.1 Provide, on request by the employer, any other material that has a bearing on the tender offer, the tenderer's commercial position (including notarized joint venture agreements), preferencing arrangements, or samples of materials, considered necessary by the employer for the purpose of a full and fair risk assessment.

Should the tenderer not provide the material, or a satisfactory reason as to why it cannot be provided, by the time for submission stated in the employer's request, the employer may regard the tender offer as non-responsive.

C.2.18.2 Dispose of samples of materials provided for evaluation by the employer, where required.

C.2.19 Inspections, tests and analysis

Provide access during working hours to premises for inspections, tests and analysis as provided for in the tender data.

C.2.20 Submit securities, bonds and policies

If requested, submit for the employer's acceptance before formation of the contract, all securities, bonds, guarantees, policies and certificates of insurance required in terms of the conditions of contract identified in the contract data.

C.2.21 Check final draft

Check the final draft of the contract provided by the employer within the time available for the employer to issue the contract.

C.2.22 Return of other tender documents

If so instructed by the employer, return all retained tender documents within twenty-eight (28) days after the expiry of the validity period stated in the tender data.

C.2.23 Certificates

Include in the tender submission or provide the employer with any certificates as stated in the tender data.

C.3 The employer's undertakings

C.3.1 Respond to requests from the tenderer

C.3.1.1 Unless otherwise stated in the tender Data, respond to a request for clarification received up to five (5) working days before the tender closing time stated in the Tender Data and notify all tenderers who collected tender documents.

C.3.1.2 Consider any request to make a material change in the capabilities or formation of the tendering entity (or both) or any other criteria which formed part of the qualifying requirements used to prequalify a tenderer to submit a tender offer in terms of a previous procurement process and deny any such request if as a consequence:

- a) an individual firm, or a joint venture as a whole, or any individual member of the joint venture fails to meet any of the collective or individual qualifying requirements;
- b) the new partners to a joint venture were not prequalified in the first instance, either as individual firms or as another joint venture; or
- c) in the opinion of the Employer, acceptance of the material change would compromise the outcome of the prequalification process.

C.3.2 Issue Addenda

If necessary, issue addenda that may amend or amplify the tender documents to each tenderer during the period from the date that tender documents are available until three (3) working days before the tender closing time stated in the Tender Data. If, as a result a tenderer applies for an extension to the closing time stated in the Tender Data, the Employer may grant such extension and, shall then notify all tenderers who collected tender documents.

C.3.3 Return late tender offers

Return tender offers received after the closing time stated in the Tender Data, unopened, (unless it is necessary to open a tender submission to obtain a forwarding address), to the tenderer concerned.

C.3.4 Opening of tender submissions

C.3.4.1 Unless the two-envelope system is to be followed, open valid tender submissions in the presence of tenderers' agents who choose to attend at the time and place stated in the tender data. Tender submissions for which acceptable reasons for withdrawal have been submitted will not be opened.

C.3.4.2 Announce at the meeting held immediately after the opening of tender submissions, at a venue indicated in the tender data, the name of each tenderer whose tender offer is opened and, where applicable, tender offer only.

C.3.4.3 Make available the record outlined in C.3.4.2 to all interested persons upon request.

C.3.5 Two-envelope system

C.3.5.1 A two-envelope system shall not be allowed, only the bid of valid tenders in the presence of tenderers' agents who choose to attend at the time and place stated in the tender data and announce the name of each tenderer whose bid is opened.

C.3.5.2 Evaluate functionality of the bids offered by tenderers, then advise tenderers who remain in contention for the award of the contract of the time and place when the financial bids will be opened. Open only the financial bids of tenderers, who score in the functionality evaluation more than the minimum number of points for functionality stated in the tender data, and announce the score obtained for the bids and the total price and any points claimed on Specific Goals system. Return unopened financial bids to tenderers whose bids failed to achieve the minimum number of points for functionality.

C.3.6 Non-disclosure

Not disclose to tenderers, or to any other person not officially concerned with such processes, information relating to the evaluation and comparison of tender offers, the final evaluation price and recommendations for the award of a contract, until after the award of the contract to the successful tenderer.

C.3.7 Grounds for rejection and disqualification

Determine whether there has been any effort by a tenderer to influence the processing of tender offers and instantly disqualify a tenderer (and his tender offer) if it is established that he engaged in corrupt or fraudulent practices.

C.3.8 Test for responsiveness

C.3.8.1 Determine, after opening and before detailed evaluation, whether each tender offer properly received:

- a) complies with the requirements of these Conditions of Tender,
- b) has been properly and fully completed and signed, and
- c) is responsive to the other requirements of the tender documents.

C.3.8.2 A responsive tender is one that conforms to all the terms, conditions, and specifications of the tender documents without material deviation or qualification. A material deviation or qualification is one which, in the Employer's opinion, would:

- a) detrimentally affect the scope, quality, or performance of the works, services or supply identified in the Scope of Work,
- b) significantly change the Employer's or the tenderer's risks and responsibilities under the contract, or
- c) affect the competitive position of other tenderers presenting responsive tenders, if it were

to be rectified.

Reject a non-responsive tender offer, and not allow it to be subsequently made responsive by correction or withdrawal of the non-conforming deviation or reservation.

C.3.9 Arithmetical errors, omissions and discrepancies

C.3.9.1 Check responsive tenders for discrepancies between amounts in words and amounts in figures. Where there is a discrepancy between the amounts in figures and the amount in words, the amount in words shall govern.

C.3.9.2 Check the highest ranked tender or tenderer with the highest number of tender evaluation points after the evaluation of tender offers in accordance with C.3.11 for:

- a) the gross misplacement of the decimal point in any unit rate;
- b) omissions made in completing the pricing schedule or bills of quantities; or
- c) arithmetic errors in:
 - (i) line item totals resulting from the product of a unit rate and a quantity in bills of quantities or schedules of prices; or
 - (ii) the summation of the prices.

C.3.9.3 Notify the tenderer of all errors or omissions that are identified in the tender offer and either confirm the tender offer as tendered or accept the corrected total of prices.

C.3.9.4 Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows:

- a) If bills of quantities or pricing schedules apply and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate shall be corrected.
- b) Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern and the tenderer will be asked to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices.

C.3.10 Clarification of a tender offer

Obtain clarification from a tenderer on any matter that could give rise to ambiguity in a contract arising from the tender offer.

C.3.11 Evaluation of tender offers

The Standard Conditions of Tender standardize the procurement processes, methods and procedures from the time that tenders are invited to the time that a contract is awarded. They are generic in nature and are made project specific through choices that are made in developing the Tender Data associated with a specific project.

Conditions of tender are by definition the document that establishes a tenderer's obligations in submitting a tender and the employer's undertakings in soliciting and evaluating tender offers. Such conditions establish the rules from the time a tender is advertised to the time that a contract is awarded and require employers to conduct the process of offer and acceptance in terms of a set of standard procedures.

The CIDB Standard Conditions of Tender are based on a procurement system that satisfies the following system

requirements:	
Requirement	Qualitative interpretation of goal
Fair	The process of offer and acceptance is conducted impartially without bias, providing simultaneous and timely access to participating parties to the same information.
Equitable	Terms and conditions for performing the work do not unfairly prejudice the interests of the parties.
Transparent	The only grounds for not awarding a contract to a tenderer who satisfies all requirements are restrictions from doing business with the employer, lack of capability or capacity, legal impediments and conflicts of interest.
Competitive	The system provides for appropriate levels of competition to ensure cost effective and best value outcomes.
Cost effective	The processes, procedures and methods are standardized with sufficient flexibility to attain best value outcomes in respect of quality, timing and price, and least resources to effectively manage and control procurement processes.

The activities associated with evaluating tender offers are as follows:

- a) Open and record tender offers received
- b) Determine whether or not tender offers are complete
- c) Determine whether or not tender offers are responsive
- d) Evaluate tender offers
- e) Determine if there are any grounds for disqualification
- f) Determine acceptability of preferred tenderer
- g) Prepare a tender evaluation report
- h) Confirm the recommendation contained in the tender evaluation report

C.3.11.1 General

The employer must appoint an evaluation panel of not less than three persons conversant with the proposed scope of works to evaluate each responsive tender offer using the tender evaluation methods and associated evaluation criteria and weightings that are specified in the tender data.

C.3.12 Insurance provided by the employer

If requested by the proposed successful tenderer, submit for the tenderer's information the policies and / or certificates of insurance which the conditions of contract identified in the contract data, require the employer to provide.

C.3.13 Acceptance of tender offer

Accept the tender offer; if in the opinion of the employer, it does not present any risk and only if the tenderer:

- a) is not under restrictions, or has principals who are under restrictions, preventing participating in the employer's procurement;
- b) can, as necessary and in relation to the proposed contract, demonstrate that he or she possesses the professional and technical qualifications, professional and technical competence, financial resources, equipment and other physical facilities, managerial capability, reliability, experience and reputation, expertise and the personnel, to perform the contract;
- c) has the legal capacity to enter into the contract;
- d) is not; insolvent, in receivership, under Business Rescue as provided for in chapter 6 of the Companies Act No. 2008, bankrupt or being wound up, has his/her affairs administered by a court or a judicial officer, has suspended his/her business activities or is subject to legal proceedings in respect of any of the foregoing;
- e) 6 of the Companies Act No. 2008, bankrupt or being wound up, has his/her affairs administered by a court or a judicial officer, has suspended his/her business activities or is subject to legal proceedings in respect of any of the foregoing;
- f) complies with the legal requirements, if any, stated in the tender data; and

- g) is able, in the opinion of the employer, to perform the contract free of conflicts of interest.

C.3.14 Prepare contract documents

C.3.14.1 If necessary, revise documents that shall form part of the contract and that were issued by the employer as part of the tender documents to take account of:

- a) addenda issued during the tender period,
- b) inclusion of some of the returnable documents and
- c) other revisions agreed between the employer and the successful tenderer.

C.3.14.2 Complete the schedule of deviations attached to the form of offer and acceptance, if any.

C.3.15 Complete adjudicator's contract

Unless alternative arrangements have been agreed or otherwise provided for in the contract, arrange for both parties to complete formalities for appointing the selected adjudicator at the same time as the main contract is signed.

C.3.16 Registration of the award

An employer must, within twenty-one (21) working days from the date on which a contractor's offer to perform a construction works contract is accepted in writing by the employer, register and publish the award on the cidb Register of Projects.

C.3.17 Provide copies of the contracts

Provide to the successful tenderer the number of copies stated in the Tender Data of the signed copy of the contract as soon as possible after completion and signing of the form of offer and acceptance.

C.3.18 Provide written reasons for actions taken

Provide upon request written reasons to tenderers for any action that is taken in applying these conditions of tender but withhold information which is not in the public interest to be divulged, which is considered to prejudice the legitimate commercial interests of tenderers or might prejudice fair competition between tenderers.

T2.2

RETURNABLE SCHEDULES

POLOKWANE MUNICIPALITY

T2.1 List of Returnable Documents

The Tenderer must complete the following returnable documents:

ANNEXURE	NAME OF RETURNATION SCHEDULE	COMPLETED AND ATTACHED [YES / NO]
1. Returnable Schedules required only for Tender evaluation purposes		
1	MBD 1 FORM	
A	Certificate of Attendance at Site Clarification Meeting	
B	Certificate of Authority of Signatory	
C	Certificate of Registration with the Construction Industry Development Board or Proof of registration with CIDB (Grade 9 CE)	
D	Certificate of authority for joint ventures (where applicable)	
E	Compulsory Enterprise Questionnaire	
F	Record of Addenda to Tender Documents	
G	Proposed Amendments and Qualifications	
H	Form of Intent to Provide a Demand Guarantee	
I	Schedule of Proposed Subcontractors	
J	Evaluation schedules and criteria	
	• Criteria 1: Experience and Qualifications of Key Personnel	
	• Criteria 2: Relevant Experience of a Company	
	• Criteria 3: Project Execution Plan	
	• Criteria 4: Financial Standing and Access to credit	
K	Bidder's current workload and commitments	
L	Bidder's recently completed (Largest) assignments – last three years	
M	Certificate of Permission to Conduct Due Diligence Investigation	
N	Certificate for Municipal Services and Payments: Annexure B	
O	Authorisation for deduction of outstanding amounts owed to Municipality: Annexure C	
P	Bidder's Disclosure Declaration of interest: MBD 4	
Q	National industrial participation programme : SBD 5	

R	Declaration for procurement above R10 Million: MBD 5	
S	Declaration of interest: MBD 6.1	
T	Compliance with OHSA (Act 85 of 1993)	
U	Day Works	
V	Job Creation Schedule	

2. Other documents that will be incorporated into the contract

- 2.1 The offer portion of the C1.1 Offer and Acceptance
- 2.2 C1.2 Contract Data (Part 2)
- 2.3 C2.2 Bills of Quantities

A. CERTIFICATE OF ATTENDANCE AT SITE CLARIFICATION MEETING

This is to certify that:

..... (Tenderer)

of (Address)

.....

was represented by the person(s) named below at the compulsory meeting held for all Tenderers at

.....(location) on (date), starting at

We acknowledge that the purpose of the meeting was to acquaint ourselves with the Site of the Works and/or matters incidental to doing the work specified in the Tender documents in order for us to take account of everything necessary when compiling our entire Tender submission.

Particulars of person(s) attending the meeting:

Name

Signature.....

Capacity.....

Name

Signature.....

Capacity.....

Note: All particulars above this horizontal divide line to be filled in by the Tenderer **prior to** signature by Employer's representative.

Attendance of the above persons at the meeting is confirmed by the representative of..... Consulting Services namely:

Name

Signature.....

Capacity.....

Date.....

B. CERTIFICATE OF AUTHORITY OF SIGNATORY

Indicate the status of the Tenderer by ticking the appropriate box hereunder. The Tenderer must complete the certificate set out below for the relevant category.

1	Company	☐
2	Partnership	☐
3	Joint Venture	☐
4	Sole Proprietor	☐
5	Close Corporation	☐

1. Certificate for Company

I, ..., chairperson of the board of directors of

....., hereby confirm that by resolution of the board

(copy attached) taken on 20....., Mr/Ms,

acting in the capacity of, was authorised to sign all documents in connection with this Tender and any contract resulting from it on behalf of the company.

As witnesses:

1.
Chairman

.....
Print Name

.....
Print Name

2.
Date

.....
Print Name

2. Certificate of Partnership

We, the undersigned, being the key partners in the business trading as

....., hereby authorise Mr/Ms

acting in the capacity of, to sign all documents in

connection with the Tender for Contract, and any contract resulting from it on our behalf.

Name	Address	Signature	Date

NOTE: This certificate is to be completed and **signed by each and all of the key partners** upon whom rests the direction of the affairs of the Partnership as a whole.

3. Certificate for Joint Venture

We, the undersigned, are submitting this Tender offer in Joint Venture and hereby authorise Mr/Ms

....., authorised signatory of the firm

....., acting in the capacity of lead partner, to

sign all documents in connection with the Tender offer for Contract and any contract resulting from it on our behalf.

This authorisation is evidenced by the attached power of attorney signed by legally authorised signatories of all the partners to the Joint Venture.

Name of Firm	Address	Authorising	
		Signature	Name
Lead Partner			

4. Certificate for Sole Proprietor

I, ..., hereby confirm that I am the sole owner of the
business trading as

Owner Name _____ Signature of Sole Owner _____ Date _____

As witnesses:

.....
 Name Signature Date

.....
 Name Signature Date

5. Certificate for Close Corporation

We, the undersigned, being the key members in the business trading as

..... hereby authorise Mr/Ms

acting in the capacity of, to sign all

documents in connection with the Tender for Contract and any contract resulting from it on our behalf.

Name	Address	Signature	Date

NOTE: This Certificate is to be completed and signed by each and all of the key members upon whom rests the direction of the affairs of the Close Corporation as a whole.

C. CERTIFICATE OF REGISTRATION WITH THE CONSTRUCTION INDUSTRY DEVELOPMENT BOARD

1. General

The Register of Contractors is established by the Construction Industry Development Board in terms of the CIDB Act 38 of 2000 and Construction Industry Development Regulations as published in Government Gazette number 26427 of 2004.

The Act makes it mandatory for public sector clients to apply this register when considering Tenders. Any enterprise that submits a Tender or enters into contract for construction works with the public sector, must be registered.

Once-off joint ventures do not have to register, provided that each partner of the joint venture is separately registered.

2. Status

Tenderers shall fill in the following sections of this form, depending on their status:

2.1 Section A

Tenderers who have accomplished registration and can provide proof of their grading designation.

2.2 Section B

Tenderers who are in the process of registration of an update to an existing registration or a renewal.

2.3 Section C

Tenderers who have submitted the first application.

2.4 Section D

Tenderers submitting this Tender offer in Joint Venture and can provide proof that each partner of the Joint Venture is separately registered.

NOTE: Only complete ONE of Sections A, B, C or D.

SECTION A

I, ...,

acting in capacity of,

was authorised to sign all documents in connection with this Tender and any contract resulting from it on behalf of the following entity:

.....

hereby declare that the above-mentioned entity has achieved registration with the Construction Industry Development Board on date:

.....

and declare that the grading designation is reflected in the following **symbols** on the registration certificate:

CIDB Grade	
Class of works	
CRS number	
Expiry date	

.....
Signature of Tenderer

.....
Signature of Witness

.....
Print Name

.....
Print Name

SECTION B

I, ...,

acting in capacity of,

was authorised to sign all documents in connection with this tender and any contract resulting from it on behalf of the following entity:

.....

hereby declare that the above-mentioned entity has achieved registration with the Construction Industry Development Board on date

.....,

furthermore, declare that the existing grading designation is:

CIDB Grade	
Class of works	
CRS number	
Expiry date	

and the following update has been applied for (mark with "X"):

Amendment of category status:	
Change of particulars:	
Annual confirmation of particulars:	
Renewal of registration:	

.....
Signature of Tenderer

.....
Signature of Witness

.....
Print Name

.....
Print Name

SECTION C

I, ...,

acting in capacity of,

was authorised to sign all documents in connection with this tender and any contract resulting from it on behalf of the following entity:

.....

hereby declare that the above-mentioned entity has submitted its FIRST APPLICATION FOR REGISTRATION with the Construction Industry Development Board on date

.....

I furthermore declare that failure to achieve registration with the Construction Industry Development Board in a category stipulated in the Tender Data within 10 days from the date of closing this tender, implies a non-responsive tender and warrants rejection of the Tender on account of non-compliance with the requirements of the Tender Data.

.....
Signature of Tenderer

.....
Signature of Witness

.....
Print Name

.....
Print Name

SECTION D

I, ...,

acting in capacity of the LEAD PARTNER in the Joint Venture,

was authorised to sign all documents in connection with this tender and any contract resulting from it and hereby declare that each partner of the Joint Venture is separately registered with the Construction Industry Development Board and declare that the grading designation is reflected in the following **symbols** on the registration certificates:

Name of Lead Partner	
CIDB Grade	
Class of works	
CRS number	
Expiry date	

Name of 2 nd Partner	
CIDB Grade	
Class of works	
CRS number	
Expiry date	

Name of 3 rd Partner	
CIDB Grade	
Class of works	
CRS number	
Expiry date	

.....
Signature of Tenderer (Lead partner)

.....
Signature of Witness

.....
Print Name (Lead partner's representative)

.....
Print Name (witness)

D. CERTIFICATE OF AUTHORITY FOR JOINT VENTURES (WHERE APPLICABLE)

Employer (this tender):

Contract Number (this tender):

NOTE 1 This form need only be completed in the event of a Joint Venture submitting this Tender.

NOTE 2 Fill in all the information requested in the spaces provided. Attach additional sheets if required.

NOTE 3 Provide a copy of the Joint Venture agreement. Demonstrate that the partners to the Joint Venture share in the ownership, control, management responsibilities, risks and profits of the Joint Venture. The Joint Venture agreement shall include specific details relating to:

- a) the contributions of capital and equipment;
- b) portions of the Contract to be performed by the partner's own resources; and
- c) portions of the Contract to be performed under the supervision of each partner.

NOTE 4 Provide copies of all written agreements between partners concerning the Joint Venture, including those that relate to ownership options and to restrictions/limits regarding ownership and control.

1. Joint Venture Particulars

Name

Postal Address

Physical Address

.....

Telephone:

Fax Number:

Name of authorized representative

2. Identity of Partner No. 1

Name

Postal Address

Physical Address

.....

Telephone:

Fax Number:

Contact Person

3. Identity of Partner No. 2

Name

Postal Address

Physical Address

.....

Telephone:

Fax Number:

Contact Person

4. Identity of Partner No. 3

Name

Postal Address

Physical Address

.....

Telephone:

Fax Number:

Contact Person

5. Description of the role of the partners in the joint venture

Partner No. 1:

.....

Partner No. 2:

.....

Partner No. 3:

.....

6. Ownership of the joint venture

(i) Ownership percentage(s) Partner No. 1 %

Partner No. 2 %

Partner No. 3 %

(ii) Partner percentage in respect of:

a) Profit and loss sharing: Partner No. 1 %

Partner No. 2 %

Partner No. 3 %

b) Initial capital contribution Partner No. 1 R

Partner No. 2 R

Partner No. 3 R

(iii) Anticipated ongoing capital contributions:

Partner No. 1 R

Partner No. 2 R

Partner No. 3 R

(iv) Contributions of equipment (specify types, quality and quantities of equipment) to be provided by each partner:

Partner No. 1:

.....

Partner No. 2:

.....

Partner No. 3:

.....

7. Recent contracts performed by partners in their own right or as partners in other joint ventures

a) Partner No. 1

(i)

(ii)

(iii)

(iv)

(v)

- b) Partner No. 2
- (i)

(ii)

(iii)

(iv)

(v)
- c) Partner No. 3
- (i)

(ii)

(iii)

(iv)

(v)

8. Control and participation in the joint venture

(Identify by name and firm those individuals who are, or will be, responsible for, and have authority to engage in the relevant management functions and policy and decision making, indicating any limitations in their authority, for example, co-signature requirements and monetary limits).

- a) Joint Venture cheque signing
-
- b) Authority to enter into contracts on behalf of the Joint Venture
-
- c) Signing, co-signing or collateralizing of loans
-
- d) Acquisition of lines of credit

.....
.....
.....

- e) Acquisition of demand bonds

.....
.....
.....

- f) Negotiating and signing of labour agreements

.....
.....
.....

9. Management of the performance of the Contract

(Fill in the name and firm of the responsible person)

- a) Supervision of construction works (field operations)

.....

- b) Major purchasing of goods and materials

.....

- c) Estimating and cost control.....

.....

- d) Technical management (management of project)

.....

10. Management and control of the joint venture

- a) Identify the managing partner

.....
.....
.....

- b) What authority does each partner have to commit or obligate the other to financial institutions, insurance companies, suppliers, subcontractors or other parties participating in the performance of the contemplated works:

Partner No. 1:

.....

Partner No. 2:

.....

Partner No. 3:

.....

c) Describe the management structure for the joint venture's work under this Contract

Management Function/Designation	Name	Partner

11. Personnel

a) State the approximate number of operative personnel (by trade/function/discipline) needed to execute the Joint Venture contract.

Trade/function/discipline	Number

- b) State the number of operative personnel to be employed on the Contract who are currently in the employ of partners:

.....

- c) State the number of operative personnel who are not currently in the employ of the respective partners and shall be engaged on the project by the Joint Venture:

.....

- d) State the name of the individual who shall be responsible for hiring Joint Venture employees:

.....

- e) State the name of the partner who shall be responsible for the preparation of Joint Venture payrolls:

.....

.....

12. Services

List the firms who provide the following services:

Service	Name	Contact Person	Telephone No.
Accounting			
Auditing			
Banking			
Insurance			
Legal			

13. Control and structure of the Joint Venture

Briefly describe the manner in which the Joint Venture is structured and controlled.

.....

.....

.....

The undersigned warrants that he/she is duly authorised to sign this Joint Venture disclosure form and affirms that the foregoing statements are correct and include all the material information necessary to identify and explain the terms and operations of the Joint Venture and the intended participation of each partner in the undertaking.

The undersigned further covenants and agrees to provide the Employer with complete and accurate information regarding actual joint venture work and the payment therefore, and any proposed changes in any provisions of the Joint Venture Agreement, and to permit the audit and examination of the books, records and files of the Joint Venture, or those of each partner relevant to the Joint Venture, by duly authorized representatives of the Employer.

Duly authorized to sign on behalf of:

..... **(the Joint Venture)**

Signature: Date:

Print Name

Address

.....

.....

Telephone:.....

Duly authorized to sign on behalf of

..... **(Partner No. 1)**

Signature: Date:

Print Name

Address

.....

.....

Telephone:.....

Duly authorized to sign on behalf of

..... **(Partner No. 2)**

Signature: Date:

Print Name

Address

.....

.....

Telephone:

Duly authorized to sign on behalf of

..... (Partner No. 3)

Signature: Date:

Print Name

Address

.....

.....

Telephone:

Duly authorized to sign on behalf of

..... (Partner No. 4)

Signature: Date:

Print Name

Address

.....

.....

Telephone:

E. COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars hereunder must be furnished.

In the case of a **Joint Venture**, **separate enterprise questionnaires** in respect of each partner/member must be completed and submitted.

Section 1: **Name of enterprise:** _____

Section 2: **VAT registration number, if any:** _____

Section 3: **CIDB registration number, if any:** _____

Section 4: **CSD number:** _____

Section 5: **Particulars of sole proprietors and partners in partnerships**

Name	Identity number	Personal income tax number

* Complete only if sole proprietor or partnership and attach separate page if more than 3 partners

Section 6: Particulars of companies and close corporations

Company registration number _____

Close corporation number _____ Tax

reference number: _____

Section 7: The attached MBD4 must be completed for each tender and be attached as a tender requirement.

Section 8: The attached MBD 6 must be completed for each tender and be attached as a requirement.

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise:

- i) authorizes the Employer to obtain a tax clearance certificate from the South African Revenue Services that my / our tax matters are in order;
- ii) confirms that the neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004;
- iii) confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption;
- iv) confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and
- v) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed

Date

Name: Position:.....

Enterprise
name

F. RECORD OF ADDENDA TO TENDER DOCUMENTS

We confirm that the following communications received from the Employer before the submission of this Tender offer, amending the Tender documents, have been taken into account in this Tender offer:

No.	Date	Title or Details
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
Attach additional pages if more space is required.		

Signed:

Date:

Print Name:

Position:

Tenderer:

G. PROPOSED AMENDMENTS AND QUALIFICATIONS

The Tenderer should record any deviations or qualifications he may wish to make to the Tender documents in this Returnable Schedule. Alternatively, a Tenderer may state such deviations and qualifications in a covering letter to his Tender and reference such letter in this schedule.

The Tenderer's attention is drawn to clause C.2.11 of the Standard Conditions of Tender referenced in the Tender Data regarding the employer's handling of material deviations and qualifications.

Page	Clause or item	Proposal

Signed:

Date:

Print Name:

Position:

Tenderer:

H. FORM OF INTENT TO PROVIDE A DEMAND GUARANTEE

If my/our Tender is accepted, I/we will, when required and within the time stipulated, provide a guarantee of

(*) Insurance Company (name)

(of address)

(*) Commercial Bank (Name)

(Branch)

(of address)

to be approved by you, the Employer, for the amount stipulated.

(*) : delete whichever is not applicable.

I/we understand that failure to produce an acceptable Demand Guarantee within the stipulated period is a fundamental breach of Contract, entitling the Employer to:

- (i) withhold all payments which may be due to the Contractor pending compliance with the stipulated requirements to produce an acceptable Demand Guarantee.
- (ii) instruct the Contractor to cease all work pending provision of the Demand Guarantee, and
- (iii) cancel the Contract.

Signed: Date:

Print Name: Position:

Tenderer:

I. SCHEDULE OF PROPOSED SUBCONTRACTORS

We notify you that it is our intention to employ the following Subcontractors for work in this contract.

If we are awarded a contract we agree that this notification does not change the requirement for us to submit the names of proposed Subcontractors in accordance with requirements in the contract for such appointments. If there are no such requirements in the contract, then your written acceptance of this list shall be binding between us.

We confirm that all Subcontractors who are contracted to construct a house are registered as home builders with the National Home Builders Registration Council.

No	Name and address of proposed Subcontractor	Nature and extent of work	Previous experience with Subcontractor.
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

Signed:

Date:

Print Name:

Position:

Tenderer:

J. EVALUATION SCHEDULES: FUNCTIONALITY & ELIGIBILITY CRITERIA

CRITERIA 1: EXPERIENCE AND QUALIFICATIONS OF KEY PERSONNEL

The experience and qualifications of the key personnel who will be responsible for the management of the project and also the operations of the facility will be evaluated in relation to the scope of work from two different points of view:

1. General experience (total duration of work activity). The experience must be set out in the C.V., stipulating/ stating name of the project, key responsibility, commencement and end date, contactable references; and
2. The education, training, professional registration and skills which are pertinent to the scope of work. Proof of education and training (certificates) must be attached to the C.V.
3. For all proposed resources, for both the Eligibility criteria and Functionality requirements, the CVs of proposed resources should preferably be structured as detailed in **Table J** below:
4. The Tenderer shall submit a project-specific organisational structure or organogram clearly identifying all key personnel proposed for the delivery of the Works. The organogram must, as a minimum, include the resources submitted in fulfilment of the eligibility and functionality requirements, and must also reflect any additional personnel or specialist resources proposed by the Tenderer to support the effective delivery of the project, including Operations and Maintenance (O&M) services. The information presented in the organogram must be consistent with the names, roles and responsibilities submitted elsewhere in the tender submission
5. Tenderer provides CV's for the following Key Personnel as listed in the eligibility and functional criteria including:
 - a. Civil Engineer;
 - b. Electrical Engineer;
 - c. Mechanical Engineer;
 - d. Operations (Plant) Manager;
 - e. Contracts Manager/Director;
 - f. Construction Manager;
 - g. Instrumentation & Control (I&C / SCADA) Design Engineer;
 - h. Quantity Surveyor (or Cost Engineer);
 - i. Construction Health and Safety Practitioner;
 - j. Environmental Practitioner; and

The CV of individuals will be used for evaluation of the each of the personnel for this section.

B. ELIGIBILITY CRITERIA

i. Civil Engineer

The Civil Engineer shall be responsible for the civil engineering works control, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following:

- A minimum of 15 years' relevant post-graduate experience in Civil Engineering design within the built environment;
- Have demonstrated experience in water and/or wastewater treatment projects;
- Hold a minimum a minimum of BSc, BEng or B Tech in Civil Engineering or the Built Environment; and
- Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA)

ii. Mechanical Engineer

The Mechanical Engineer shall be responsible for the mechanical engineering works control, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following:

- a minimum of 15 years' relevant post-graduate experience in Mechanical Engineering within the built environment;
- Have demonstrated experience in water and/or wastewater treatment projects;
- Hold a minimum a minimum of BSc, BEng or B Tech in Mechanical Engineering or the Built Environment.
- Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA)

iii. Electrical Engineer

Electrical Engineer shall be responsible for the electrical engineering works control, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements and shall have the following:

- A minimum of 15 years' relevant post-graduate experience in Electrical Engineering within the built environment;
- Have demonstrated experience in water and/or wastewater treatment projects;
- Hold a minimum a minimum of BSc, BEng or B Tech in Electrical Engineering or the Built Environment.
- Hold a Pr. Eng or Pr. Tech Eng valid professional status with the Engineering Council of South Africa (ECSA)

iv. The WWTW Operations (Plant) Manager

The Plant Manager shall be responsible for the overall operation, performance, compliance and maintenance management of the wastewater treatment works, ensuring that all treatment processes, assets and systems function safely, reliably and in accordance with regulatory requirements. The role includes oversight of operations staff, coordination of maintenance activities, performance monitoring, incident management, and skills transfer to City personnel to enable sustainable handover at the end of the operating period. The Plant Manager shall have the following:

- Minimum 8 years' experience in WWTW operations with demonstrated experience with biological treatment processes;
- Have demonstrated experience in managing wastewater treatment projects;
- Hold a minimum a minimum of BSc, BEng or B Tech in Water/Wastewater Treatment, Chemical Engineering, Civil Engineering, or Process Engineering; and
- Experience with regulatory compliance (e.g. Green Drop or equivalent).

C. FUNCTIONALITY CRITERIA:

i. Contracts Manager/Director (8 points)

- The Contractor shall appoint a Contract Manager / Contracts Director with a minimum of 15 years' post-graduate experience in the Civil construction industry and a minimum three-year Diploma in the Built Environment and be professionally registered with the relevant statutory body
- The Contract Manager / Contracts Director shall be responsible for the overall management of the project on behalf of the Contractor, including project management, financial management, and contractual administration. Responsibilities include the preparation and control of construction programmes, cash flows, and budgets, as well as the management of all contractor personnel assigned to the project
- The Contract Manager / Contracts Director shall serve as the primary point of contact for the Employer and the Employer's Agent, attend all contract site meetings, and be accountable for health and safety compliance and overall quality management for the project
- Attach a detailed CV with relevant academic qualifications and proof of Pr. Eng or Pr. Tech Eng registration (as per Table J1 template below). The scoring shall be conducted as follows:
 - **Qualifications (1 point):**
 - Four (4) year university degree or higher in the Built Environment – 1 point
 - Three (3) year university diploma or degree in Built Environment – 0,5 points
 - Qualifications not as per requirements
 - **Professional registration (1 point):**
 - Professional registration in the ECSA Pr Eng category – 1 point
 - Professional registration in the ECSA Pr Tech or Pr Techni category – 0,5 points
 - Professional registration not valid, not relevant or not as per requirements – 0 points
 - **Work experience in civil engineering construction projects (6 points):**
 - From 25 years of experience and above – 6 points
 - From 15 years to 25 years of experience – 4 points
 - Lower than 15 years, not properly detailed or not as per tender requirements – 0 point

ii. Construction Manager (7 points)

- The Contractor shall appoint a Construction Manager with demonstrated experience in wastewater treatment projects with a minimum of 10 years' post-graduate experience in the Civil construction industry. Minimum three-year Diploma in the Built Environment and professional registration with the statutory body
- The Construction Manager shall be full-time on site for the duration of the construction period and construction programme, particularly when construction activities are underway or when reasonably required by the Employer's Agent.
- The Construction Manager shall be delegated appropriate authority by the Contractor and shall be authorised to receive, on behalf of the Contractor, all oral and written instructions and communications from the Employer's Agent, the Employer's Agent's Representative, or any other duly authorised person.
- Attach a detailed CV with relevant academic qualifications and proof of Pr.CM, Pr.CPM (SACPCMP) registration (as per Table J1 template below). The scoring shall be conducted as follows:
 - **Qualifications (1 point):**
 - Four (4) year university degree or higher in the Built Environment – 1 point
 - Three (3) year university diploma or degree in Built Environment – 0,5 points
 - Qualifications not as per requirements
 - **Professional registration (1 point):**
 - Professional registration in the Pr.CM or Pr CPM category – 1 point
 - Professional registration not valid, not relevant or not as per requirements – 0 points

- **Work experience in WTW or WWTW projects (5 points):**
 - From 15 years of experience and above – 5 points
 - From 10 years to 15 years of experience – 4 points
 - Lower than 10 years, not properly detailed or not as per tender requirements – 0 point

iii. Control & Instrumentation (C&I) Engineer (5 points)

- The Contractor shall appoint a C&I Engineer with demonstrated experience in water and/or wastewater treatment projects with a minimum of 10 years' post-graduate experience in the Civil construction industry.
- The C&I Engineer shall hold a minimum three-year Diploma or Degree in C&I or the Built Environment and be professionally registered with the relevant statutory body
- The C&I Engineer shall be responsible for the C&I, coordination, and technical support of the works, ensuring compliance with applicable standards, specifications, and contractual requirements.
- Attach a detailed CV with relevant academic qualifications and proof of Pr.Eng, ECSA Pr. Tech or Pr. Techni registration (as per Table J1 template below). The scoring shall be conducted as follows:
 - **Qualifications (1 point):**
 - Four (4) year university degree or higher in the Built Environment – 1 points
 - Three (3) year university diploma or degree in Built Environment – 0,5 points
 - Qualifications not as per requirements
 - **Professional registration (1 point):**
 - Professional registration in the Pr. Eng – 1 points
 - Professional registration in the ECSA Pr. Tech or Pr. Techni – 0.5 points
 - Professional registration not valid, not relevant or not as per requirements – 0 points
 - **Work experience in WTW or WWTW projects (3 points):**
 - From 15 years of experience and above – 3 points
 - From 10 years to 15 years of experience – 2 points
 - Lower than 10 years, not properly detailed or not as per tender requirements – 0 point

iv. Quantity Surveyor (QS) (5 points)

- The Contractor shall appoint a Quantity Surveyor (QS) with demonstrated experience in water and/or wastewater treatment projects with a minimum of 10 years' post-graduate experience in the Civil construction industry.
- The Quantity Surveyor hold a relevant three-year Diploma or Degree in Quantity Surveying or the Built Environment and be professionally registered with the relevant statutory body.
- The Quantity Surveyor shall be responsible for cost control, measurement, valuation, and financial reporting, including the preparation and assessment of payment certificates, variations, and final accounts, in accordance with the contract and applicable standards.
- Attach a detailed CV with relevant academic qualifications and proof of Pr.Eng, ECSA Pr. Tech or Pr. Techni registration (as per Table J1 template below). The scoring shall be conducted as follows:
 - **Qualifications (1 point):**
 - Four (4) year university degree or higher in QS – 1 points
 - Three (3) year university diploma or degree in QS – 0,5 points
 - Qualifications not as per requirements
 - **Professional registration (1 point):**
 - Professional registration as SACQSP PrQS – 1 points
 - Professional registration as Candidate QS – 0.5 points
 - Professional registration not valid, not relevant or not as per requirements – 0 points
 - **Work experience in WTW or WWTW projects (3 points):**

- From 15 years of experience and above – 3 points
- From 10 years to 15 years of experience – 2 points
- Lower than 10 years, not properly detailed or not as per tender requirements – 0 point

v. Construction Health & Safety Officer (5 points)

- The Contractor shall appoint a Construction Health & Safety Officer with demonstrated experience in water and/or wastewater treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry.
- The Construction Health & Safety Officer shall hold a relevant three-year Diploma or Degree in Occupational Health and Safety, Construction Management, or a related field and be professionally registered with the relevant statutory body. Registration as Professional registration as Construction H&S Officer (CHSO) (SACPCMP) is a minimum requirement. Without registration, qualification and experience will also score a zero (0).
- The Construction Health & Safety Officer shall be responsible for ensuring compliance with the Occupational Health and Safety Act, Construction Regulations, and the project-specific Health and Safety Plan, including monitoring, reporting, incident management, and coordination with the Employer's Agent for the duration of the works.
- Attach a detailed CV with relevant academic qualifications and proof of Construction H&S Officer (CHSO) (SACPCMP) registration (as per Table J1 template below). The scoring shall be conducted as follows:
 - **Qualifications (1 point):**
 - Three (3) year university diploma or degree in Safety Management, Health or Built environment or relevant – 1 points
 - Any other qualification/certificate in Safety Management, Health or Built environment or relevant – 0,5 points
 - Qualifications not as per requirements
 - **Professional registration (1 point):**
 - Professional registration as Construction H&S Officer (CHSO) (SACPCMP) – 1 points
 - Professional registration not valid, not relevant or not as per requirements – 0 points
 - **Work experience in WTW or WWTW projects (3 points):**
 - From 15 years of experience and above – 3 points
 - From 10 years to 15 years of experience – 2 points
 - Lower than 10 years, not properly detailed or not as per tender requirements – 0 point

vi. Environmental Officer (5 points)

- The Contractor shall appoint an Environmental Officer with demonstrated experience in water and/or wastewater treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry.
- The Environmental Officer shall hold a relevant three-year Diploma or Degree in Environmental Management, Environmental Science, or a related field and be professionally registered with the relevant statutory body
- The Environmental Officer shall be responsible for ensuring compliance with environmental legislation, approval conditions, and the Environmental Management Programme (EMPr), including monitoring, reporting, and liaison with the Employer's Agent and relevant authorities for the duration of the construction works.

vii. Environmental Officer (5 points)

- The Contractor shall appoint an Environmental Officer with demonstrated experience in water and/or wastewater treatment projects, with a minimum of 10 years' post-graduate experience in the Civil construction industry.
- The Environmental Officer shall hold a relevant three-year Diploma or Degree in Environmental Management, Environmental Science, or a related field and be professionally registered with the relevant statutory body

- The Environmental Officer shall be responsible for ensuring compliance with environmental legislation, approval conditions, and the Environmental Management Programme (EMPr), including monitoring, reporting, and liaison with the Employer's Agent and relevant authorities for the duration of the construction works.
- Attach a detailed CV with relevant academic qualifications and proof of Construction SACNASP Pr Sci Nat or SACNASP Certified Sci Nat registration (as per Table J1 template below). The scoring shall be conducted as follows:
 - **Qualifications (1 point):**
 - Four (4) year university degree in Science degree with honours or relevant – 1 points
 - Three (3) Year Science degree/Diploma/Btech or relevant – 0,5 points
 - Qualifications not as per requirements
 - **Professional registration (1 point):**
 - Professional registration as SACNASP Pr Sci Nat – 1 points
 - Registration as SACNASP Certified Sci Nat – 0.5 points
 - Professional registration not valid, not relevant or not as per requirements – 0 points
 - **Work experience in WTW or WWTW (3 points):**
 - From 15 years of experience and above – 3 points
 - From 10 years to 15 years of experience – 2 points
 - Lower than 10 years, not properly detailed or not as per tender requirements – 0 point

Table J1

CV Template				
Proposed resource Information				
Proposed Position as per the tender				
Name of the Firm (tenderer)				
Date of Employment				
Full Names of the proposed staff member				
Date of birth				
Nationality				
Professional registration category (ECSA / SACPCMP) e.g. Pr.Eng			Pr Number:	
Education (Attach copies)				
Year Obtained	Institution		Degree (s) Obtained	
Experience				
Employment History Date e.g. (Jan 2000 – Sept 2012)	Position Held	Company Name	Project details: Project name, detailed description and Responsibilities in line with the criteria	Sector Experience
References (at least two)				
Name	Company	Position	Number	Email

Enclosure: Copies of certificates of academic qualifications and Certificate of Professional registration. Copies of qualifications along with detailed CV of personnel. For registration certificates, provide a registration number or full names written in the certificate, the Pr. Registration status will then be verified online during the Evaluation process through the relevant Professional body online search system. Foreign Qualifications to be accompanied by SAQA verification.

A bidder is expected to reproduce this template so that the information needed therein could be comprehensively covered.

NOTES

Index of documentation attached to this schedule:

.....
.....
.....

CRITERIA 2: RELEVANT EXPERIENCE OF A COMPANY (40 POINTS)

This will take into consideration similar contracts successfully completed by the bidder with proof attached.

1) CIVIL ENGINEERING WORKS - CONSTRUCTION (20 points):

Relevant experience of a company in Water Treatment works or Wastewater projects – Civil Engineering works.

Previous experience of the company – Civil Engineering works

- a) The Tenderer shall provide no more than four (4) project references in wastewater or water treatment works projects completed within the **last fifteen (15) years**, using the template provided in the Returnable Schedules.
- a) The civil works experience must be in wastewater treatment works and/or water treatment works related projects (local or international) with a construction value greater than R 350 million (per individual project) excluding VAT.
- a) Where a project included multiple disciplines under a single contract, the Tenderer may cross-reference the same project under each applicable discipline, provided that the Tenderer clearly indicates the scope performed per discipline.
- a) If the Tenderer provides more than four (4) project references, only the first four (4) project references as they are ordered in the Tenderer's Response will be selected for evaluation. Utilize Table J2 below to complete a list of completed projects. This list of completed projects should be supplemented with the following evidence in sub item (e) below.
- a) The Tenderer shall substantiate its experience by submitting the following:
 - i. A reference letter, appointment letter and completion certificate in the letterhead of the client shall include: The name of a client, tenderer's names, project amount, the scope of work / nature of works, the duration of the project (the start and end date), confirmation that the work was successfully completed, signature of client representative, contactable references (email and phone numbers). If the reference is in the tenderer's template, the stamp in the letter, contacts and signatures should be those of the previous client; **OR**
 - ii. Attach appointment letters (in client's letterhead, with reachable contact details) **AND** completion certificates detailing a brief description of the scope of works, project value, start & completion dates of the projects (all signed by client representatives). If the completion certificate contains all the details i.e. client names, project description (including size in Ml/day), project duration (or start and end date), project amount and signed by all parties, then there is no need of an appointment letter.
 - iii. Should the scope of work not be detailed in the appointment letter or the completion certificate, the tenderer must submit the approved scope of work for that particular project being used to evaluate the tenderers experience.
- a) In the case of a Joint Venture, qualifying projects undertaken by any member of the Joint Venture may be submitted.
- a) Only completed projects/contracts will be considered for evaluation and allocation of points.
- a) Failure to submit the required project information may negatively affect the Tenderer's score.
- a) **Points / scoring broken down as follows:**
 - No projects listed and/or project is incomplete or information not as per requirements = 0 points
 - One (1) project with wastewater or water treatment scope and minimum value of R 350 million = **1 point**

- Two (2) projects with wastewater or water treatment scope and minimum value of R 350 million = **5 points**
- Three (3) projects with wastewater or water treatment scope and minimum value of R 350 million = **7 points**
- Four (4) projects with wastewater or water treatment scope and minimum value of R 350 million = **10 points**

WORK EXPERIENCE OF A TENDERER TEMPLATE (THIS IS A GUIDE)

- i. List a maximum of **four (4) Civil works (water/wastewater)** construction contracts which your company has started and successfully completed. Utilise the information on **Table J2** below.

Table J2

EMPLOYER (NAME AND TEL No.)	NATURE OF WORK (WATER/WASTEWATER, NOTABLE PLANT COMPONENTS, INCLUDING AVERAGE CAPACITY OF PLANT Mℓ/day)	CONTRACT AMOUNT	START DATE	COMPLETION DATE
	Civil works (construction) for Water treatment or Wastewater treatment – Project No. 1			
	Civil works (construction) for Water treatment or Wastewater treatment – Project No. 2			
	Civil works (construction) for Water treatment or Wastewater treatment – Project No. 3			
	Civil works (construction) for Water treatment or Wastewater treatment – Project No. 4			

The tenderer is required to reproduce this template to ensure that all required information is comprehensively addressed. Tenderers may, however, use their own templates, provided that all the information specified above is fully included.

2) MECHANICAL WORKS – CONSTRUCTION (10 points):

Relevant Experience of Company in Mechanical works for Water Treatment works or Wastewater Treatment Plants

- a) The Tenderer shall provide no more than four (4) project references in mechanical works projects completed within the **last fifteen (15) years**, using the template provided in the Returnable Schedules (**Table J3**).
- b) The mechanical works experience must be in wastewater treatment works and/or water treatment works related projects (local or international) with a construction value greater than R 200 million (per individual project) excluding VAT.
- c) Where a project included multiple disciplines under a single contract, the Tenderer may cross-reference the same project under each applicable discipline, provided that the Tenderer clearly indicates the scope performed per discipline.
- d) If the Tenderer provides more than four (4) project references, only the first four (4) project references as they are ordered in the Tenderer's Response will be selected for evaluation. Utilize Table J3 below to complete a list of completed projects. This list of completed projects should be supplemented with the following evidence in sub item (e) below.
- e) The Tenderer shall substantiate its experience by submitting the following:
 - i. A reference letter in the letterhead of the client shall include: The name of a client, tenderer's names, the project amount, the scope of work/nature of works, the duration of the project (the start and end date), confirmation that the work was successfully completed, signature of client representative, contactable references (email and phone numbers). If the reference is in the tenderer's template, the stamp in the letter, contacts and signatures should be those of the previous client; OR
 - ii. Attach appointment letters (in client's letterhead, with reachable contact details) AND completion certificates detailing a brief description of scope of works, project value, start & completion dates of the projects (all signed by client representatives). If the completion certificate contains all the details i.e. client names, project description (including size in Ml/day), project duration (or start and end date), project amount and signed by all parties, then there is no need of an appointment letter.
 - iii. Should the scope of work not be detailed in the appointment letter or the completion certificate, the tenderer must submit the approved scope of work for that particular project being used to evaluate the tenderers experience.
 - iv. Where the scope of mechanical works formed part of an overall water treatment plant and/or wastewater treatment plant project that included other classes of works, a detailed breakdown of the works shall be provided. This breakdown must clearly identify the scope and value attributable to the mechanical discipline, class of works or components and shall be submitted as supporting evidential material. Acceptable forms of evidence include extracts from the signed Final Account, signed Final payment, signed reference letters, or approved Bills of Quantities.
- f) In the case of a Joint Venture, qualifying projects undertaken by any member of the Joint Venture may be submitted.
- g) Only completed projects/contracts will be considered for evaluation and allocation of points.
- h) Failure to submit the required project information may negatively affect the Tenderer's score.
- i) **Points / scoring broken down as follows:**
 - No projects listed and/or project is incomplete or information not as per requirements = 0 points
 - One (1) project with wastewater or water treatment scope and minimum value of R 200 million = **1 point**

- Two (2) projects with wastewater or water treatment scope and minimum value of R 200 million = **5 points**
- Three (3) projects with wastewater or water treatment scope and minimum value of R 200 million = **7 points**
- Four (4) projects with wastewater or water treatment scope and minimum value of R 200 million = **10 points**

WORK EXPERIENCE OF A TENDERER TEMPLATE (THIS IS A GUIDE)

- ii. List a maximum of **Four (4) Mechanical works (water/wastewater)** projects which your company has started and successfully completed. Utilise the information on **Table J3** below.

Table J3

EMPLOYER (NAME AND TEL No.)	NATURE OF WORK (WATER/WASTEWATER, NOTABLE PLANT COMPONENTS, INCLUDING AVERAGE CAPACITY OF PLANT M ³ /day)	CONTRACT AMOUNT	START DATE	COMPLETION DATE
	Mechanical works (construction) for Water treatment or Wastewater treatment – Project No. 1			
	Mechanical works (construction) for Water treatment or Wastewater treatment – Project No. 2			
	Mechanical works (construction) for Water treatment or Wastewater treatment – Project No. 3			
	Mechanical works (construction) for Water treatment or Wastewater treatment – Project No. 4			

The tenderer is required to reproduce this template to ensure that all required information is comprehensively addressed. Tenderers may, however, use their own templates, provided that all the information specified above is fully included.

3) ELECTRICAL WORKS – CONSTRUCTION (10 points)

Relevant Experience of Company in Electrical works for Water Treatment works or Wastewater Treatment Plants

- a) The Tenderer shall provide no more than four (4) project references in Electrical works projects completed within the **last fifteen (15) years**, using the template provided in the Returnable Schedules (**Table J4**).
- b) The electrical works experience must be in wastewater treatment works and/or water treatment works related projects (local or international) with a construction value greater than R 100 million (per individual project) excluding VAT.
- c) Where a project included multiple disciplines under a single contract, the Tenderer may cross-reference the same project under each applicable discipline, provided that the Tenderer clearly indicates the scope performed per discipline.
- d) If the Tenderer provides more than four (4) project references, only the first four (4) project references as they are ordered in the Tenderer's Response will be selected for evaluation. Utilize Table J4 below to complete a list of completed projects. This list of completed projects should be supplemented with the following evidence in sub item (e) below.
- e) The Tenderer shall substantiate its experience by submitting the following:
 - i. A reference letter, appointment letter and completion certificate in the letterhead of the client shall include: The name of a client, tenderer's names, project amount, the scope of work / nature of works, the duration of the project (the start and end date), confirmation that the work was successfully completed, signature of client representative, contactable references (email and phone numbers). If the reference is in the tenderer's template, the stamp in the letter, contacts and signatures should be those of the previous client; **OR**
 - ii. Attach appointment letters (in client's letterhead, with reachable contact details) AND completion certificates detailing a brief description of scope of works, project value, start & completion dates of the projects (all signed by client representatives). If the completion certificate contains all the details i.e. client names, project description (including size in Ml/day), project duration (or start and end date), project amount and signed by all parties, then there is no need of an appointment letter.
 - iii. Should the scope of work not be detailed in the appointment letter or the completion certificate, the tenderer must submit the approved scope of work for that particular project being used to evaluate the tenderers experience.
 - iv. Where the scope of electrical works formed part of an overall water treatment plant and/or wastewater treatment plant project that included other classes of works, a detailed breakdown of the works shall be provided. This breakdown must clearly identify the scope and value attributable to the electrical components and shall be submitted as supporting evidential material. Acceptable forms of evidence include extracts from the signed Final Account, signed Final payment, signed reference letters, or approved Bills of Quantities.
- f) In the case of a Joint Venture, qualifying projects undertaken by any member of the Joint Venture may be submitted.
- g) Only completed projects/contracts will be considered for evaluation and allocation of points.
- h) Failure to submit the required project information may negatively affect the Tenderer's score.
- i) **Points / scoring broken down as follows:**
 - No projects listed and/or project is incomplete or information not as per requirements = 0 points
 - One (1) project with wastewater or water treatment scope and minimum value of R 100 million = **1 point**
 - Two (2) projects with wastewater or water treatment scope and minimum value of R 100 million = **5 points**

- Three (3) projects with wastewater or water treatment scope and minimum value of R 100 million = **7 points**
- Four (4) projects with wastewater or water treatment scope and minimum value of R 100 million = **10 points**

WORK EXPERIENCE OF A TENDERER TEMPLATE (THIS IS A GUIDE)

- iii. List a maximum of **Four (4) Electrical works (water/wastewater)** construction contracts which your company has started and successfully completed. Utilise the information on **Table J4** below.

Table J4

EMPLOYER (NAME AND TEL No.)	NATURE OF WORK (WATER/WASTEWATER, NOTABLE PLANT COMPONENTS, INCLUDING AVERAGE CAPACITY OF PLANT Mℓ/day)	CONTRACT AMOUNT	START DATE	COMPLETION DATE
	Electrical works for Water treatment or Wastewater treatment – Project No. 1			
	Electrical works for Water treatment or Wastewater treatment – Project No. 2			
	Electrical works for Water treatment or Wastewater treatment – Project No. 3			
	Electrical works for Water treatment or Wastewater treatment – Project No. 4			

The tenderer is required to reproduce this template to ensure that all required information is comprehensively addressed. Tenderers may, however, use their own templates, provided that all the information specified above is fully included.

4) OPERATIONS & MAINTENANCE (10 points)

Relevant Experience of Company in Operations and Maintenance (O&M) works for Water Treatment works or Wastewater Treatment Plants

- a) The Tenderer shall provide no more than four (4) project references in Operations and Maintenance works completed within the **last fifteen (15) years**, using the template provided in the Returnable Schedules (**Table J5**).
- b) Operation and maintenance of wastewater treatment works (local or international) with an average treatment capacity of not less than 10 ML/day per facility, successfully operated and maintained for a minimum continuous period of one (1) year per facility, within the past fifteen (15) years.
- c) Where required for valuation consistency, the O&M experience may alternatively be demonstrated by wastewater treatment facilities with an annual O&M contract value of not less than R 30 million per annum.
- d) Where a project included multiple disciplines under a single contract, the Tenderer may cross-reference the same project under each applicable discipline, provided that the Tenderer clearly indicates the scope performed per discipline.
- e) If the Tenderer provides more than four (4) project references, only the first four (4) project references as they are ordered in the Tenderer's Response will be selected for evaluation. Utilize Table J5 below to complete a list of completed projects. This list of completed projects should be supplemented with the following evidence in sub item (f) below.
- f) The Tenderer shall substantiate its experience by submitting the following:
 - i. A reference letter, appointment letter and completion certificate in the letterhead of the client shall include: The name of a client, tenderer's names, project amount, the scope of work / nature of works, the duration of the project (the start and end date), confirmation that the work was successfully completed, signature of client representative, contactable references (email and phone numbers). If the reference is in the tenderer's template, the stamp in the letter, contacts and signatures should be those of the previous client; **OR**
 - ii. Attach appointment letters (in client's letterhead, with reachable contact details) AND completion certificates detailing a brief description of scope of works, project value, start & completion dates of the projects (all signed by client representatives). If the completion certificate contains all the details i.e. client names, project description (including size in ML/day), project duration (or start and end date), project amount and signed by all parties, then there is no need of an appointment letter.
 - iii. Should the scope of work not be detailed in the appointment letter or the completion certificate, the tenderer must submit the approved scope of work for that particular project being used to evaluate the tenderers experience.
 - iv. Where the scope of O&M works formed part of an overall water treatment plant and/or wastewater treatment plant project that included other classes of works, a detailed breakdown of the works shall be provided. This breakdown must clearly identify the scope and value attributable to the O&M scope and shall be submitted as supporting evidential material. Acceptable forms of evidence include extracts from the signed Final Account, signed Final payment, signed reference letters, or approved Bills of Quantities.
- g) In the case of a Joint Venture, qualifying projects undertaken by any member of the Joint Venture may be submitted.
- h) Only completed projects/contracts will be considered for evaluation and allocation of points.
- i) Failure to submit the required project information may negatively affect the Tenderer's score.
- j) **Points / scoring broken down as follows:**
 - No projects listed and/or project is incomplete or information not as per requirements = 0 points
 - One (1) project with wastewater or water treatment scope and minimum annual O&M value of R 30 million = **1 point**

- Two (2) projects with wastewater or water treatment scope and minimum annual O&M value of R 30 million = **5 points**
- Three (3) projects with wastewater or water treatment scope and minimum annual O&M value of R 30 million = **7 points**
- Four (4) projects with wastewater or water treatment scope and minimum annual O&M value of R 30 million = **10 points**

List a maximum of **Four (4)** O&M works (**water/wastewater**) which your company has started and successfully completed. Utilise the information on **Table J5** below.

Table J5

EMPLOYER (NAME AND TEL No.)	NATURE OF WORK (WATER/WASTEWATER, NOTABLE PLANT COMPONENTS, INCLUDING AVERAGE CAPACITY OF PLANT Mℓ/day)	Contract Amount	Start Date	COMPLETION DATE
	Operations and Maintenance - for Water treatment or Wastewater treatment works – Project No. 1			
	Operations and Maintenance for Water treatment or Wastewater treatment works – Project No. 2			
	Operations and Maintenance for Water treatment or Wastewater treatment works – Project No. 3			
	Operations and Maintenance for Water treatment or Wastewater treatment works – Project No. 4			

The tenderer is required to reproduce this template to ensure that all required information is comprehensively addressed. Tenderers may, however, use their own templates, provided that all the information specified above is fully included.

SIGNED ON BEHALF OF TENDERER:

CRITERIA 3: PROJECT EXECUTION PLAN [15 POINTS]

The maximum total that can be scored under Project Execution Plan is 15 points.

Each criterion of the Project Execution Plan will be evaluated, scored and weighted, the total of which is a maximum of 100%.

1. An organogram to indicate members of the contractor – 6 points
2. Tenderer's understanding of the scope – Methodology or approach paper – 6
3. Preliminary Programme – 3 points

Scoring of each aspect will be undertaken as follows

	Project Execution Plan evaluation criteria	Points Allocated	Weighting															
1	The Tenderer shall submit a project specific organogram clearly illustrating the Organisational structure for the execution of the Works and the provision of Operations and Maintenance (O&M) services.. Organogram Requirements: The organogram must: - Clearly distinguish between the Contractor, Joint Venture partners (if applicable), and all Subcontractors; - Identify all key personnel assigned to the project, including both construction-phase and O&M-phase resources; - Explicitly reflect O&M resources, including operational, maintenance, and supervisory roles responsible for the operation and maintenance of the wastewater treatment works; - Show clear reporting lines and interfaces between construction, commissioning, and O&M functions; - Reflect each key person under the correct contracting entity (i.e. main contractor, JV partner, or subcontractor), with no ambiguity regarding contractual responsibility; and - Key personnel reflected in the organogram must be consistent with the personnel schedules and CVs submitted elsewhere in the tender submission. - any additional personnel or specialist resources proposed by the Tenderer to support the effective delivery of the project, including Operations and Maintenance (O&M) services	Points for 1 are allocated as follows: Points Allocation <table><tr><td>A project-specific organogram is provided that fully complies with all the requirements and elements listed under “<i>Organogram Requirements</i>”, including clear identification of contracting entities, key personnel, O&M resources, reporting lines, and consistency with submitted CVs and personnel schedules</td><td>6</td></tr><tr><td>A project-specific organogram is provided but partially complies with the listed requirements and elements (e.g. some elements are omitted, unclear, or insufficiently detailed).</td><td>3</td></tr><tr><td>No organogram is submitted, or the organogram is generic, not project-specific, or does not meaningfully address the listed requirement</td><td>0</td></tr></table>	A project-specific organogram is provided that fully complies with all the requirements and elements listed under “ <i>Organogram Requirements</i> ”, including clear identification of contracting entities, key personnel, O&M resources, reporting lines, and consistency with submitted CVs and personnel schedules	6	A project-specific organogram is provided but partially complies with the listed requirements and elements (e.g. some elements are omitted, unclear, or insufficiently detailed).	3	No organogram is submitted, or the organogram is generic, not project-specific, or does not meaningfully address the listed requirement	0	6									
A project-specific organogram is provided that fully complies with all the requirements and elements listed under “ <i>Organogram Requirements</i> ”, including clear identification of contracting entities, key personnel, O&M resources, reporting lines, and consistency with submitted CVs and personnel schedules	6																	
A project-specific organogram is provided but partially complies with the listed requirements and elements (e.g. some elements are omitted, unclear, or insufficiently detailed).	3																	
No organogram is submitted, or the organogram is generic, not project-specific, or does not meaningfully address the listed requirement	0																	
2	The Tenderer shall submit a Methodology / Approach Papers: C. Approach to, Construction, Testing and Commissioning The Tenderer shall submit a Methodology or Approach Paper demonstrating a clear understanding of the requirements for the design, construction, testing and commissioning of the Works. The Approach Paper must address, at a minimum: - The approach to fulfilling the engineering works obligations for mechanical, electrical, control and instrumentation, and building works components; - Coordination, reviews, approvals and integration across disciplines;	Points Allocation <table><tr><td>Excellent:</td><td>Comprehensive, innovative, clearly implementable</td><td>6</td></tr><tr><td>Very Good:</td><td>Well structured, project specific, risk aware</td><td>4</td></tr><tr><td>Good:</td><td>Adequate, logical, meets minimum requirements</td><td>3</td></tr><tr><td>Fair:</td><td>Partially addresses requirements with evident gaps</td><td>2</td></tr><tr><td>Poor:</td><td>Superficial, generic, unclear, and approaches not separated</td><td>1</td></tr></table>	Excellent:	Comprehensive, innovative, clearly implementable	6	Very Good:	Well structured, project specific, risk aware	4	Good:	Adequate, logical, meets minimum requirements	3	Fair:	Partially addresses requirements with evident gaps	2	Poor:	Superficial, generic, unclear, and approaches not separated	1	6
Excellent:	Comprehensive, innovative, clearly implementable	6																
Very Good:	Well structured, project specific, risk aware	4																
Good:	Adequate, logical, meets minimum requirements	3																
Fair:	Partially addresses requirements with evident gaps	2																
Poor:	Superficial, generic, unclear, and approaches not separated	1																

	Project Execution Plan evaluation criteria	Points Allocated		Weighting
	• The construction methodology, sequencing and quality management approach; • The approach to testing, commissioning and performance verification of all systems and plant; • The methodology for identifying, managing and resolving defects during commissioning and the defects liability period; and • Key success factors and risk mitigation measures for achieving a fully functional and compliant facility D. Approach to Operations & Maintenance and Skills Transfer The Tenderer shall submit a separate Methodology or Approach Paper demonstrating a clear and comprehensive understanding of the requirements for Operations and Maintenance (O&M) of the wastewater treatment works, including skills transfer and capacity building for the City. The O&M and Skills Transfer Approach Paper must address, at a minimum: • The proposed approach to day-to-day operation and maintenance of the wastewater treatment works over the two (2) year operating period; • The approach to ensuring operational performance, reliability, regulatory compliance and environmental management; • Preventive, corrective and reactive maintenance strategies and asset management practices; • The approach to O&M readiness, including staffing, systems, procedures and reporting; • The Skills Transfer and Capacity Building Plan, including on-the-job training, mentoring, shadowing and progressive handover of operational responsibilities to City personnel; • A phased handover strategy demonstrating how the City will be capacitated to assume full operational responsibility at the end of the Contract period; and • Key success factors and measurable outcomes for skills transfer and handover readiness	Not addressed:	No submission or irrelevant content	0
4	The Tenderer shall submit a Preliminary Programme for the execution of the Works. The Programme will be evaluated based on the following:	Points Allocation Excellent: Comprehensive, well-structured, clearly reasoned and realistic, fully integrated and risk aware programme		3

	Project Execution Plan evaluation criteria	Points Allocated			Weighting
	- Inclusion of all major activities and deliverables across the project lifecycle, including solutions development, procurement, construction, testing, commissioning and O&M mobilisation; - Logical sequencing of activities and realistic identification of dependencies and interfaces between disciplines; - Identification of the critical path and key programme drivers; - Clearly defined milestones, including, commencement of construction, commissioning, practical completion and handover - Realism and feasibility of activity durations, taking into account the nature, scale and complexity of the Works; and - The Preliminary Programme should demonstrate that the Tenderer has a clear, logical and achievable plan for delivering the Works in accordance with the Contract requirements.	Good:	Complete, logical and compliant programme	2	
		Fair:	Basic programme with limited detail and weak logic	1	
		Poor:	Incomplete, illogical	0	
	TOTAL				100%

Notes:**Index of documentation attached to this schedule:**

.....

.....

SIGNED ON BEHALF OF TENDERER:

CRITERIA 4: FINANCIAL STATUS (10 POINTS)

Resources available to the tenderer showing that there is proof of available credit to source all necessary material and equipment to start and conclude the project (it must be specific to this tender /project). Points / scoring broken down as follows:

Source of funding /available credit*	Points per criteria	Max Points
Proof of funding in the form of a bank statement, confirmed credit facility, issued by an Authorised Financial Service Provider, demonstrating available funds of more than R50 000 000	10	10
Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of not less than R20 000 000.00 and not more than R50 000 000.00	5	
Proof of funding in the form of a bank statement, confirmed credit facility, or letter of financial support issued by an Authorised Financial Service Provider, demonstrating available funds of less than R20 000 000.00	0	
Total scored		

Financial standing/Ability to execute the project

NB: Bidders are required to attach the most recent proof of funding from Registered Financial Institutions (Funding letter, credit facility letter or bank statement with available cash not older than 60 days from date of tender closure.

Failure to do so will result in the loss of points.

Notes:

Index of documentation attached to this schedule:

.....

.....

.....

K. BIDDER'S CURRENT COMMITMENTS AND WORKLOAD

List a maximum of five contracts which your enterprise is engaged in and has not yet completed

Contract Description	Location	Client	Contract Amount	Expected Completion (month & year)
Project Name: Location: Nature of work:				
Project Name: Location: Nature of work:				
Project Name: Location: Nature of work:				
Project Name: Location: Nature of work:				

A bidder is expected to reproduce this template so that the information needed therein could be comprehensively covered.

.....

Signature

.....

Date

.....

Position

.....

Name of bidder

L. BIDDER'S RECENTLY COMPLETED (LARGEST) ASSIGNMENTS

List the four largest assignments (any scope) completed by your enterprise in the last three years

Project Name and Nature of Work Performed	Client	Consultant Contact Person	Telephone No.	Contract Amount
Project Name: Location: Nature of work:				
Project Name: Location: Nature of work:				
Project Name: Location: Nature of work:				

A bidder is expected to reproduce this template so that the information needed therein could be comprehensively covered.

.....

Signature

.....

Date

.....

Position

.....

Name of bidder

M. CERTIFICATE OF PERMISSION TO CONDUCT DUE DILIGENCE INVESTIGATION

Notes to tenderer

1. The tenderer shall complete the declaration below.
2. In the event of a Joint Venture (JV), each member of the JV shall comply with the above requirements.
- I, ... (name), the undersigned in my capacity
as.....(position), on behalf of(name of
company), herewith grant consent that the Municipality or any of their appointed Service Providers
may conduct a due diligence investigation on..... (name of company or JV)
to evaluate our ability to perform the contract as stipulated in the Standard Conditions of Tender,
Clause C.3.13(b).

In addition, any information in this regard requested by the Municipality or any of their appointed
Service Providers, shall be submitted within the timelines of the request.

.....	
Signature	Date
.....	
Position	Name of bidder

ANNEXURE: B

N. CERTIFICATE FOR MUNICIPAL SERVICES AND PAYMENTS

TO: MUNICIPAL MANAGER, POLOKWANE MUNICIPALITY

FROM: _____(Name of Tenderer)

FURTHER DETAILS OF TENDERER(S); DIRECTORS/SHAREHOLDERS/PARTNERS, ETC.

Directors/shareholders/Partner	Physical address of the Business	Municipal Account No.	Physical residential address of the Director/ Shareholder/ Partner	Municipal Account No.

NB: Please attach certified copy of ID document(s)

.....
Signatory

.....
Date

Witnesses

1.
Full Names

.....
Signature

.....
Date

2.
Full Names

.....
Signature

.....
Date

ANNEXURE: C

O. AUTHORISATION FOR DEDUCTION OF OUTSTANDING AMOUNTS OWED TO MUNICIPALITY

TO: MUNICIPAL MANAGER, POLOKWANE MUNICIPALITY

FROM: (Name of the Tenderer or Consortium)

I, ... the undersigned, hereby authorise the Polokwane Municipality to deduct the full amount outstanding by the business organisation/Director/Shareholder/Partner, etc. from any payment due by us/me.

Signed at

Date_____ Month _____ 20 _____

Print Name:.....

Signature:

Thus done and signed for and on behalf of the Tenderer/Contractor

.....
Signatory

.....
Date

Witnesses

1. Full Names	 Signature	 Date
2. Full Names	 Signature	 Date

P. BIDDER'S DISCLOSURE MBD4

1. PURPOSE OF THE FORM

Any person (natural or juristic) may make an offer or offers in terms of this invitation to bid. In line with the principles of transparency, accountability, impartiality, and ethics as enshrined in the Constitution of the Republic of South Africa and further expressed in various pieces of legislation, the bidder is required to make this declaration in respect of the details set out hereunder.

Where a person/s are listed in the Register for Tender Defaulters and / or the List of Restricted Suppliers, that person will automatically be disqualified from the bid process.

2. Bidder's declaration:

2.1 Is the bidder, or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest¹ in the enterprise, employed by the state?

YES/NO

2.1.1 If so, furnish particulars of the names, individual identity numbers, and, if applicable, state employee numbers of sole proprietor/ directors / trustees / shareholders / members/ partners or any person having a controlling interest in the enterprise, in table below.

Full Name	Identity Number	Name of institution	State

2.2 Do you, or any person connected with the bidder, have a relationship with any person who is employed by the procuring institution? **YES/NO**

¹ the power, by one person or a group of persons holding the majority of the equity of an enterprise, alternatively, the person/s having the deciding vote or power to influence or to direct the course and decisions of the enterprise.

2.2.1 If so, furnish particulars:

.....
.....

2.3 Does the bidder or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest in the enterprise have any interest in any other related enterprise whether or not they are bidding for this contract?
YES/NO

2.3.1 If so, furnish particulars:

.....
.....

3 DECLARATION

I,..... the

undersigned,(name)....in submitting

the accompanying bid, do hereby make the following statements that I certify to be true and complete in every respect:

- 3.1 I have read and I understand the contents of this disclosure;
- 3.2 I understand that the accompanying bid will be disqualified if this disclosure is found not to be true and complete in every respect;
- 3.3 The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However, communication between partners in a joint venture or consortium² will not be construed as collusive bidding.
- 3.4 In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications, prices, including methods, factors or formulas used to calculate prices, market allocation, the intention or decision to submit or not to submit the bid, bidding with the intention not to win the bid and conditions or delivery particulars of the products or services to which this bid invitation relates.
- 3.4 The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.
- 3.5 There have been no consultations, communications, agreements or arrangements made by the bidder with any official of the procuring institution in relation to this procurement process prior to and during the bidding process except to provide clarification on the bid submitted where so required by the institution; and the bidder was not involved in the drafting of the specifications or terms of reference for this bid.
- 3.6 I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

I CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 1, 2 and 3 ABOVE IS CORRECT.

² Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

I ACCEPT THAT THE STATE MAY REJECT THE BID OR ACT AGAINST ME IN TERMS OF PARAGRAPH 6 OF PFMA SCM INSTRUCTION 03 OF 2021/22 ON PREVENTING AND COMBATING ABUSE IN THE SUPPLY CHAIN MANAGEMENT SYSTEM SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....	
Signature	Date
.....	
Position	Name of bidder

This document must be signed and submitted together with your Tender

Q. THE NATIONAL INDUSTRIAL PARTICIPATION PROGRAMME

INTRODUCTION

The National Industrial Participation (NIP) Programme, which is applicable to all government procurement contracts that have an imported content, became effective on the 1 September 1996. The NIP policy and guidelines were fully endorsed by Cabinet on 30 April 1997. In terms of the Cabinet decision, all state and parastatal purchases / lease contracts (for goods, works and services) entered into after this date, are subject to the NIP requirements. NIP is obligatory and therefore must be complied with. The Industrial Participation Secretariat (IPS) of the Department of Trade and Industry (DTI) is charged with the responsibility of administering the programme.

1 PILLARS OF THE PROGRAMME

1.1 The NIP obligation is benchmarked on the imported content of the contract. Any contract having an imported content equal to or exceeding US\$ 10 million or other currency equivalent to US\$ 10 million will have a NIP obligation. This threshold of US\$ 10 million can be reached as follows:

- (a) Any single contract with imported content exceeding US\$10 million.or
- (b) Multiple contracts for the same goods, works or services each with imported content exceeding US\$3 million awarded to one seller over a 2 year period which in total exceeds US\$10 million. or
- (c) A contract with a renewable option clause, where should the option be exercised the total value of the imported content will exceed US\$10 million. or
- (d) Multiple suppliers of the same goods, works or services under the same contract, where the value of the imported content of each allocation is equal to or exceeds US\$ 3 million worth of goods, works or services to the same government institution, which in total over a two (2) year period exceeds US\$10 million.

1.2 The NIP obligation applicable to suppliers in respect of sub-paragraphs 1.1 (a) to 1.1 (c) above will amount to 30 % of the imported content whilst suppliers in respect of paragraph 1.1 (d) shall incur 30% of the total NIP obligation on a *pro-rata* basis.

1.3 To satisfy the NIP obligation, the DTI would negotiate and conclude agreements such as investments, joint ventures, sub-contracting, licensee production, export promotion, sourcing arrangements and research and development (R&D) with partners or suppliers

A period of seven years has been identified as the time frame within which to discharge the obligation

2. REQUIREMENTS OF THE DEPARTMENT OF TRADE AND INDUSTRY

2.1 In order to ensure effective implementation of the programme, successful Tenderers (contractors) are required to, immediately after the award of a contract that is in excess of **R10 million** (ten million Rands), submit details of such a contract to the DTI for reporting purposes.

2.2 The purpose for reporting details of contracts in excess of the amount of R10 million (ten million Rands) is to cater for multiple contracts for the same goods, works or services; renewable contracts and multiple

suppliers for the same goods, works or services under the same contract as provided for in paragraphs 1.1.(b) to 1.1. (d) above.

3 TENDER SUBMISSIONS AND CONTRACT REPORTING REQUIREMENTS OF TENDERERS AND SUCCESSFUL TENDERERS (CONTRACTORS)

3.1 Tenderers are required to sign and submit this Standard Tendering Document (SBD 5) together with the Tender on the closing date and time.

3.2 In order to accommodate multiple contracts for the same goods, works or services; renewable contracts and multiple suppliers for the same goods, works or services under the same contract as indicated in sub-paragraphs 1.1 (b) to 1.1 (d) above and to enable the DTI in determining the NIP obligation, successful Tenderers (contractors) are required, immediately after being officially notified about any successful Tender with a value in excess of R10 million (ten million Rands), to contact and furnish the **DTI with the following information:**

- Tender / contract number.
- Description of the goods, works or services.
- Date on which the contract was accepted.
- Name, address and contact details of the government institution.
- Value of the contract.
- Imported content of the contract, if possible.

3.3 The information required in paragraph 3.2 above must be sent to the Department of Trade and Industry, Private Bag X 84, Pretoria, 0001 for the attention of Mr Elias Malapane within five (5) working days after award of the contract. Mr Malapane may be contacted on telephone (012) 394 1401, facsimile (012) 394 2401 or e-mail at Elias@thedti.gov.za for further details about the programme.

4 PROCESSES TO SATISFY THE NIP OBLIGATION

4.1 Once the successful Tenderer (contractor) has made contact with and furnished the DTI with the information required, the following steps will be followed:

- (a) the contractor and the DTI will determine the NIP obligation;
- (b) the contractor and the DTI will sign the NIP obligation agreement;
- (c) the contractor will submit a performance guarantee to the DTI;
- (d) the contractor will submit a business concept for consideration and approval by the DTI;
- (e) upon approval of the business concept by the DTI, the contractor will submit detailed business plans outlining the business concepts;
- (f) the contractor will implement the business plans; and
- (g) the contractor will submit bi-annual progress reports on approved plans to the DTI.

4.2 The NIP obligation agreement is between the DTI and the successful Tenderer (contractor) and, therefore, does not involve the purchasing institution

Tender number

Closing Date:

Name of Tenderer

Postal address

.....

Signature

Name (in print)

Date

R. DECLARATION FOR PROCUREMENT ABOVE R10 MILLION (ALL APPLICABLE TAXES INCLUDED)

For all procurement expected to exceed R10 million (all applicable taxes included), Tenderers must complete the following questionnaire

1 Are you by law required to prepare annual financial statements for auditing?

1.1 If yes, submit audited annual financial statements for the past three years or since the date of establishment if established during the past three years.

.....
.....

2 Do you have any outstanding undisputed commitments for municipal services towards any Municipality for more than three months or any other service provider in respect of which payment is overdue for more than 30 days?

2.1 If no, this serves to certify that the Tenderer has no undisputed commitments for municipal services towards any municipality for more than three months or other service provider in respect of which payment is overdue for more than 30 days.

2.2 If yes, provide particulars.

.....
.....
.....

* Delete if not applicable

3 Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract?
***YES / NO**

3.1 If yes, furnish particulars

.....
.....

4 Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality / municipal entity is expected to be transferred out of the Republic? ***YES/NO**

4.1 If yes, furnish particulars

.....
.....

CERTIFICATION

I, THE UNDERSIGNED (NAME)

CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS CORRECT.

I ACCEPT THAT THE STATE MAY ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....
Signature

.....
Date

.....
Position

.....
Name of Tenderer

MBD 6.1

S. PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2022

This preference form must form part of all tenders invited. It contains general information and serves as a claim form for preference points for specific goals.

NB: BEFORE COMPLETING THIS FORM, TENDERERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF THE TENDER AND PREFERENTIAL PROCUREMENT REGULATIONS, 2022

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to invitations to tender:

- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included); and

1.2 To be completed by the organ of state

- a) The applicable preference point system for this tender is the 90/10 preference point system.
- b) The 90/10 preference point system will be applicable in this tender. The lowest/ highest acceptable tender will be used to determine the accurate system once tenders are received.

1.3 Points for this tender (even in the case of a tender for income-generating contracts) shall be awarded for:

- (a) Price; and
- (b) Specific Goals.

1.4 To be completed by the organ of state:

The maximum points for this tender are allocated as follows:

	POINTS
PRICE	90
SPECIFIC GOALS	10
Total points for Price and SPECIFIC GOALS	100

1.5 Failure on the part of a tenderer to submit proof or documentation required in terms of this tender to claim points for specific goals with the tender, will be interpreted to mean that preference points for specific goals are not claimed.

1.6 The organ of state reserves the right to require of a tenderer, either before a tender is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the organ of state.

2. DEFINITIONS

- (a) **“tender”** means a written offer in the form determined by an organ of state in response to an invitation to provide goods or services through price quotations, competitive tendering process or any other method envisaged in legislation;
- (b) **“price”** means an amount of money tendered for goods or services, and includes all applicable taxes less all unconditional discounts;
- (c) **“rand value”** means the total estimated value of a contract in Rand, calculated at the time of bid

invitation, and includes all applicable taxes;

- (d) **“tender for income-generating contracts”** means a written offer in the form determined by an organ of state in response to an invitation for the origination of income-generating contracts through any method envisaged in legislation that will result in a legal agreement between the organ of state and a third party that produces revenue for the organ of state, and includes, but is not limited to, leasing and disposal of assets and concession contracts, excluding direct sales and disposal of assets through public auctions; and
- (e) **“the Act”** means the Preferential Procurement Policy Framework Act, 2000 (Act No. 5 of 2000).

3. FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

3.1. POINTS AWARDED FOR PRICE

3.1.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

$$\begin{array}{ccc}
 \text{80/20} & \text{or} & \text{90/10} \\
 P_s = 80 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right) & \text{or} & P_s = 90 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right)
 \end{array}$$

Where

P_s = Points scored for price of tender under consideration
 P_t = Price of tender under consideration
 $P_{\min}$ = Price of lowest acceptable tender

3.2. FORMULAE FOR DISPOSAL OR LEASING OF STATE ASSETS AND INCOME GENERATING PROCUREMENT

3.2.1. POINTS AWARDED FOR PRICE

A maximum of 80 or 90 points is allocated for price on the following basis:

$$\begin{array}{ccc}
 \text{80/20} & \text{or} & \text{90/10} \\
 P_s = 80 \left(1 + \frac{P_t - P_{\max}}{P_{\max}} \right) & \text{or} & P_s = 90 \left(1 + \frac{P_t - P_{\max}}{P_{\max}} \right)
 \end{array}$$

Where

P_s = Points scored for price of tender under consideration
 P_t = Price of tender under consideration
 $P_{\max}$ = Price of highest acceptable tender

4. POINTS AWARDED FOR SPECIFIC GOALS

- 4.1. In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in table 1 below as may be supported by proof/documentation stated in the conditions of this tender:
- 4.2. In cases where organs of state intend to use Regulation 3(2) of the Regulations, which states that, if it is unclear whether the 80/20 or 90/10 preference point system applies, an organ of state must, in the tender documents, stipulate in the case of—
- (a) an invitation for tender for income-generating contracts, that either the 80/20 or 90/10 preference point

system will apply and that the highest acceptable tender will be used to determine the applicable preference point system; or

- (b) any other invitation for tender, that either the 80/20 or 90/10 preference point system will apply and that the lowest acceptable tender will be used to determine the applicable preference point system, then the organ of state must indicate the points allocated for specific goals for both the 90/10 and 80/20 preference point system.

Table 1: Specific goals for the tender and points claimed are indicated per the table below.

(Note to organs of state: Where either the 90/10 or 80/20 preference point system is applicable, corresponding points must also be indicated as such.

Note to tenderers: The tenderer must indicate how they claim points for each preference point system.)

The specific goals allocated points in terms of this tender	MEANS OF VERIFICATION DOCUMENTS REQUIRED	Number of points allocated (90/10 system) (To be completed by the organ of state)	Number of points claimed (90/10 system) (To be completed by the tenderer)
Ownership of 51% or more by persons who are black	CSD/Company registration copy and ID Copies of directors	3	
Ownership of 51% or more by persons who are woman	CSD/Company registration copy and ID Copies of directors	3	
Ownership of 51% or more by persons who are disabled	Medical report indicating disability	2	
Ownership of 51% or more by persons who are youth	CSD/Company registration copy and ID Copies of directors	1	
Ownership by persons who are residing within jurisdiction of Polokwane Municipality	municipal rates and taxes statement of account/ signed valid leasing agreement/Letter from tribal authority	1	
Total points claimed		10	

Table 2: Business entity ownership disclosure

Bidders must list all shareholders and provide ownership information in terms of the business entity registration certificate

Full Names	Identity Number	% Of Ownership	South African (Yes/No)	Race	Gender (M/F)	Disable (Yes/No)	Youth (Yes/No)	Local Enterprise (Yes/No)

DECLARATION WITH REGARD TO COMPANY/FIRM

4.3. Name of company/firm.....

4.4. Company registration number:

4.5. TYPE OF COMPANY/ FIRM

- ☐ Partnership/Joint Venture / Consortium
- ☐ One-person business/sole propriety
- ☐ Close corporation
- ☐ Public Company
- ☐ Personal Liability Company
- ☐ (Pty) Limited
- ☐ Non-Profit Company
- ☐ State Owned Company

[TICK APPLICABLE BOX]

4.6. I, the undersigned, who is duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the specific goals as advised in the tender, qualifies the company/ firm for the preference(s) shown and I acknowledge that:

- i) The information furnished is true and correct;
- ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;
- iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 4.2, the contractor may be required to furnish documentary proof to the satisfaction of the organ of state that the claims are correct;
- iv) If the specific goals have been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the organ of state may, in addition to any other remedy it may have –
 - (a) disqualify the person from the tendering process;
 - (b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;
 - (c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;
 - (d) recommend that the tenderer or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and
 - (e) forward the matter for criminal prosecution, if deemed necessary.

.....
SIGNATURE(S) OF BIDDERS(S)

DATE:

ADDRESS

.....

T. COMPLIANCE WITH OHSA (ACT 85 OF 1993)

Tenderers are required to satisfy the Employer and the Engineer as to their ability and available resources to comply with the above by answering the following questions and providing the relevant information required below.

1. Is the Contractor familiar with the OHSA (ACT 85 of 1993) and its Regulations?	YES	/	NO
2. Who will prepare the Contractor's Health and Safety Plan? (Provide a copy of the person/s curriculum vitae/s or company profile).	YES	/	NO
3. Does the Contractor have a health and safety policy? (If yes, provide a copy). How is this policy communicated to all employees?	YES	/	NO
4. Does the Contractor keep records of safety aspects of each construction site? If yes, what records are kept?	YES	/	NO
5. Does the Contractor conduct monthly safety meetings? If yes, who is the chairperson of the meeting, and who attend these meetings?	YES	/	NO
6. Does the Contractor have a safety officer in his employment, responsible for the overall safety of his company? If yes, please explain his duties and provide a copy of his CV.	YES	/	NO
7. Does the Contractor have trained first aid employees? If yes, indicate, who.	YES	/	NO
8. Does the Contractor have a safety induction-training programme in place? (If yes, provide a copy)	YES	/	NO

.....
Signature

.....
Date

.....
Position

.....
Name of Tenderer

U. DAY WORK SCHEDULE

This Daywork Schedule shall be used for the valuation of any Variation or additional work which the Engineer determines cannot be valued in accordance with the rates and prices in the Schedule of Prices, as provided for under Sub-Clause 13.3.1 [Variation by Instruction].

In respect of Labour, Materials, and Contractor's Equipment used in such work but not specifically listed in the Daywork Schedule, the Contractor shall be paid the Cost plus Profit (using the percentage stated in the Contract Data), as defined in Sub-Clause 1.1.20 [Cost Plus Profit].

The rates quoted by the Tenderer shall apply for payment purposes only when the Engineer issues an instruction under Sub-Clause 13.5 [Daywork]. All such work shall be subject to the daily submission of "Statements" (records) to the Engineer for signature and approval, in accordance with the procedures set out in Sub-Clause 13.5 [Daywork].

1. LABOUR AND MATERIALS

Rates and prices entered in the schedule shall be held to allow for net cost of labour and materials delivered to site respectively with the percentage allowances stated in the schedule of quantities.

2. PLANT AND EQUIPMENT

The Tenderers shall list all major items of plant and equipment to be used on the works and which may be required for use on day works. The proposed hire rates of these items shall be entered against each type of machine, such rates to include for all relevant costs of plant hire inclusive of fuels and lubricants but exclusive of labour charges for the operators, which will be paid for under sub-clause (1) above.

The rates for plant items not listed in the schedule will be the ruling plant hire rates, inclusive of fuels and lubricants but exclusive of labour charges for the operators, inclusive of a 7,5% handling charge. It is therefore in the Tenderers interest to ensure that the list is complete.

Should there be insufficient space on the pages provided; the Tenderer shall add further pages as required.

THE RATES FOR THE PLANT AND EQUIPMENT MENTIONED IN THE SCHEDULE SHALL BE FILLED IN FOR THE ITEMS REQUESTED. SHOULD AN ITEM BE OMITTED IT SHALL BE DEEMED TO HAVE BEEN INCLUDED IN THE OTHER DAYWORKS RATES.

I. LABOUR

DESIGNATION		RATE	
Description	Unit Measure	R	C
Brick Layers	per hour		
Pipe Layers	per hour		
Plant Operators	per hour		
Truck Drivers	per hour		
Labour - unskilled	per hour		
- semi-skilled	per hour		
- skilled	per hour		

II. MATERIALS

DESIGNATION		RATE	
Description	Unit Measure	R	C
Cement	per 50 kg pocket delivered		
Concrete Sand (River Sand)	per m ³ delivered		
Concrete Aggregates	per m ³ delivered		
Imported Material G5 type	per m ³ delivered (stockpiled on site)		
Imported Material G8 type	per m ³ delivered (stockpiled on site)		

III. TRANSPORT

DESIGNATION		RATE	
Description	Unit Measure	R	C
14-Seater Mini Bus (Taxi)	per day		
18-Seater Mini Bus	per day		
65-Seater Bus	per day		

IV. PLANT AND EQUIPMENT

[illegible]

[illegible]

*Only applicable on authority of the Engineer.

V. JOB-CREATION SCHEDULE

The Government has identified Organs of State sourcing activities as key enablers to achieve the National Development Plan (NDP) objective of reducing unemployment from the current baseline of 28% to 6%.

In order to give effect to these job creation objectives, Tenderers are required to provide the following undertaking of new jobs that will be created (either by them or by their subcontractors) should they be awarded this tender.

Tenderers to note, that if successful, any deviations from the Job creation Schedule in the contract phase will be subject to acceptance by the Project Manager in terms of the Conditions of Contract.

a) Please indicate total number of new jobs that will be created over the term of the contract:

Total number and value of new jobs created	Total number of new jobs	Total rand value of new jobs created

b) (Of the total number of new jobs created, please indicate the number and value of new jobs to be created for the following designated groups:

Designated group	Total number of new jobs	Total rand value of new jobs
Black men		
Black women		
Black Youth		
Black people living in rural or underdeveloped areas or townships		

c) (Of the total number of new jobs created, please indicate the number of skilled, semi-skilled and unskilled new jobs that will be created over the term of the contract:

Designated group	Total number of Skilled jobs	Total number of Semiskilled jobs	Total number of Unskilled jobs
Black men			
Black women			
Black Youth			
Black people living in rural or underdeveloped areas or townships			
Other			

d) Please indicate the number of new jobs to be created, broken down per quarter over the term of the contract.

Year 1	Q1	Q2	Q3	Q4
Total number of new jobs				
Number of new jobs for Black men				

Number of new jobs for black women				
Number of new jobs for black youth				
Number of new jobs for black people living in rural or underdeveloped areas or townships				
Number of new jobs for black People with Disabilities				
Number of new jobs for other categories				
Number of new skilled jobs				
Number of new semi-skilled jobs				
Number of new unskilled jobs				
TOTAL ANTICIPATED JOBS (PER QUARTER / PER YEAR)				

Year 2	Q1	Q2	Q3	Q4
Total number of new jobs				
Number of new jobs for Black men				
Number of new jobs for black women				
Number of new jobs for black youth				
Number of new jobs for black people living in rural or underdeveloped areas or townships				
Number of new jobs for black People with Disabilities				
Number of new jobs for other categories				
Number of new skilled jobs				
Number of new semi-skilled jobs				
Number of new unskilled jobs				
TOTAL ANTICIPATED JOBS (PER QUARTER / PER YEAR)				

Year 3	Q1	Q2	Q3	Q4
Total number of new jobs				
Number of new jobs for Black men				

Number of new jobs for black women				
Number of new jobs for black youth				
Number of new jobs for black people living in rural or underdeveloped areas or townships				
Number of new jobs for black People with Disabilities				
Number of new jobs for other categories				
Number of new skilled jobs				
Number of new semi-skilled jobs				
Number of new unskilled jobs				
TOTAL ANTICIPATED JOBS (PER QUARTER / PER YEAR)				



POLOKWANE MUNICIPALITY

PART C1: AGREEMENTS AND CONTRACT DATA

C1.1: FORM OF OFFER AND ACCEPTANCE

C1.2: CONTRACT DATA

C1.3: DEMAND GUARANTEE AND RETENTION MONEY GUARANTEE

C1.4: AGREEMENT IN TERMS OF SECTION 37(2) OF THE OCCUPATIONAL HEALTH AND
SAFETY ACT No 85 OF 1993

C1.5: AGREEMENT WITH ADJUDICATOR

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C1.1 Form of Offer and Acceptance

OFFER

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract for the procurement of construction works viz.:

Project Description:

.....

.....

Contract No.

The Tenderer, identified in the Offer signature block, has examined the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, and by submitting this offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorized, signing this part of this Form of Offer and Acceptance, the Tenderer offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

The offered total of the prices inclusive of value-added-tax is

.....

.....

..... (Amount in words); R (Amount in figures)

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Tenderer before the end of the period of validity stated in the Tender Data, whereupon the Tenderer becomes the party named as the Contractor in terms of the Conditions of Contract identified in the Contract Data.

Signature(s)

Print Name(s)

Capacity

For the Tenderer

.....

.....

(Name and address of organization)

Signature of witness.....

Date:

Print Name

IMPORTANT NOTE: This page to be duly completed by the Tenderer before submitting the Tender.

ACCEPTANCE

By signing this part of this Form of Offer and Acceptance, the Employer accepts the Tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Tenderer's Offer shall form an agreement between the Employer and the Tenderer upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

The terms of the contract are contained in

Part 1: Agreements and Contract Data (which include this Agreement)

Part 2: Pricing Data

Part 3: Scope of Work

Part 4: Site Information

and drawings and documents or parts thereof, which may be incorporated by reference into parts 1 to 4 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto, as listed in the Tender Schedules, as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which shall be signed by the authorized representative(s) of both parties.

The Tenderer shall, within 7 days of receiving a completed copy of this Agreement (including the Schedule of Deviations, if any), contact the Employer's Agent (whose details are given in the Contract Data) to arrange the delivery of any guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data. Failure to fulfil any of the obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Tenderer receives one fully completed copy of this original document, including the Schedule of Deviations (if any). Such date should be confirmed in a manner that can be read, copied and recorded and shall be accepted by the contracting parties as the Commencement Date. This agreement shall constitute a binding contract between the parties.

Signature(s)

Print Name(s)

Capacity

For the Employer

.....

(Name of Municipality)

.....

.....

(Address of Municipality)

Signature of witness.....

Date:

Print Name

SCHEDULE OF DEVIATIONS

The extent of deviations from the Tender documents issued by the Employer before the Tender closing date is limited to those permitted in terms of the Conditions of Tender.

A Tenderer’s covering letter shall not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid, be the subject of agreements reached during the process of offer and acceptance, the outcome of such agreement shall be recorded here.

Any other matter arising from the process of offer and acceptance either as a confirmation, clarification or change to the Tender documents, and which it is agreed by the Parties becomes an obligation of the contract, shall also be recorded here.

Any change or addition to the Tender documents arising from the above agreements and recorded here shall also be incorporated into the final Contract Document.

- 3.1

Subject

.....

Details

.....
- 3.2

Subject

.....

Details

.....
- 3.3

Subject

.....

Details

.....

By the duly authorized representatives signing this Schedule of Deviations, the Employer and the Contractor agree to and accept the foregoing Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or changes to the terms of the offer agreed by the Contractor and the Employer in concluding this process of offer and acceptance; in witness thereof the parties hereto have caused this agreement to be executed.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the Tender documents and the receipt by the Contractor of a completed signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

Signed by:

Signed by:

Print Name:

Print Name:

Address:

Address:.....

.....

.....

.....

.....

For and on behalf of the **Employer** in the
Presence of

For and on behalf of the **Contractor** in the
presence of

Witness:

Witness:

Print Name:

Print Name:

Date:

Date:



POLOKWANE MUNICIPALITY

C.1.2 CONTRACT DATA

- C.1.2.1 CONDITIONS OF CONTRACT
- C.1.2.2 PARTICULAR CONDITIONS PART A - CONTRACT DATA
- C.1.2.3 PARTICULAR CONDITIONS PART B – SPECIAL PROVISIONS

CONTRACT DATA
PRWWTW Phase 2B – **FIDIC Yellow Book, 2nd ED, 2017**

1. CONDITIONS OF CONTRACT

- 1.1. The Conditions of Contract are the FIDIC Conditions of Contract for Plant and Design-Build for Electrical & Mechanical Plant, and for Building and Engineering Works, designed by the Contractor, Second Edition 2017 published by the *Fédération Internationale des Ingénieurs-Conseils* (hereinafter referred to as “FIDIC Yellow Book, 2nd ED, 2017” / “FIDIC Yellow”).
- 1.2. The Contract Data (including variations and additions) shall amplify, modify, or supersede, the FIDIC Yellow Book, 2nd ED, 2017 to the extent specified below, and shall take precedence and shall govern
- 1.3. Each item of data given below is cross-referenced to the clause in the FIDIC Yellow Book, 2nd ED, 2017 to which it mainly applies.
- 1.4. This document is obtainable separately. Each party to the Contract shall purchase its own copy of the FIDIC Yellow Book, 2nd ED, 2017 available from its publisher:

South African Institution of Civil Engineering
Private Bag X200
Halfway House 1685
South Africa
Tel +27 (0)11 805 5947

The following notes apply:

Note 1

Certain *pro-forma* forms and *pro-forma* agreements contained FIDIC Yellow Book have been adapted for this contract.

Those *pro-forma* forms and *pro-forma* agreements contained in the FIDIC Yellow Book do not apply where replaced by similar *pro-forma* forms and *pro-forma* agreements in this document.

2. PART A — CONTRACT DATA (FIDIC YELLOW 2017)

FIDIC Yellow Sub-Clause	Item / Data field (per tender)	Contract Data (Project-specific)
1.1.20	Cost Plus Profit — % to be added to Cost	5%
1.1.27; 11.1	Defects Notification Period (DNP)	365 calendar days (12 months) from Date of Completion
1.1.30; 1.3(d)	Employer (address for communications)	City Manager, Polokwane Municipality; Civic Centre, Cnr Bodenstein & Landdros Mare, Polokwane 0699; PO Box 111, Polokwane 0700; khethiwen@polokwane.gov.za
1.1.35; 1.3(d)	Engineer (address for communications)	ZAKUMI Consulting Engineers (ZCE), Dr Talent Diotrefe Banda; ZCE House, 21 Compensatie Street, CBD, Polokwane 0699; admin@zce.co.za
1.1.86; 8.2	Time for Completion — Taking-Over of Whole of the Works	730 calendar days (24 months)
1.3(a)(ii)	Agreed method of electronic transmission	Electronic mail only
1.3(d)	Address of Contractor for communications	[To be inserted at award]
1.4	Governing law	Republic of South Africa

1.4	Ruling language; Language for communications	English; English
1.8	Number of additional paper Documents	One
1.15	Total liability of Contractor — cap	Accepted Contract Amount (per 1.15)
2.1	Right of access to Site after LoA	21 days for portion required; 42 days for whole Site
2.4	Employer's financial arrangements	Grant under the RBIG programme
4.2; 4.2.1	Performance Security (percent; currency; issuer)	10% of Accepted Contract Amount; ZAR; issued by SA-registered financial institution approved by Employer
4.4(a); 4.4(b)	Maximum allowable accumulated value of work subcontracted / parts not permitted	Up to 70% may be subcontracted; no limitation on parts prohibited
4.7.2	Period for notification of errors in items of reference	28 days from Commencement Date
4.19	Period of payment for temporary utilities	Monthly
4.20	Number of additional paper copies of progress reports	Ten (10)
5.5, 5.6, 5.7 11 and 12	Operation and Maintenance and training prior to Take Over	12 months after project commissioning
6.5	Normal working hours on the Site	Mon–Fri 06:00–18:00; Sat 06:00–14:00
6.5	Locally recognised days of rest	SAFCEC year-end break; SA statutory public holidays; Sundays; municipal election day (2026)
8.3	Number of additional paper copies of programmes	10
8.3	Planning software to be utilised	Candy (CCS) or Microsoft Project
8.8	Delay damages payable per day (Whole of Works)	R 100,000.00 per day
8.8	Concurrent Sections/Whole delay rule	Use daily amount for the Section with the highest delay damages value
8.8	Maximum amount of delay damages	10% of the Accepted Contract Amount
13.3; 13.5; 14.3	Method of measurement / valuation basis	In accordance with Bill of Quantities or Schedules; valuation under Clause 13 Variation/Daywork; Statements per Clause 14
13; 1.1.20	Percentage profit (valuation reference)	As stated under 1.1.20; applied in valuation/daywork per Clause 13
13.4(b)(ii)	Percentage rate on Provisional Sums for overheads & profit	15%
13.7	Contract Price Adjustment — coefficients	$x=0.15$; $a=0.25$; $b=0.30$; $c=0.35$; $d=0.10$
14.2; 14.2.3	Total amount of Advance Payment; instalments; currency; deductions	10% once-off; ZAR; deductions per 14.2.3; APG required
14.3	Period of payment (statements cycle)	Statements after the end of each month
14.3(b)	Number of additional paper copies of Statements	One (1)
14.3(iii); 14.9	Percentage of retention; Limit of Retention Money	Retention 10%; limit 5% of Accepted Contract Amount

14.5(b)(i)	Plant & Materials for payment when shipped	None
14.5(c)(i)	Plant & Materials for payment when delivered to Site	All civil works materials as listed in civil BoQ
14.6.2	Minimum amount of Interim Payment Certificate (IPC)	R 500,000.00
14.7(a)	Period for payment of Advance Payment	28 days
14.7(b)(i)	Period for Employer to make interim payments (14.6)	56 days
14.7(b)(ii)	Period for Employer to pay under Final Payment (14.13)	28 days
14.7(c)	Period for Employer to make final payment to Contractor	56 days
14.8	Financing charges for delayed payment	Prime overdraft rate + 3% (Standard Bank of South Africa Limited, Pretoria) on the date of payment
14.9; 8.2; 8.8; 1.1.76	Sections — RFC/RFO (value %, time, DD)	RFC: 0% value; 700 days; R100,000/day. RFO (whole): 100% value; 730 days; R100,000/day
14.11.1(b)	Additional paper copies of draft Final Statement	One (1)
14.15; 14.15(a)(i); 14.15(c); 14.15(f)	Currencies of payment; proportions; Delay Damages currency; rates of exchange	ZAR; Local 100%; Delay Damages ZAR 100%; rates per 14.15(f)
17.2(d)	Forces of nature risks allocated to Contractor	None-additional
19.1	Permitted deductible limits	Per policy terms (as approved)
19.2	Insurance minima — Works; Goods; PI; fitness-for-purpose; injury to persons/property; injury to employees	Works R10 million; Goods R5 million; PI R20 million; Fitness for purpose R5 million; Injury to persons/property R5 million; Injury to employees R5
19.2.4	Third-party liability amount	R 20,000,000.00
19.2.6	Other insurances required by law & local practice	SASRIA (riot) insurance for 'Contract Works' and 'Construction Plant' to the value of the Works and replacement value of Construction Equipment on Site respectively
21.1	Time for appointment of DAAB	56 days
21.1	DAAB shall comprise	1 member nominated from Association of Arbitrators (Southern Africa)
21.1	List of proposed DAAB members — Employer	TBA; TBA; TBA
21.1	List of proposed DAAB members — Contractor	To be provided
21.2	Appointing entity (official) for DAAB members	Chairman, Association of Arbitrators (Southern Africa)

Particular Conditions Part B – Special Provisions

CLAUSE 1 - GENERAL PROVISIONS

Definitions (project-specific additions to FIDIC Yellow 1.1):

“Contract” means the Form of Offer and Acceptance, Contract Data, these Conditions, the Specifications, the Drawings, the Schedules, and the further documents (if any), which are listed in the Form of Offer and Acceptance, and further includes drawings and documents or parts thereof, which any of the aforesaid documents incorporate by reference.”. (FIDIC 1.1).

“Letter of Acceptance” means the Form of Acceptance contained in Part C1.1.2 of the tender documents. (FIDIC 1.1).

“Letter of Tender” means the Form of Offer contained in Part C1.1.1 of the tender documents. (FIDIC 1.1).

“Specification” means the document entitled Scope of Work, as included in the Contract, and any additions and modifications to the Scope of Work in accordance with the Contract. Such document specifies the Works. (FIDIC 1.1).

“Employer’s Requirements” means the documents entitled employer’s requirements or references to the employer’s requirements, as included in the Contract, and any additions and modifications to such documents or references in accordance with the Contract. Such documents or references specify the purpose, scope, and/or design and/or other technical criteria, for particular components of the Works as may be applicable (FIDIC 1.1).

“Supplementary Agreement” means a signed agreement, titled “Supplementary Agreement”, made between the Parties subsequent to the signing of the Contract. (FIDIC framework 1.1/1.5).

“Appendix to Tender” means the completed section in Part C1 (C1.2.2 Contract Data — Information provided by the Employer) included in the Contract Data. (FIDIC 1.1).

“Expiry Date” means the last day of the Defects Notification Period for the whole of the Works. (FIDIC 11.1/1.1).

“Ready for Commissioning (RFC)” means the status when pre-commissioning tests under Sub-Clause 7.4 and Sub-Clause 9.1(a) are completed and commissioning tests under Sub-Clause 9.1(b) can safely commence. (FIDIC 7.4; 9.1).

“Ready for Operation (RFO)” means the status when the Taking-Over Certificate for the whole of the Works has been issued under Clause 10, provided RFC has been achieved. (FIDIC 10; 9.1).

“Construction Period” means from the Commencement Date to RFC. (FIDIC 8.1; 9.1).

“Commissioning Period” means from RFC to RFO. (FIDIC 9.1; 10.1).

“Bill of Quantities” shall also mean the Pricing Schedule contained in Part C2 (section C2.2). (FIDIC 14/13 context).

“Letter of Access to the Site” means a letter issued by the Employer giving the Contractor access rights in accordance with Sub-Clause 2.1. (FIDIC 2.1).

“Targeted Enterprise” means an enterprise as defined in the Tender Data for targeted development objectives. (Project-specific; FIDIC 4.1 framework).

“Day/Year” shall bear the following meanings **“day”** means calendar day; **“year”** means 365 calendar days, unless otherwise indicated. (Contract interpretation; FIDIC 1.1).

“Mobilisation Period” means the period between the Commencement Date and the date of Access to Site; requirements are set out in Scope of Works Part C3, Section D1000 (stakeholder/community liaison; targeted labour/enterprise utilisation). (FIDIC 1.5; 1.8; 2.1).

Priority of documents and communications (email as approved medium) are set out below and apply alongside these definitions. (FIDIC 1.3; 1.5).

Contract Agreement (Form of Offer & Acceptance);
Appendix to Tender within the Contract data
Letter of Acceptance (Letter of Award) including any Memorandum of Understanding;
Letter of Tender;
Particular Conditions Part A — Contract Data;
Particular Conditions Part B — Special Provisions;
FIDIC Yellow Book 2017 General Conditions;
Particular Specifications;
Drawings (including Employer’s typical drawings);
Standard Specifications;
Pricing Data (Bill of Quantities/Pricing Schedule);
Returnable Schedules; Site Information;

Description of Works; Part C5 Annexures; and other listed documents.
Bill of Quantities (Pricing Data (Part C2))
Addenda/MoUs take precedence over the document they modify. (FIDIC 1.5).

Contract Agreement: ***"The Parties shall enter into a Contract Agreement when the Employer issues the Form of Acceptance (see Particular Condition 1.1.1.3). The Contract Agreement shall be in the form prescribed in the tender documents"***

Communications: Notices and other communications may be transmitted via the Employer-approved email system; any Notice shall be titled "Notice", reference the applicable Sub-Clause, and be copied to the addresses stated in the Contract Data. (FIDIC 1.3). ***"However, such notice, instruction, consent or request is not deemed to have been delivered by virtue of its appearance in the minutes of meetings."***

Joint and several liability: In the event that such consent is obtained from the Employer, 2 notarially certified copies of the new signed joint venture agreement, or signed amended joint venture agreement, as the case may be, shall be submitted to the Employer with a copy to the Engineer within 28 days of signature by the separate parties to the amended joint venture agreement. (FIDIC 1.14).

Anti-corruption: the Contractor shall comply with applicable laws (including the Prevention and Combating of Corrupt Activities Act, 2004); consequences include forfeiture and deduction of profits arising from corrupt acts. (FIDIC 1.13 framework).

The Contractor (which for the purpose of this Sub-Clause 1.13 [Corrupt Practices] shall include his directors, employees, agents, shareholders and/or partners) warrants that the performance of his obligations shall in no way constitute an infringement or other violation of the laws of the Republic of South Africa, and in particular will under no circumstances engage in any activities which may constitute corruption or corrupt activities within the ambit of the *Prevention and Combating of Corrupt Activities Act 12 of 2004*, such activities to include:

accepting or agreeing, or offering to accept or give or offer any gratification to any person in order to influence such other person to act in a manner that amounts to the illegal dishonest exercise or performance of any power, duty, statutory, contractual or other legal obligation; or

procuring that any person, directly or indirectly, accepts or agrees or offers to accept any gratification from another person or gives or agrees or offers to give

to any other person any gratification in order to improperly influence the conclusion or performance of his obligations in terms of this Contract.

In addition to any right which the Employer may have to cancel, in the event that the Contractor is convicted on a charge relating to, or concerning corruption, bribery or fraud during the 10-year period preceding the Base Date, or being convicted on a charge relating to, or concerning corruption, bribery or fraud, or in the event that the Contractor gives or offers any person any bribe, gratuity, commission or other thing of value as contemplated in Sub-Clause 1.13(a) or 1.13(b):

The Contractor shall forfeit any profit derived from this Contract;

The Contractor will make payment thereof on demand; and

The Employer shall be entitled to deduct such amount from any amount which is due or may become due and payable to the Contractor whether arising from this Contract or any other contract between the Employer and the Contractor."

Clause 2 — The Employer

Right of access to the Site: (FIDIC 2.1; 2.4).

Access shall be granted within 21 days for portions required and within 42 days for the whole Site after the Letter of Acceptance.

Employer's financial arrangements are recorded as a grant under the RBIG programme.

Clause 3 — The Engineer

Engineer's duties/authority: (FIDIC 3.2)

The Engineer shall obtain the approval of the Employer before carrying out the following duties in accordance with the Contract:

Giving notice of the Commencement Date (FIDIC 8.1);

Issuing an instruction in terms of Sub-Clause 8.9 [Employer's Suspension] to suspend the progress of part or all of the Works (FIDIC 8.9);

Instructing or approving a Variation in terms of Sub-Clause 13.1 [Right to Vary], the estimated effect of which will be to increase the Contract Price by an amount exceeding R1 000 000 calculated at prices at the Base Date of the Contract.

Provided that such approval by the Employer shall not be required for instructions or notices which, in the sole opinion of the Engineer, are required to meet an emergency or are otherwise required to ensure the safety or security of the Works or of any person or property

Delegation: if the Engineer does not respond within 7 days to a Contractor's Notice challenging an assistant's instruction/certificate/opinion/valuation, the assistant's act is deemed confirmed. (FIDIC 3.4; 3.7). ***"However, if the Contractor questions any Notice, instruction, certificate, opinion or valuation given by an assistant, the Contractor may by giving a Notice refer the matter to the Engineer. The Engineer shall be deemed to have confirmed the assistant's Notice, instruction, certificate, opinion or valuation if the Engineer does not respond, within 7 days after receiving the Contractor's Notice, reversing or varying the assistant's Notice, instruction, certificate, opinion or valuation (as the case may be)."***

Clause 4 — The Contractor

General obligations: cooperate and provide access, information and facilities reasonably required by the Engineer. (FIDIC 4.1).

"The Contractor shall liaise and co-operate with the Engineer and his assistants and provide them with such access, information and facilities as they may reasonably require in order to enable them to perform their duties under the Contract."

Design obligations: where Contractor undertakes design, it shall be performed by suitably qualified, ECSA-registered designers; the Contractor and design Subcontractors shall maintain Professional Indemnity insurance (minimum R 5,000,000) throughout the Defects Notification Period. Designers shall be available for discussions until DNP expiry. The Contractor shall notify the Engineer within 28 days from Commencement of any errors/faults/defects in the Employer's Requirements/Specification/items of reference; resulting changes shall be handled under Clause 13. (FIDIC 5.1; 5.2.1–5.2.2; 19.2; 4.7.2; 13).

Liens/security/retention: the Contractor waives and abandons any lien/security/right of retention over the Works, Plant, Materials and Contractor's Documents, and shall procure equivalent waivers from Subcontractors. (FIDIC 4.1).

"The Contractor hereby waives and abandons any Contractor's lien and any other security or right of retention which he may have in respect of the Works, Plant, Materials, and Contractor's Documents, and shall not be entitled to withhold delivery of the same to the Employer. The Contractor shall ensure that his Subcontractors similarly waive any liens, securities and rights which they may have and shall indemnify and hold the Employer harmless against and from any claims, demands, proceedings, loss, damage, costs and expenses made or incurred in respect thereof."

Contractor's Documents: submissions shall follow the defined programme (SANS 1200A); any errors/ambiguities/inconsistencies/inadequacies found in Contractor's Documents shall be corrected at the Contractor's cost notwithstanding any consent/approval/No-objection by the Engineer. (FIDIC 4.4).

Performance Security: if its validity would lapse before the Performance Certificate and Clearance of Site, the Employer may suspend payments until extension evidence is provided. (FIDIC 4.2.1–4.2.2).

Setting out: notification periods and procedures per Contract Data; errors to be notified within 28 days from Commencement Date. (FIDIC 4.7.2).

Unforeseeable physical conditions: hydrological conditions exclude rainfall/effects of rainfall (addressed under 8.5); costs prior to 7 days before notice under 4.12.1 are deemed included in rates/prices. (FIDIC 4.12; 8.5).

Contractor's Equipment: title to Contractor-owned Equipment vests in the Employer upon arrival on Site (without prejudice to Contractor's use/responsibility) and re-vests upon authorised removal or entitlement to TOC for the whole Works; rights under hire agreements are ceded to the Employer (hire charges remain for Contractor's account). (FIDIC 4.17).

Finds: archaeological, paleontological and mineralogical finds are handled per specified procedures. (FIDIC 4.23 topic).

Socio-Economic Development: comply with SED objectives/targets per Specifications; penalties apply for non-compliance. (FIDIC 4.1 framework.)

H&S & environment (IDD): appoint a site-based Environmental Control Officer (ECO) prior to Commencement; include monthly environmental compliance reporting (EA/EMP, incidents) in Progress Reports. (FIDIC 4.8; 4.18; 4.20(g)).

Design review (IDD): Engineer's Review Period for Contractor's Documents is 21 days; absent Notice, No-objection is deemed; resubmission timelines apply. (FIDIC 5.2.2).

Design Error: (FIDIC 5.8)

"If errors, omissions, ambiguities, inconsistencies, inadequacies or other defects are found in the Contractor's Documents, they and the Works shall be corrected at the Contractor's cost, notwithstanding any consent, approval or No-objection given by the Engineer under the Contract"

Training (IDD): structured O&M training is a condition precedent to any Taking-Over Certificate. (FIDIC 5.5; 10.1).

Clause 5 — Subcontracting (FIDIC 4.4; 4.5; 14.7; 14.9).

Subcontractors: the Contractor shall coordinate and proactively facilitate Subcontractor performance; enter written subcontracts on the standard FIDIC form (2011).

Pay each Subcontractor within 7 days after the Engineer issues the Main Contractor's Payment Certificate, without deductions for Contractor-supplied plant/equipment/materials/fuel. Disclose all subcontracting arrangements; retention held for Subcontractors shall be pro-rata and (for Targeted Enterprises) capped at 5% of the tendered CPG value; release 50% of retention at Subcontract completion and the balance after 12 months free of defects (save where Performance Certificate is delayed due to attributable defects).

No performance security is required for Targeted Enterprise Subcontractors; penalties are capped at 10% of the accepted subcontract amount; Subcontractors/suppliers must be registered on the National Treasury CSD, in good standing under COIDA and the relevant Bargaining Council, and registered with CIDB in appropriate categories. Non-disclosure/non-compliance may trigger termination consideration or penalty up to 10%.

Add the following sub-paragraphs:

"(e) The Contractor shall enter into a written subcontract agreement with the Subcontractor. The subcontract agreement between the Contractor and the Subcontractor shall be the standard FIDIC subcontract agreement (version 2011).

(f) If the Contractor is required to employ one or more Subcontractors under his targeted enterprise development, then the provisions of Sub-Clause 5.4 [Evidence of Payments] shall apply as if such Subcontractor is a Nominated Subcontractor.

(g) Each subcontract shall include the provisions:

- i. The Contractor undertakes to pay the Subcontractor the full value as being due to the Subcontractor, without any deduction for plant, equipment, materials or fuel supplied by the Contractor. Any assistance that the Contractor may have made to the Subcontractor that requires recovery from the Subcontractor, will be recovered by the Contractor through normal commercial debt repayment processes;***
- ii. The Contractor undertakes to make payment to the Subcontractors within 7 days after the date on which the Engineer has issued the Main Contractor's Payment Certificate;***

(h) The Contractor shall disclose all subcontracting arrangements.

(i) The total retention money held for all subcontractors shall not exceed the maximum value of the retention money as specified 10% and shall be held pro-rata per subcontractor.

(j) The total value of retention money held from sub-contractors who are Targeted Enterprises shall not exceed 5 percent of the tendered CPG value (for Targeted Enterprises).

(k) 50% of the retention money held for each Subcontractor shall be released on completion of the subcontract works. The remainder of the Subcontractor's retention money shall be released when a Subcontractor's work does not show any defect within 12 (twelve) months after the completion of the subcontract. However, the Subcontractor's retention money may be withheld but only if the Performance Certificate is unable to be issued because of defective workmanship attributable to the Subcontractor.

(l) No performance security shall be required for Targeted Enterprise sub-contractors.

(m) Penalties for sub-contractors shall be limited to 10% of the accepted sub-contract amount.

(n) All Subcontractors and suppliers shall be registered on the National Treasury's Central Supplier Database (CSD).

(o) All Subcontractors shall be in good standing in terms of COIDA and shall be registered with the Bargaining Council for the Civil Engineering Industry (Government Notice R.490 – Part III contained in Government Gazette No. 37750) or other relevant Bargaining Council.

(p) All Subcontractors shall be registered with the CIDB in the appropriate category for the class of work to be performed.

If the Contractor fail to disclose all subcontracting agreements, or fail to comply with the requirements of this clause he shall be given 14 days to make representation as to why:

- i the contract shall not be terminated;***
- ii the Contractor shall not be penalised up to 10% of the value of the contract."***

Clause 6 — Staff and Labour

Superintendence: unless otherwise approved, at least one English-competent member of superintending staff (speaking/reading/writing/understanding engineering/construction terminology) shall be present at each installation/location and for each working shift. (FIDIC 6.8).

Conduct: misconduct includes discriminatory treatment, cultural/racial slurs, hate speech and incitement; training/induction shall promote dignity and mutual respect. (FIDIC 6.9; 6.11).

Records: add socio-economic category to personnel records; include details of Equipment due for delivery/removal (subject to Engineer approval). (FIDIC 6.10).

Festivals & customs: due regard to recognised festivals/days of rest; no EOT for compliance. (FIDIC 6.13).

Alcohol/drugs and arms: prohibited on Site, save arms by authorised security personnel. (FIDIC 6.14–6.15).

Clause 7 — Plant, Materials and Workmanship

Defects & acceptance: if a non-conforming item is accepted at Employer's discretion, payment shall be reduced as determined under 3.7; concession does not set precedent; otherwise, remedial work applies. (FIDIC 7.5; 3.7).

Remedial work: additional work required to obviate removal/replacement/re-execution/re-design shall be carried out at Contractor's cost and may be valued under 12.3. (FIDIC 7.6; 12.3).

Rate of progress: after a Notice to Correct (15.1), the Employer may omit Sections/parts and engage third parties; Contractor remains liable for completion and necessary acceleration costs; no compensation arises from such omission. (FIDIC 8.7; 15.1).

Delay damages: clause wording adjusted per Contract Data (removal of cross-reference to 20.2); claims procedures apply separately. (FIDIC 8.8; 20.2).

Payment for Plant/Materials after suspension: conditions include evidence of ownership and formal transfer clauses when applicable. (FIDIC 8.11).

Accelerated completion: upon Employer's request, the Contractor shall submit priced bids or explain inability; if accepted, conclude a Supplementary Agreement stating revised Time for Completion, programme revisions, price adjustments and other agreed amendments before acceleration begins; additional resources not covered in such agreement are at Contractor risk. (FIDIC 8.2; 8.3).

Clause 9 — Tests on Completion

Commissioning planning: Contractor participates in planning meetings and prepares a final approved commissioning plan/programme per Specification; TOC withheld until final O&M manuals are received; testing sequence comprises pre-commissioning (inspections; dry/cold functional tests) and commissioning tests (operational tests under available conditions). (FIDIC 9.1; 10.1).

Performance guarantees (IDD): Employer's Requirements shall include a Schedule of Performance Guarantees (KPIs) defining performance criteria, base input conditions, measurement methods, sampling frequency, and independent audit requirements; linkage to tests and payment to be defined per ER/Contract Data. (FIDIC guidance to Clause 12 / ER).

Clause 10 — Employer's Taking-Over

Taking-Over of parts: edits to sub-paragraphs per Contract Data; after partial TOC, the Contractor continues to be liable for care of such parts under 17.2. (FIDIC 10.2; 17.2).

Clause 11 — Defects after Taking-Over

DNP extension: for repaired/replaced Plant/parts, the DNP restarts upon recommencement of operation (and after repeated tests if necessary) and runs for the full specified period. (FIDIC 11.3).

Clause 12 — Measurement and Evaluation

Method of measurement: in accordance with the Specification and the Bill of Quantities, supported by schedules. (FIDIC 13 context).

Valuation: thresholds adjusted (e.g., 0.25%; 5%); non-conforming items valued upon Employer concession under 7.5; timely application for new rates/prices required within specified periods following final measurement or Variation instruction. (FIDIC 13.3; 12.3).

Clause 13 — Variations and Adjustments

Variation procedure: by approval of the client; Contractor to respond as practicable and in any case not later than 42 days; daywork valuation per Daywork Schedule with daily statements/resource records and priced submissions. (FIDIC 13.3.1; 13.3.2; 13.5).

Changes in Laws: statutory price increases (fuel, minimum wages, licensing fees, customs/duties, contributions to Compensation/Unemployment) are handled under Contract Price Adjustment and not as changes in Laws. (FIDIC 13.6).

Contract Price Adjustment (CPA): apply coefficients x, a, b, c, d per Contract Data and Stats SA/SEIFSA indices; use the latest available index if current is unpublished with subsequent adjustment upon publication; after expiry of Time for Completion, apply indices favourable to the Employer for work done thereafter (unless additional work/variations ordered post-TFC). (FIDIC 13.7).

Clause 14 — Contract Price and Payment

Advance Payment Guarantee: Use the annexed form; if extension evidence is not provided when required, the Employer may suspend payment or deduct the balance/part thereof. (FIDIC 14.2.1; 14.2.3).

Plant & Materials off-Site: payment requires ownership evidence or acceptable indemnity and other conditions; total off-site payments capped at 10% of the Accepted Contract Amount where stated. (FIDIC 14.5).

Payment administration: submit notarised designations of authorised signatories, notarised specimen signatures, and certified company resolutions for bank instructions. (FIDIC 14.7).

Discharge: reference to Clause 21 (Disputes and Arbitration) corrected. (FIDIC 14.12).

Clause 15 — Termination by Employer

Completion after maximum Delay Damages: if TOC for the whole Works has not been issued, the Employer may fix a final Time for Completion including passing the Tests; failing completion (not due to Employer), the Employer may (a) require completion, (b) complete the Works itself (costs for Contractor), or (c) terminate in whole/part. (FIDIC 15.2.4).

Clause 16 — Suspension and Termination by Contractor

Amendments: delete 16.2.1(g)(i); under 16.4(b) exclude indirect/consequential losses (including loss of profit/contract) except where expressly provided or where Employer is guilty of fraud/deliberate default/reckless misconduct. (FIDIC 16.2; 16.4).

Clause 17 — Care of the Works and Indemnities

Terminology and notification adjustments: responsibility for care extends to TOC issuance; losses/damage to be notified within 7 days from awareness or when reasonably should have been aware; IP rights notices adjusted. (FIDIC 17.1; 17.2; 17.3).

Clause 18 — Exceptional Events

Climatic conditions: exceptionally adverse climatic conditions are excluded from Exceptional Events; delays from weather are addressed under 8.5 (EOT). (FIDIC 18; guidance; 8.5).

Clause 19 — Insurance

Minimum insurance: Works R 10,000,000; Goods R 5,000,000; liability for breach of professional duty (PI) R 5,000,000; fitness for purpose R 5,000,000; injury to persons & property R 5,000,000; injury to employees R 5,000,000; third-party liability R 20,000,000; SASRIA (riot) insurance for Works value and replacement value of Construction Equipment on Site. (FIDIC 19.1; 19.2; 19.2.4; 19.2.6).

O&M phase (IDD): maintain Public Liability, Pollution Liability and Product Liability with limits stated in the Contract Data; provide proofs at Taking-Over and prior to O&M commencement. (FIDIC 19.2).

Clause 20 — Employer's and Contractor's Claims

Claims procedure: matters of EOT/cost/disruption are pursued under Clause 20.2 in accordance with contract timelines and evidentiary requirements. (FIDIC 20.2).

Clause 21 — Disputes and Arbitration

DAAB reference content: Statement of Case/Response must include issues in dispute, items not in dispute, fully argued positions, facts, legal/contentious bases, relief sought, and supporting documentation (including Engineer's instruments). (FIDIC 21.4.1).

Arbitration: Association of Arbitrators (Southern Africa); place of arbitration Pretoria, Republic of South Africa. (FIDIC 21.6 as amended).

DAAB composition (IDD): standing DAAB of three members to be appointed within 28 days; appointing authority fallback: Chairman, Association of Arbitrators (Southern Africa). (FIDIC 21.1–21.2).

DAAB Agreement Appendix: editorial changes per project (e.g., use of "DAAB Agreement", "chairperson").

Clause 22 — Section 37(2) Undertaking (OHSA)

The Contractor shall provide the Section 37(2) Undertaking prior to Site entry; all responsibility (civil and criminal) for health and safety matters in relation to the Works rests with the Contractor; the Contractor indemnifies the Employer against any loss/damage/injury/death, save where caused by the Employer's willful action/omission or gross negligence. (Local law aligned under FIDIC 4.8 framework).

Clause 23 — General (Commercial alignment; FIDIC 23.1–23.8)

Entire Agreement;

No Claim outside the Contract;

No Waiver;

Non-variation in writing;

no cession/delegation without consent;

no partnership;

non-exclusive jurisdiction of the Gauteng Provincial Division of the High Court, Pretoria;

subsequent maintenance contracts with cession of extended warranties to the operator after the Expiry Date where applicable.

3. **Proposed Additions — Required Contract Data/Special Provisions (with Yellow clause anchors)**

IDD Recommendation (Part A)	FIDIC Yellow Clause/Sub Clause	Draft Contract Data wording
Design responsibility & qualified designers	5.1; 5.2.1–5.2.2	The Contractor is responsible for the design of designated elements in the Employer's Requirements. Designers shall be ECSA registered and suitably qualified. The Contractor shall submit designer CVs and registrations; the Engineer's Review Period for Contractor's Documents is 21 days, with No objection deemed if no Notice is issued within that period.
Professional Indemnity (PI) insurance limits	19.2; 5.1	Minimum PI insurance for Contractor and design Subcontractors: R20 million (each claim/aggregate), maintained through the Defects Notification Period. Certificates of Insurance shall be provided before the Commencement Date and upon renewal.
Schedule of Performance Guarantees & KPI auditability	12; Employer's Requirements (Schedule of Performance Guarantees)	Include a Schedule of Performance Guarantees with KPI definitions, targets, base input conditions, measurement methods, sampling frequency, and independent audit requirements. Link KPI compliance to payment/penalties under Clause 14.
DAAB composition and appointment timing	21.1–21.2	Standing DAAB of three (3) members to be appointed within 28–56 days after the Commencement Date. Appointing authority fallback: Chairman of the Association of Arbitrators (Southern Africa).
Pr.CHSA appointment & OHS submissions	4.8	Appoint a Professional Construction Health & Safety Agent (Pr.CHSA) prior to Commencement. Submit the H&S Plan and Baseline Risk Assessment within 21 days of Commencement for Engineer's review.
Environmental Control Officer (ECO) & reporting	4.18; 4.20(g)	Appoint a site-based Environmental Control Officer before Commencement. Include monthly environmental compliance reporting (EA/EMP) in progress reports.
O&M Agreement	5.7	The Contractor shall be responsible for the Operations and Maintenance (O&M) Contract for the Polokwane Municipality 20 Ml/day Polokwane Regional Wastewater Treatment Plant (PRPRWWTW) as per C5.7. Failure to do so shall render the Contractor liable for penalties.
Programme content requirements	8.3	Sub-Clause 8.3 – Programme Before the first paragraph, add the following paragraph: “Unless expressly so stated in the Letter of Acceptance, acceptance of the Tender will not signify acceptance of the Tendered Programme, nor will it in any way relieve the Contractor of any of his responsibilities under the Contract.” Programme shall show critical path, logic links, resource histograms, cash-flow, interfaces between civil/mech/elec, procurement and delivery, testing and commissioning. Format: Candy CCS or Microsoft Project.
		Sub-Clause 8.4 - Extension of Time for Completion At the end of sub-paragraph (c), add: “EOT due to adverse climatic conditions at the Site which are Unforeseeable and the consequence of such climatic conditions, shall be calculated separately for each calendar

		month or part thereof from the Commencement Date until RFC, in accordance with the following formula: $V = (N_w - N_n) + \left(\frac{R_w - R_n}{x} \right)$ Where: V = Extension of Time in calendar days for the calendar month under consideration Nw = Actual number of days during the calendar month on which a rainfall of 10 mm or more has been recorded Nn = Average number of days for the calendar month on which a rainfall of 10 mm or more has been recorded, as derived from existing rainfall records Rw = Actual recorded rainfall for the calendar month Rn = Average rainfall for the calendar month, as derived from existing rainfall records x = 20 - Average values from existing rainfall records shall be as per Table 1 below (no other source of climatic data shall be accepted for this purpose): - If V is negative and its absolute value exceeds Nn, then V shall be equal to minus Nn. - If V is positive and greater than the number of calendar days in the calendar month under consideration, then V shall be taken as equal to the number of calendar days in the relevant calendar month. - The factor (Nw - Nn) shall be considered to represent a fair allowance for days during which rainfall exceeds 10 mm and the factor (Rw - Rn)/x shall be considered to represent a fair allowance for those days when rainfall does not exceed 10 mm but wet conditions prevent or disrupt work. - The total Extension of Time shall be the algebraic sum of all monthly totals for the contract period, but if the algebraic sum is negative the Time for Completion shall not be reduced due to subnormal rainfall. Extension of Time for a part of a month shall be calculated using pro rata values of Nn and Rn. The algebraic sum shall be rounded to the nearest day. Accurate rain gauging shall be taken at a suitable point on Site by the Contractor for [urposes of determining Nw and Rw, and the Contractor shall, at his own expense, take all necessary precautions to ensure that the rain gauges cannot be interfered with. At the end of the Sub-Clause, add the following paragraphs: "Notwithstanding anything to the contrary in the Contract, the Contractor shall not be entitled to an extension of the Time for Completion where he has not used all reasonable endeavours to prevent, reduce or mitigate the delay, including providing such temporary measures as may be necessary to enable work to continue and the Works and Contractor's Equipment to be protected during claim events.

		The rules and procedures for assessing the Contractor's entitlement to an EOT where there is concurrency between delays attributable to both Parties shall be as per the approach given in the Delay and Disruption Protocol published by the Society of Construction Law (UK): https://www.scl.org.uk/sites/default/files/SCL_Delay_Protocol_2nd_Edition_Final.pdf
O&M phase insurances	19.2	For the O&M period, maintain Public Liability R 20 000 000.00, Pollution Liability [INSERT R], and Product Liability [INSERT R]. Provide proof at Taking Over and before O&M starts.
Subcontractor payment discipline & retention caps	4.4; 14.7; 14.9	Pay subcontractors within 7 days of the Contractor receiving payment from the Employer. Retention for targeted enterprises capped at 5% of the tendered CPG value; disclose all subcontracting arrangements.
Design submissions — Review periods	5.2.2	Standard Review Period for Contractor's Documents: 21 days. No objection deemed after the Review Period unless the Engineer issues a Notice; resubmissions to include a revision schedule.
Training as condition precedent to Taking Over	5.5; 10.1	Provide structured operations and maintenance training. Issue of any Taking Over Certificate is conditional on completion of training to the Engineer's satisfaction.

<i>Table 1 – RAINFALL RECORDS FOR PERIOD: 2006 – 2016</i> <i>RAINFALL STATION: Polokwane Lat: 23.8570 Lon: 29.451 Height 1226m Average No of Days with Rainfall exceeding 10mm: 9.8 days/year</i> <i>Average Rainfall: 488.6mm/year station no: 0677802BX</i>												
MON	AVE	ST	N DAY	NUM	1	5.1	10.1	20.1	50.1	100.1	MAX R	MAX RAIN
MON		DEV	RAIN	MON	5	10	20	50	100	900	DAY	DATE
JAN	65.9	39.3	65.9	11	3.4	2.1	1.3	0.7	0	0	38	1/18/2013
FEB	47.3	49.7	47.3	11	1.6	0.9	1.1	0.6	0	0	49	2/26/2006
MAR	58.4	33.2	58.4	11	3	1.3	1.1	0.7	0.1	0	51.5	3/27/2006
APR	43.3	46.6	43.3	11	1.5	1	0.7	0.5	0.1	0	68	4/4/2011
MAY	10.4	14	10.4	11	0.5	0.4	0.3	0.1	0	0	29.2	5/8/2009
JUN	1.7	3.6	1.7	11	0.3	0	0.1	0	0	0	12	6/10/2009
JUL	2.4	4.3	2.4	11	0.3	0.1	0.1	0	0	0	12.1	7/4/2007
AUG	2.3	5.6	2.3	11	0.2	0	0.1	0	0	00	19.2	8/15/2011
SEP	6.6	8.2	6.6	11	0.4	0.4	0.1	0.1	0	0	22.5	9/4/2015
OCT	48.1	29.5	48.1	11	1.5	0.7	1.4	0.6	0	0	38.2	10/29/2009
NOV	97.7	40.5	97.7	11	3.1	2	1.3	1.5	0.2	0	65.5	11/12/2008
DEC	104.6	56.3	104.6	11	3.8	1	1.7	1.9	0.1	0	55	12/16/2014
YR	488.6		67.9		19.5	9.8	9.2	6.8	0.5	0	488.6	

POLOKWANE MUNICIPALITY

(Not to be completed at tender stage)

C1.3 Performance Guarantee

In accordance with Sub-Clause 4.2 [Performance Security] of the FIDIC Yellow Book, 2017 Edition.

Contract No:

Description of Contract:

.....

GUARANTOR DETAILS AND DEFINATIONS

“Guarantor” means:

.....(Please put name of firm)

Please address:

.....

Postal address:

.....

Tel:

Fax:

“Employer” means: **POLOKWANE MUNICIPALITY**.

“Contractor” means:

..... (Please put name of firm)

“Guarantee sum” means: 10% of the contract amount

“**Engineer**” means:

“**Works**” means: Permanent works together with temporary works

“**Site**” means: The land and other places, made available by the Employer for the purpose of the contract, on under over in or through which the works are to be executed or carried out.

“**Contractor**” means: The Agreement made in terms of the Form of Offer and Acceptance and such amendments or additions to the Contractor as may be agreed in writing between the parties.

“**Contract Sum**” means: The accepted amount inclusive for tax of R

Amount in words:

.....

..... **“Expiry Date”** This Guarantee shall expire upon the issue of the **Completion Certificate** issued by Polokwane Municipality signed by the **Director of Water and Sanitation Services**, as such date is advised to the Guarantor in writing confirmed by the Employer.

CONTRACT DETAILS

Engineer issues: Interim Payment Certificates, Final Payment Certificate and the Certificate Completion of the Work as defined in the Contract.

PERFORMANCE GUARANTEE

1. The Guarantor's liability shall be limited to the amount of the Guaranteed Sum.
2. **Expiry Date** This Guarantee shall expire upon the issue of the final completion certificate issued by Polokwane Municipality signed by the Director of ENGINEERING Services, as such date is advised to the Guarantor in writing confirmed by the Employer
The Engineer and/or the Employer shall advise the Guarantor in writing of the date on the Certificate of the works has been issued.
3. The Guarantor hereby acknowledges that:
 - 3.1. Any reference in this performance Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a surety ship;
 - 3.2. Its obligation under this Performance Guarantee is restricted to the payment of money.
4. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor hereby undertakes to pay the Employer the sum certified upon receipt of the documents identified in 4.1 to 4.3:
 - 4.1. A copy of a first written demand issues by the Employer to the Contractor stating that payment of a sum certified by the Engineer and/ or Employer in an Interim or Final Payment Certificate has not been made in terms of the Contract and failing such payment within seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 4.2;
 - 4.2. A first written demand issued by the Employer to the Guarantor at the Guarantor's physical address and / or postal address with a copy to the Contractor stating that period of seven (7) days has elapsed since the first written demand terms of 4.1 and the sum certificate has still not been paid;
 - 4.3. A copy of the aforesaid payment certificate which entails the Employer to receive payment in terms of the Contract sum in 4.
5. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor undertakes to pay to the Employer the Guaranteed sum or the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor at the Guarantor's physical address and/ or postal address calling up this Performance Guarantee, such demand stating that:
 - 5.1. The contractor has been termination due to the Contractor's default and this performance Guarantee is called up in terms of 5; or
 - 5.2. A provisional or final sequestration or liquidation court order has been granted against the Contractor and that the Performance Guarantee is called up in terms of 5; and
 - 5.3. The aforesaid written demand is accompanied by a copy of the notice of termination and/or the provisional /final sequestration and/or the provisional liquidation court order.

6. It is recorded that the aggregate amount of payments required to be made by the Guarantor in terms of 4 and 5 shall not exceed the Guarantor's maximum liability in terms of 1.
7. Payment by the Guarantor in terms of 4 or 5 shall be made within seven (7) calendar days upon receipt of the first written demand to the guarantor.
8. Payment by Guarantor in terms of 5 will only be made against the return of the original Performance Guarantee by the Employer.
9. The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer may deem fit and the Guarantor shall not have the right to claim his release from his Performance Guarantee on account alleged to be prejudicial to the Guarantor.
10. The Guarantor chooses the physical address and postal address as stated above for the service of all notices for all purposes in connection herewith.
11. This Performance Guarantee is neither negotiable nor transferable and shall expire in terms of 2, where after on claims will be considered by the Guarantor. The original of this Guarantee shall be returned to the Guarantor after it has expired.
12. This Performance Guarantee, with the required demand notices in terms of 4 or 5, shall be regarded as a liquid document for the purposes of obtaining a court order.
13. Where this Performance Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of Section 45 of the Magistrate's Court Act No 32 of 1944, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of the Magistrate's Court.

Sign at

Date

Guarantor's signatory (1)

Capacity

Guarantor's signatory (2)

Capacity

Witness signatory (1)

Witness signatory (2)

RETENTION MONEY GUARANTEE

(Not to be completed at tender stage)

In accordance with Sub-Clause 14.9 [Payment of Retention Money] of the FIDIC Yellow Book, 2017 Edition.

Contract No:

Description of Contract:

.....

GUARANTOR DETAILS AND DEFINATIONS

“Guarantor” means:

.....(Please put name of firm)

Please address:

.....

Postal address:

.....

Tel:

Fax:

“Employer” means: **POLOKWANE MUNICIPALITY.**

“Contractor” means:

..... (Please put name of firm)

“Guarantee sum” means: 10% of the contract amount

“**Engineer**” means:

“**Works**” means: Permanent works together with temporary works

“**Site**” means: The land and other places, made available by the Employer for the purpose of the contract, on under over in or through which the works are to be executed or carried out.

“**Contractor**” means: The Agreement made in terms of the Form of Offer and Acceptance and such amendments or additions to the Contractor as may be agreed in writing between the parties.

“**Contract Sum**” means: The accepted amount inclusive for tax of R

Amount in words:

.....

..... **“Expiry Date”** This Guarantee shall expire upon the issue of the **Completion Certificate** issued by Polokwane Municipality signed by the **Director of Water and Sanitation Services**, as such date is advised to the Guarantor in writing confirmed by the Employer.

CONTRACT DETAILS

Engineer issues: Interim Payment Certificates, Final Payment Certificate and the Certificate Completion of the Work as defined in the Contract.

RETENTION GUARANTEE

1. The Guarantor's liability shall be limited to the amount of the Guaranteed Sum.
2. **Expiry Date** This Guarantee shall expire upon the issue of the final completion certificate issued by Polokwane Municipality signed by the Director of ENGINEERING Services, as such date is advised to the Guarantor in writing confirmed by the Employer
The Engineer and/or the Employer shall advise the Guarantor in writing of the date on the Certificate of the works has been issued.
3. The Guarantor hereby acknowledges that:
 - 3.1. Any reference in this performance Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a surety ship;
 - 3.3. Its obligation under this Retention Guarantee is restricted to the payment of money.
4. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor hereby undertakes to pay the Employer the sum certified upon receipt of the documents identified in 4.1 to 4.3:
 - 4.1. A copy of a first written demand issues by the Employer to the Contractor stating that payment of a sum certified by the Engineer and/ or Employer in an Interim or Final Payment Certificate has not been made in terms of the Contract and failing such payment within seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 4.2;
 - 4.2. A first written demand issued by the Employer to the Guarantor at the Guarantor's physical address and / or postal address with a copy to the Contractor stating that period of seven (7) days has elapsed since the first written demand terms of 4.1 and the sum certificate has still not been paid;
 - 4.3. A copy of the aforesaid payment certificate which entails the Employer to receive payment in terms of the Contract sum in 4.
5. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor undertakes to pay to the Employer the Guaranteed sum or the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor at the Guarantor's physical address and/ or postal address calling up this Performance Guarantee, such demand stating that:
 - 5.1. The contractor has been terminated due to the Contractor's default and this Retention Guarantee is called up in terms of 5; or
 - 5.2. A provisional or final sequestration or liquidation court order has been granted against the Contractor and that the Retention Guarantee is called up in terms of 5; and
 - 5.3. The aforesaid written demand is accompanied by a copy of the notice of termination and/or the provisional /final sequestration and/or the provisional liquidation court order.

6. It is recorded that the aggregate amount of payments required to be made by the Guarantor in terms of 4 and 5 shall not exceed the Guarantor's maximum liability in terms of 1.
7. Payment by the Guarantor in terms of 4 or 5 shall be made within seven (7) calendar days upon receipt of the first written demand to the guarantor.
8. Payment by Guarantor in terms of 5 will only be made against the return of the original Retention Guarantee by the Employer.
9. The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer may deem fit and the Guarantor shall not have the right to claim his release from his Retention Guarantee on account alleged to be prejudicial to the Guarantor.
10. The Guarantor chooses the physical address and postal address as stated above for the service of all notices for all purposes in connection herewith.
11. This Retention Guarantee is neither negotiable nor transferable and shall expire in terms of 2, where after on claims will be considered by the Guarantor. The original of this Guarantee shall be returned to the Guarantor after it has expired.
12. This Retention Guarantee, with the required demand notices in terms of 4 or 5, shall be regarded as a liquid document for the purposes of obtaining a court order.
13. Where this Retention Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of Section 45 of the Magistrate's Court Act No 32 of 1944, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of the Magistrate's Court.

Sign at

Date

Guarantor's signatory (1)

Capacity

Guarantor's signatory (2)

Capacity

Witness signatory (1)

Witness signatory (2)

C1.4 OCCUPATIONAL HEALTH AND SAFETY AGREEMENT

This agreement is mandatory for all contractors appointed by the Polokwane Municipality or any other institution that do work for or on behalf of Municipality.

This agreement is between:

THE CONTRACTOR:

Herein represented by

In his capacity as Being duly authorized hereto hereinafter referred to

as "contractor".

Compensation Commissioner Number:
(Attach a copy of the Registration
Certificate to this agreement)

Company : Name:

Registration Number:

CEO: Name:

ID Number:

Physical Address:

.....

.....

**And the POLOKWANE MUNICIPALITY
(Hereinafter referred to as "the Council")**

1. DEFINITIONS

1.1	CONTRACTOR	Means the "Contractor" as defined in the "Principal Contract". Annexed hereto in his capacity as mandatory.
1.2	MANDATORY	Includes an agent, contractor or subcontractor for work to be done or service rendered, but without derogating from his status in his own right as an employer of people or user of equipment, machinery, tools or materials.
1.3	THE PRINCIPAL CONTRACT	Means the contract annexed hereto as annexure "A".
1.4	MUNICIPALITY	Means the Polokwane Municipality

1.5 **RISK CONTROL OFFICER** A person appointed in writing by Municipality.

1.6 Any definitions contained in any Statute hereinafter mentioned shall have the meaning allocated to it by the specific statute.

2. OBJECTIVE

2.1 Whereas Municipality and the Contractor have entered into a contract for service (work) as fully indicated in the "Principle Contract" and whereas the "Contractor" agreed to indemnify Municipality against the risks stated hereunder whether foreseeable or not, and, whereas it is agreed between the parties that it is of cardinal importance to safeguard both Municipality and the Contractor's obligation in terms of relevant legislation as well as to extend the obligation as a company and/or legal person and/or person as an entity concerned with health, safety and the environment.

2.2 These rules are applicable to all contractors performing work for Municipality within the jurisdictional area of the Municipality and on any premises, which are owned, rented or developed by the Municipality.

2.3 The Municipality acts through those officials or persons who are generally or specifically charged with the responsibility, in terms of legislation, as well as any other official or person who is generally or specifically charged with the control and supervision of the project.

IT IS HEREBY AGREED AS FOLLOWS:

3. INDEMNITIES

3.1 The "Contractor" hereby indemnifies the "Municipality" against any loss in respect of all claims, proceeding, damages, costs and expenses arising out of any claim or proceeding pertaining to the non compliance by the "Contractor" of any statutory requirements and/or requirements regarding the following Acts in particular pertaining to the provisions of:

3.1.1 The Occupational Health and Safety Act 85 of 1993 (as amended), including the Construction Regulations, 2003 as promulgated on 18 July 2003, in terms of Section 43 of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993), in Government Gazette No. 25207 and Regulation Gazette No. 7721. See Annexure B.

3.1.2 The Health Act 63 of 1977.

3.1.3 Road Traffic Act 29 of 1989 (as amended).

3.1.4 Environment Conservation Act 73 of 1989.

3.1.5 The National Water Act 36 of 1998.

3.1.6 The Criminal Procedure Act 51 of 1977.

3.1.7 The Explosives Act 26 of 1956.

3.1.8 The Arms and Ammunition Act 75 of 1969.

3.1.9 Compensation for Occupational Injuries and Diseases Act 130 of 1993.

3.1.10 The Labour Relations Act 66 of 1995.

3.1.11 The Unemployment Insurance Act 30 of 1966 (as amended).

3.1.12 The Basic Conditions of Employment Act 75 of 1997 (as amended).

3.1.13 Standards Act 29 of 1993.

3.1.14 any statutory provisions in any act and/or any law or bylaw of any local government and/or any published official standard incorporated into any statute or bylaw relating to the completion of the work set out in the "Principal Contract".

3.1.15 Any other health and safety standard prescribed by the "Municipality".

- 3.2 The "Contractor" shall ensure that he familiarizes himself with the requirements of the above legislation and that he, his employees and any subcontractor will comply with all the statutory provisions contained in them.
- 3.3 The "Contractor" shall indemnify the "Municipality" in respect of any physical loss or damage to any plant, equipment or other property belonging to the "Contractor" or for which he is responsible and he hereby indemnifies the "Municipality" against any loss in respect of all claims, proceedings, damages, costs and expenses consequent upon the loss of or damage to any plant, equipment or other property belonging to, or which is the responsibility of, any subcontractor, agent or employee of the subcontractor.
- 3.4 The "Contractor" shall and hereby indemnifies the "Municipality" against any liability, loss, claim or proceedings whatsoever, whether arising in common law or by statute, consequent on personal injuries to or the loss of health or death of any person whosoever arising out of or in the course of or caused by the execution of the "Principal Contract".
- 3.5 The "Contractor" shall and hereby indemnifies the "Municipality" against any liability, loss, claim or proceedings consequent on loss of or damage to any movable or immovable property arising out of or in the course of or caused by the execution of the "Principal Contract" and due to any act or omission of the "Contractor", his agents, servants or subcontractors.

4. PERFORMANCE SAFE WORKING PRACTICE

- 4.1 The "Municipality" requires a high standard of safe work performance from all employees and expects that the standard be maintained by the "Contractor" within the "Municipality's" jurisdictional area or on its premises.
- 4.2 Irrespective of human considerations, the maintaining of these health and safety rules shall be the execution of the prescribed legal requirements. These rules are not to hinder the "Contractor" in rendering services or indemnify the "Contractor" from any legal responsibility to ensure healthy and safe work circumstances.
- 4.3 The "Municipality" shall assist the "Contractor" in any practical considerations to accommodate the healthy and safe execution of work and therefore require co-operation in the execution of these safety rules.

5. LOCK OUT PROCEDURE

- 5.1 When power or air driven machines or equipment, electrical apparatus or pipe lines are examined, repaired, adjusted, cleaned, lubricated or serviced in any other way than normal servicing, then all isolating switches, -levers, valves or appliances must be put in the "off" or "closed" position and locked.
- 5.2 Should more than one team work on a machine, then each person in control of a team, must put a separate lock on the switch, lever, valve or appliance.

6. CRANES, VEHICLES AND HOISTING

- 6.1 For each crane or hoisting equipment used, the "Contractor" must submit a valid and recent test certificate or other form of the last examination of the machine or equipment, to the "Municipality".
- 6.2.1 Only trained personnel with written permission and where determined by Law, with a valid driver's license, may be allowed to operate any electrical diesel or petrol driver overhead crane, hydraulic or electrical hoisting equipment, self-driven forklift, tractor or any other crane or vehicle. No employee of the "Contractor" may perform any overhead work or work on an overhead crane or hoisting equipment or work near cranes or crane rail, before:

- i) An agreement was concluded with the “Municipality”.
- ii) Approval has been obtained from the “Municipality” to perform the work.
- iii) All applicable danger – and warning symbolic signs are put into position, or exemption, if applied for, is in operation.

6.3 The “Contractor” shall be wholly responsible for any loss or damage to cranes, hoisting equipment, plant, machines or equipment brought onto the work site by the “Contractor”

7. MACHINE VALANCES, PROTECTION AND FENDING

7.1 No machine valances, protection or fending may be removed from machines, manholes, etc without the written permission of “Council” if applicable exemption procedures were not appropriated.

8. SCAFFOLD, LADDERS, TOOLS AND EQUIPMENT

8.1 No equipment or appliance belonging to “Municipality” may be used without written permission from “Municipality”.

8.2 Unless prior arranged, “Contractors” must bring sufficient tools and equipment to the site to finish the contract, including offices and storerooms. The mentioned equipment remains the responsibility of the “Contractor” with respect to loss, damage and theft.

8.3 In exceptional cases, where tools and equipment belonging to “Municipality” are used to finish the contract, the said equipment and tools are used on own risk and the “Contractor” indemnifies “Municipality” from any claims that may arise. The said indemnity must be in writing, as well as information regarding the loan period, identification and condition of tools and equipment. The “Contractor” is responsible for the returning of said tools and equipment in the same condition or better. The “Contractor” is responsible to “Municipality” for any damage or excessive wear of such tools or equipment and material.

9. EXCAVATIONS

9.1 Before any excavations commence, written permission must be obtained from “Municipality” to confirm the location of existing electrical cables, water pipes, etc.

9.2 All excavations and obstructions in floor, tar and dirt surfaces must be fenced effectively and safeguarded between sundown and sunup with a sufficient amount of red/yellow warning lights and symbolic signs.

9.3 The surrounding area must be kept clean, safe and tidy during excavation. Excess material may not obstruct unnecessarily.

9.4 If any property is in danger during excavation, it must be supported and the proposed support work must be submitted to the Department of Labour (OHS) and “Municipality” for approval.

9.5 Written permission must be obtained from “Municipality” to grant admittance to restricted areas as well as areas where dangerous or poisonous gases are present.

10. FIRST AID

10.1 The “Contractor” must provide and maintain a first aid box equipped according to legal requirement where more than (5) five persons are employed. The first aid box must be in the care of a person with a competency certificate from one of the following organizations:

- (i) SA Red Cross Association;
- (ii) St Johns Ambulance;
- (iii) SA First Aid League; or
- (iv) A person or organization approved by the Chief inspector for this purpose.

- 10.2 A visible notice must be put up on any work premises with the name of the person responsible for first aid. In an emergency "Municipality's" Ambulance / Fire Department or emergency services may be contacted at (015) 290 2000.

11. FLAMMABLE LIQUIDS

- 11.1 The "Contractor" shall be held responsible for the necessary precautionary fire prevention measures. No smoking signs must be put up where applicable. The "Contractor's" employees must be informed of "Municipality's" fire prevention measures and evacuation procedures.

12. COMPENSATION BY CONTRACTOR

- 12.1 The "Contractor" shall be held responsible for all loss of and damage to property, the death or injury of persons, the resultant loss or damage suffered as well as all law suits, claims, costs, charges, fines and expenses due to negligence, violation of statutory liability or neglect of the "Contractor" or the "Contractor's" employees.

13. TRANSGRESSION OF RULES AND MISBEHAVIOUR

- 13.1 The "Contractor" is warned that any act(s) leading to damage or loss of employees of the "Contractor" or the "Municipality" shall not be tolerated. The "Municipality" may (without any reason) demand that any employee of the "Contractor" be withdrawn from the principal "Contract" or site.

14. INCIDENT REPORTING

- 14.1 All incidents referred to in Section 24 of the Occupational Health and Safety Act and or other incidents shall be reported, by the "Contractor", to the Department of Labour, as well as to the "Municipality" and should such an incident take place outside normal working hours, on a Saturday, Sunday or Public holiday provided with a written report relating to any incident.
- 14.2 The "Municipality" will obtain an interest in the issue of any formal inquiry conducted in terms of the Occupational Health and Safety Act in any incident involving the "Contractor" and/or his employees and/or his subcontractors.
- 14.3 The "Contractor" undertakes to report to "Municipality" anything deemed to be unhealthy and/or unsafe and that he undertakes to verse his employees and/or subcontractors in this regard.

15. LIAISON AND SUPERVISION

- 15.1 The "Contractor" hereby undertakes to liaise on a regular basis with the designated Risk Control Officer and "Municipality" representative regarding any hazards or incidents that may be identified or encountered during the performance of the "Principal Contract".

16. SERVICE INTERRUPTION

- 16.1 Should any work done by the "Contractor" cause a possible interruption, written permission must be obtained from "Municipality", before such work commences. The "Contractor" may not switch on or off any compressed air, steam, oxygen, vacuum supply or electrical supply without written permission from the "Municipality".

17. CONFIDENTIALITY

- 17.1 The "Contractor" and his employees shall regard all data, documentation and information of the contract and related documentation as confidential.

17.2 Lost documentation/plans or related documentation shall immediately be reported in writing to the "Municipality".

17.3 The "Contractor" shall not put up any advertisements or billboard at the site without permission.

17.4 The "Contractor" shall not take photographs of the contract site or part thereof or any work process or part thereof, without written permission from the "Municipality", or have photographs taken, published or let it be published.

18. CONTRACT SITE AND PRESERVATION

18.1 Employees of the "Contractor" shall not be allowed entrance to the site unless a valid identity document, issued by "Municipality", is displayed. The mentioned documents shall only be valid for a limited period, where after it must be renewed.

19. COMPLETION OF WORK

19.1 The "Contractor" or his employees shall not leave the contract site before the "Municipality" is satisfied that the contract is completed according to the requirements and standards set out in the contract and that the working site is left in a satisfactory and safe condition.

20. LIQUOR, DRUGS, DANGEROUS WEAPONS AND FIREARMS

20.1 The "Contractor" shall ensure that no liquor, drugs, dangerous weapons or firearms be brought onto the premises.

21. SEARCHES

21.1 The "Contractor" and any person engaged in the contract work may at any time be searched by "Municipality" appointed security personnel and all packages, suitcases, etc. must be presented to the access control point for examination prior to them being brought onto the property or leaving the property.

22. GENERAL CONDITIONS

22.1 Notwithstanding anything to the contrary in this agreement, it is hereby specifically determined that the "Contractor"-

22.1.1 shall have acquainted himself and be conversant with the contents of all statutory provisions applicable to the health and safety of workers and other persons on the site including the execution of the work, and in particular the conditions contained in the Occupational Health and Safety Act, 1993 (Act 85/1993), and the regulations promulgated in terms thereof, and shall comply therewith meticulously and in all aspects and/or take care that it is complied with;

22.1.2 shall be obliged to immediately execute all instructions given to him by an authorized representative of "Municipality" in order to ensure and uphold the implementation and enforcement of the provisions referred to in sub-paragraph 1, to the satisfaction of the said representative;

22.1.3 shall indemnify the "Municipality" against any or all liability which may be incurred by the "Municipality" as a result of the omission of the "Contractor", his employees, sub-contractors and/or representatives to comply with the provisions referred to in sub-paragraph 1, or to ensure that it shall be complied with;

22.1.4 shall undertake to pay upon demand any and/or all legal costs and other expenses which "Municipality" may have incurred as a consequence of any criminal charges or other proceedings pending against, or involving the "Municipality" as a result of the contravention or non-compliance by the

“Contractor”, his employees, sub-contractors and/or representative of any of the statutory provisions referred to in sub-paragraph 1.

22.1.5 Should the “Contractor” neglect to immediately execute any health and safety written orders issued to him, or to his employee in charge of the works, in terms of the stipulations of sub-paragraph 2, the “Municipality” shall be entitled to suspend the execution of the works and take the necessary steps to execute or have such order executed. Under these circumstances the contractor shall be obliged to pay “Municipality”, upon demand, all costs and expenses incurred by “Municipality”, in order to execute or have the said orders executed.

22.1.6 Should the abovementioned steps not establish a healthy and safe work environment the “Municipality” will be entitled to terminate the contract without incurring any further costs or claims from the contractor?

23. “CONTRACTOR” IDENTIFICATION BOARD

23.1 The “Contractor” shall provide on any work premises a temporary identification board containing at all worksites the following information:

- Company name on behalf of which division/department the work is being done.
- The contact number and name of the person representing the “Contractor”.
- The contact number and name of the person representing “Municipality”

24. ACKNOWLEDGEMENT

24.1 The “Contractor” hereby acknowledges that he has read and received a copy of the “Principal Contract” and agrees to be bound by and undertakes to observe all the terms and conditions of the “Principal Contract”. This appointment is made in terms of Section 37(2) of the Occupational Health and Safety Act, 85 of 1993.

25. EXCEPTIONS AND OMISSIONS

26. REMARKS

THE CONTRACTOR

SIGNED AT ON THIS DAY OF

WITNESSES:

..... 1.

THE CONTRACTOR

2.

THE MUNICIPALITY

SIGNED AT ON THIS DAY OF

WITNESSES:

..... 1.

THE MUNICIPALITY

2.

b) INDEMNITY CERTIFICATE

Contractor:

Employer: Polokwane Municipality

Contract:

I/we Hereafter the
"Contractor"

"Contractor" hereby indemnifies the Polokwane Municipality (Municipality) against any claim of whatever sort which may arise directly or indirectly from the execution by me/us of the above-mentioned contract and which may be instituted against "Municipality", as well as of any loss or damage which the "Municipality" suffers or expenditure the "Municipality" incurs to prevent responsibility for such claim, loss or damage, whatever the cause of such claim may be or whatever loss or damage the "Municipality" suffers.

THUS done and signed at on this day of

..... 20.....

WITNESSES:

1.
CONTRACTOR

2.
MUNICIPALITY

c) ACKNOWLEDGEMENT CERTIFICATE

I, in my capacity as.....

Duly authorized hereto representing

..... Contractors, acknowledge receipt
of a copy of the Polokwane Municipality's safety manual for contractors and the under mentioned person as my
supervisor regarding all works and services which must be executed by the Contractor. The appointment is done
in terms of the Occupational Health and Safety Act, 1993 (Act 85/1993).

SIGNED AT ON 20.....

I, ... accept the abovementioned appointment,
and declare that I am familiar with the contents of the Polokwane Municipality's Safety Manual for contractors
CASUALTIES REGISTRATION NUMBER

.....

.....

.....

SIGNED AT ON 20.....

SIGNATURE:

WITNESSES: 1.

2.

A copy of this certificate shall be submitted to the "Municipality" before any work commences.

C1.5: Agreement with Adjudicator

This agreement is made on the.....day of 20.....between: the Employer

(name of company / organisation)

of (address)

.....and the Contractor

(name of company / organisation)

of (address).....

..... (hereinafter called **the Parties**)

And

(name).....

of (address)

..... (hereinafter called **the Adjudicator**)

Disputes or differences may arise/have arisen* between the Parties under a Contract dated.

and known as Contract No.....

(Contract title).....

and these disputes or differences shall be/have been* referred to adjudication in accordance with the CIDB Adjudication Procedure, (hereinafter called "**the Procedure**") and the Adjudicator may be or has been requested to act.

(* Delete as necessary)

IT IS NOW AGREED as follows:

1. The rights and obligations of the Adjudicator and the Parties shall be as set out in the Procedure.
2. The Adjudicator hereby accepts the appointment and agrees to conduct the adjudication in accordance with the Procedure.
3. The Parties bind themselves jointly and severally to pay the Adjudicator's fees and expenses in accordance with the Procedure as set out in the Contract Data.
4. The Parties and the Adjudicator shall at all times maintain the confidentiality of the adjudication and shall endeavour to ensure that anyone acting on their behalf or through them will do likewise, save with the consent of the other Parties which consent shall not be unreasonably refused.
5. The Adjudicator shall inform the Parties if he intends to destroy the documents which have been sent to him in relation to the adjudication and he shall retain documents for a further period at the request of either Party.

SIGNED by:

(Signature):

(Signature):

(Signature):

Name:
who warrants that he/ she is
duly authorised to sign for and
on behalf of the **First Party** in
the presence of

Name:
who warrants that he/ she is
duly authorised to sign for
and on behalf of the **Second
Party** in the presence of

Name:
the **Adjudicator** in the
presence of

Witness 1:

Witness 2:

Witness 3:

(Signature).....

(Signature).....

(Signature).....

Name:

Name:

Name:

Address:

Address:

Address:

.....

.....

.....

Date:

Date:

Date:

POLOKWANE MUNICIPALITY

POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS PHASE 2B: CIVIL, MECHANICAL & ELECTRICAL WORKS (MULTI-YEAR PROJECT)

PART C2: PRICING DATA

C2.1: PRICING INSTRUCTIONS

C2.2: BILL OF QUANTITIES

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C2.1 PRICING INSTRUCTIONS

1. GENERAL

The pricing instructions describe the criteria and assumptions which will be assumed in the Contract that the Bidder has taken into account when developing his prices. The Bills of Quantities record the Contractor's rates for providing supplies, services, engineering and construction works in accordance with the Scope of Work.

The terms of payment and the provisions for price adjustment, if applicable, are established in the Contract Data. These items are not described in the Pricing Data.

The Bidder's obligations in pricing the Bidder offer and the Employer's undertakings in the checking and correction of arithmetical errors are dealt with in the Standard Conditions of Bidder contained in Annexure F of SANS 294, as amended in and read in conjunction with the Bidder Data.

2. DOCUMENTS MUTUALLY EXPLANATORY

The documents forming the Contract are to be taken as mutually explanatory of one another. The Bill of Quantities forms an integral part of the Contract Documents and shall be read in conjunction with the Bidder Data, Contract Data, Scope of Work, Site Information General and Special Conditions of Contract, the Specifications and the Drawings.

3. DEFINITIONS

For the purpose of this Bill of Quantities, the following words shall have the meanings hereby assigned to them:

Unit : The unit of measurement for each item of work as defined in the Scope of Work and Site Information.

Quantity : The number of units of work for each item.

Rate : The payment per unit of measurement at which the Contractor Contracts to do the work.

Amount : The product of the quantity and the rate Bidded for an item.

Sum : An amount contracted for an item, the extent of which is described in the Bill of Quantities, the specifications or elsewhere but the quantity of work of which is not measured in any units.

4. DESCRIPTIONS

Descriptions in the Bill of Quantities are abbreviated and comply generally with those in the Standardised Specifications. Clause 8 of each Standardised Specification, read together with the relevant clauses of the Scope of Work, set out what ancillary or associated activities are included in the rates for the operations specified. Should any requirements of the measurement and payment clause of the applicable Standardised Specification, or the Scope of Work, conflict with the terms of the Bill, the requirements of the Standardised Specification or Scope of Work, as applicable, shall prevail.

5. REFERENCES

The clauses in a specification in which further information regarding the schedule item can be obtained appear under "Reference clause" in the Bill. The reference clauses indicated are not necessarily the only sources of information in respect of scheduled items. Further information and specifications may be found elsewhere in the contract documents. Standardised Specifications are identified by the letter or letters which follow SABS in the SABS 1200 series of specifications, eg. G for SABS 1200 G.

6. UNITS OF MEASUREMENT

The units of measurement indicated in the Bill of Quantities are metric units.

The following abbreviations are used in the Bill of Quantities:

%	=	per cent
h	=	hour
ha	=	hectare
kg	=	kilogram
kl	=	kilolitre
km	=	kilometre
km-pass	=	kilometre-pass
kW	=	kilowatt
l	=	litre
m	=	metre
mm	=	millimetre
MN	=	meganewton
MN-m	=	meganewton-metre
MPa	=	megapascal
m ²	=	square metre
m ³	=	cubic metre
m ³ -km	=	cubic metre-kilometre
m ² -pass	=	square metre-pass
no	=	number
PC sum	=	Prime Cost sum
Prov Sum	=	Provisional Sum
sum	=	lump sum
t	=	ton (1 000 kg)

7. NET MEASUREMENTS

Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for off-cuts and waste.

8. QUANTITIES

The quantities set out in these Bills of Quantities are approximate and do not necessarily represent the actual amount of work to be done. The quantities of work accepted and certified for payment will be used for determining payments due and not the quantities given in the Bills of Quantities.

The Contract Amount to be determined in accordance with the conditions of contract identified in the Contract Data shall be computed from the actual quantities of authorized work done, value at rates determined in terms of the Contract Data, against the respective items in the Bill of Quantities.

9. CURRENCY

All rates and sums of money quoted in the Bill of Quantities shall be in Rand and whole cents. Fractions of a cent shall be discounted.

10. VALUE ADDED TAX

Value Added Tax shall be excluded from the rates and sums contracted for the various items of work included in the Bill of Quantities. VAT will be added as a single entry to the summary.

11. RATES AND PRICES

11.1 General

- a) The Contractor must price each item in the Bill of Quantities in BLACK INK. Reproduced computer printouts of the Bills of Quantities will not be acceptable.
- b) The rates and prices to be inserted in the Bill of Quantities shall cover all the services and incidentals for the work described under the several items. Such prices and rates shall cover all costs and expenses that may be required in and for the execution of the work described, and shall cover the cost of all general risks, liabilities and obligations set forth or implied in the documents on which the Bidder is based, as well as overhead charges and profit. Reasonable prices shall be inserted as these will be used as a basis for assessment of payment for additional work that may have to be carried out.
- c) Where the Contractor is required to furnish detailed drawings and designs or other information in terms of the Contract Data, all costs thereof shall be deemed to have been provided for and included in the unit rates and sum amounts contracted for the items scheduled in the Bill of Quantities. Separate additional payments will not be made.
- d) A price or rate is to be entered against each item in the Bill of Quantities, whether the quantities are stated or not. An item against which no price is entered will be considered to be covered by the other prices or rates in the Bill. The Contractor will not be paid for items against which no rate or lump sum has been entered in the Bill of Quantities.
- e) Should the Contractor group a number of items and contract one lump sum for such group of items, this single lump sum shall apply to that group of items and not to each individual item.
- f) Should the Contractor indicate against any item that compensation for such item is included in another item, the rate for the item included in another item shall be deemed nil.
- g) A submission may be regarded as non-responsive if any rates or lump sums in the Bill of Quantities are, in the opinion of the Employer, unreasonable or out of proportion.

11.2 "Rate only" items

The Contractor shall fill in a rate (in the rate column) against all items where the words "rate only" appear in the Amount column, which rate will constitute payment for work which may be done in terms of this item. Such "rate-only" items are used where it is estimated that little or no work will be required under the item or where the item is to be considered as an alternative to another item for which a quantity is given.

11.3 Arithmetic

Excepting where Sum Amounts are required or where Provisional Sums have been indicated, the Contractor shall enter an applicable rate in the Rate Column of the Bill of Quantities for each

scheduled item. He shall also enter an appropriate sum in the Amount column for each scheduled item, by determining in the applicable line item the product of the Quantity and the Unit Rate.

If there is an error in the line item resulting from the product of the unit rate and the quantity, the rate shall be binding and the error of extension as entered in the Bidder offer will be corrected by the Employer in determining the Contract Price.

Where there is an error in addition, either as a result of other corrections required by this checking process or in the Bidder's addition of prices, such error will be corrected by the Employer in determining the Contract Price.

11.4 Labour Intensive work

Item numbers in the schedule of quantities suffixed by the letter "L" shall denote a payment item in respect of work which is required to be executed by labour intensive construction methods. Item numbers with the suffix "L" are not necessarily an exhaustive list of all the activities which must be done by hand, and this clause does not over-ride any of the requirements in the generic labour intensive specification in the Scope of Works.

Payment for items which are designated to be constructed labour-intensively (either in this schedule or in the Scope of Works) will not be made unless they are constructed using labour-intensive methods. Any unauthorised use of plant to carry out work which was to be done labour-intensively will not be condoned and any works so constructed will not be certified for payment.

12. VARIATION IN TEXT

No alteration, erasure or addition is to be made in the text of the Bill of Quantities. Should any alteration, erasure or addition be made, it will not be recognized; the original wording of the Bill of Quantities will be adhered to.

13. CONTRACT SKILLS DEVELOPMENT GOALS (CSDG)

These pricing assumptions generally apply to Section 1 of the Bill of Quantities.

13.1 BASIC PRINCIPLES

The Contractor is referred to Part C2.1 Pricing Assumptions: Clause 3: General Pricing Assumptions. The contractor shall determine the CSDG expressed in Rand, which shall not be less than the contract amount multiplied by a percentage (%) factor given in Table 2 in the Standard for the applicable class of construction works.

13.2 The contractor's attention is brought to the following:

13.2.1 The Employer shall include a line item under the Skills Development in the Final Tender Summary section described as "Minimum Contract Skills Development Goal (CSDG)" as illustrated in table below:

Table 2: Construction skills development goals for different classes of engineering and construction works contracts.

Class of construction works as identified in terms of the cidb regulation		Construction skills development goal (%)
Designation	Description	
CE	Civil Engineering	0.25
CE and GB	Civil Engineering and General Building	0.375
EB	Electrical Engineering work (buildings)	0.25
EP	Electrical Engineering works (infrastructure)	0.25
GB	General Building	0.5
ME	Mechanical Engineering	0.25
	Specialist works	0.25

13.2.2 To prevent a tender being non-responsive, the Employer shall bring to the Contractor's attention the required CSDG percentage (%) as prescribed in the final tender summary section. The percentage (%) factor multiplied by the sub-total of the tender amount will determine the minimum CSDG that needs to be achieved in the contract.

13.3 Payment to the contractor to accommodate Work Integrated Learners and Candidates for Professional Registration:

13.3.1 The Contractor shall apportion the cost of accommodating work integrated learners (P1 and P2 learners) and candidates for professional registration by using Table 3 in the Standard and this cost will be used to determine the value in Rand and will be added to the provisions for training as provided for in the Preliminary & General section in the Bill of Quantities/ Pricing schedules/ Activity schedule.

13.4 Supervisors and Mentors

13.4.1 Payment to the Contractor for supervision and mentoring Part/ Full occupational qualification and Trade qualification learners:

13.4.1.1 The Employer shall make no provision for an additional payment item for the payment of the supervisor and/ or mentors for the provision of training as provided for in the Preliminary & General section of the Bill of quantities/ Pricing schedules/ Activity schedule for the training of part time/ full time occupational learners and/ or trade qualification learners.

13.4.2 Payment to the contractor for supervision and mentoring Work Integrated Learners and Candidates for professional registration:

13.4.2.1 The Contractor shall apportion the cost of mentoring work integrated learners (P1 and P2 learners) and candidates for professional registration by using Table 3 in the Standard and will form part of the cost as provided for in the Preliminary & General section in the Bill of Quantities for training.

14. INDIRECT TARGETING – ENTERPRISE DEVELOPMENT

14.1 The Employer shall determine the percentage to be paid for the Contract Participation Goal (CPG) on the contract, and this amount shall be stated under the section Enterprise Development as a Provisional Sum in the Preliminaries and Generals (P&Gs).

14.2 The rates illustrated in table 3 are the recommended rates to guide the Employer to determine the amount for Enterprise Development per targeted enterprise. The Employer may adjust these rates which may be affected by factors such as location of the project. The Employer must include this amount as a Provisional Sum in the Preliminary and General (P&G) section as illustrated.

Table 3: The notional cost of providing training opportunities per quarter.

Type of Training Opportunity	Provision for stipends (Unemployed learners only)	Provisions for mentorship	Provisions for additional costs*	Total costs	
				Unemployed learners	Employed learners
Method 1					
Occupational qualification	R7 000	R0	R9 000	R16 000	R9 000
Method 2					
TVET College graduates	R14 000	R0	R9 000	R23 000	N/A
Apprenticeship	R14 000	R0	R12 000	R26 000	R12 000
Method 3					
P1 and P2 learners	R24 000	R20 000	R4 500	R48 500	N/A
Method 4					
Candidates with a 3 year diploma	R37 000	R20 000	R4 500	R61 500	R20 000
Candidates with 4 year qualification	R47 000	R20 000	R4 500	R71 500	R20 000

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C2.2 BILL OF QUANTITIES

NB: According to **Sub-Clause 4.1 [Contractor's General Obligations]** and **Sub-Clause 5.1 [General Design Obligations]**, the Contractor shall be deemed to have full responsibility for the design of the Works, irrespective of any construction drawings or data provided by the Employer. Furthermore, in accordance with **Sub-Clause 14.1 [The Contract Price]**, the lump sum Contract Price is deemed to include all costs for the Contractor's design obligations, including the scrutiny of Employer's Requirements and the rectification of any errors found therein. The Contractor shall not be entitled to additional payment for design refinements necessary to ensure the Works are fit for their intended purpose.

SUMMARY OF SCHEDULES

DESCRIPTION	TOTAL AMOUNTS
PART A: PRELIMINARY AND GENERAL	
SCHEDULE 1: PRELIMINARY AND GENERAL	
SCHEDULE 2: CIDB B.U.I.L.D ALLOWANCES	
PART A - SUB TOTAL AMOUNT Excluding VAT:	
PART B: CIVIL	
SCHEDULE 1: HEAD OF WORKS	
SCHEDULE 2: PRIMARY SETTLING TANKS	
SCHEDULE 3: PRIMARY SLUDGE PUMP STATION	
SCHEDULE 4: BALANCING TANK	
SCHEDULE 5: BIOLOGICAL REACTOR	
SCHEDULE 6: DIVIDING CHAMBER NO 2	
SCHEDULE 7: SECONDARY SETTLING TANKS	
SCHEDULE 8: RAS PUMP STATION	
SCHEDULE 9: SLUDGE DAY TANK	
SCHEDULE 10: THICK SLUDGE TANK	
SCHEDULE 11: FERRIC CHLORIDE BULK TANKS	
SCHEDULE 12: PRECIPITATION TANK	
SCHEDULE 13: SLUDGE DIGESTERS	
SCHEDULE 14: STEEL STAIRCASES AND BRIDGES	
SCHEDULE 15: INTERCONNECTING PIPEWORK	
SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.	
SCHEDULE 17: LANDSCAPING	
SCHEDULE 18: STRUCTURAL JOINTS	
SCHEDULE 19: RETAINING BLOCK WALLS AND PLATFORMS PAVING	
SCHEDULE 20: SITE WORKS - EARTHWORKS AND ROADS	
SCHEDULE 21: PARSHALL FLUMES AND CHANNELS	
SCHEDULE 22: DAYWORKS	
SCHEDULE 23: SLUDGE DRYING BEDS	
SCHEDULE 24: ACCESS ROADS	
SCHEDULE 25: FENCING	
SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE	
SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER	
SCHEDULE 28: SCUM PUMP STATION	
SCHEDULE 29: FIREWATER AND SERVICE WATER PUMP STATION - CIVIL WORKS	
PART B - SUB TOTAL AMOUNT Excluding VAT:	
PART C: MECHANICAL	
SCHEDULE NO 1: CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS	
SCHEDULE NO 2: CONTRACTOR'S ESTABLISHMENT ON SITE	
SCHEDULE NO 3: TESTING AND COMMISSIONING	

SUMMARY OF SCHEDULES

DESCRIPTION	TOTAL AMOUNTS
SCHEDULE NO 4: STRUCTURAL METALWORK	
SCHEDULE NO 5: PIPEWORK	
SCHEDULE NO 6: FLOW CONTROL VALVES AND SLUICE GATES	
SCHEDULE NO 7: DRY WELL PUMPS	
SCHEDULE NO 8: HOISTING EQUIPMENT	
SCHEDULE NO 9: SUBMERSIBLE PUMPING EQUIPMENT	
SCHEDULE NO 10: MECHANICAL FRONT RAKED SCREENS	
SCHEDULE NO 11: MANUALLY CLEANED SCREENS	
SCHEDULE NO 12: SURFACE-MOUNTED MECHANICAL MIXERS AND AERATORS	
SCHEDULE NO 13: BAFFLES, WEIRS AND OTHER SPECIALLY FABRICATED DEVICES	
SCHEDULE NO 14: MECHANICALLY SCRAPED SETTLING TANKS	
SCHEDULE NO 15: CHLORINATION	
SCHEDULE NO 16: MECHANICAL DEGRITTER SYSTEMS	
SCHEDULE NO 17: SCREENINGS HANDLING EQUIPMENT	
SCHEDULE NO 18: DIFFUSED AERATION EQUIPMENT	
SCHEDULE NO 19: LINEAR SCREENS AND BELT FILTER PRESSES	
SCHEDULE NO 20: ANAEROBIC DIGESTERS	
SCHEDULE NO 21: CHEMICAL DOSING PLANT	
SCHEDULE NO 22: DEWATERED SLUDGE HANDLING	
SCHEDULE NO 23: FIRE WATER PUMP STATION	
SCHEDULE NO 24: PARSHALL FLUMES	
SCHEDULE NO 25: OPERATIONS AND MAINTENANCE	
PART C - SUB TOTAL AMOUNT Excluding VAT:	
PART D: ELECTRICAL, CONTROL AND INSTRUMENTATION	
SCHEDULE 1: PRELIMINARY AND GENERAL	
SCHEDULE 2: ELECTRICAL, CONTROL AND INSTRUMENTATION	
PART D - SUB TOTAL AMOUNT Excluding VAT:	
PART E: BUILDING WORKS	
SCHEDULE 1: BUILDING WORKS	
PART E - SUB TOTAL AMOUNT Excluding VAT:	
SUB TOTAL (1) ADDING PART A, PART B, PART C, PART D & PART E Excluding VAT:	
ALLOW FOR CONTINGENCIES AMOUNT [10.00% MULTIPLIED BY SUB TOTAL (1)]:	
ALLOW FOR CONTRACT PRICE ADJUSTMENT (CPA) [12.00% MULTIPLIED BY SUB TOTAL (1)]:	
CIDB CONTRACT SKILLS DEVELOPMENT GOALS (CSDG) [0.25% FACTOR MULTIPLIED BY SUB TOTAL (1)]:	
ALLOW FOR CIDB BUILD FEES [0.20% FACTOR MULTIPLIED BY SUB TOTAL (1)]:	
SUB TOTAL (1) Excluding VAT:	
ADD VALUE ADDED TAX (VAT) (15%):	
TOTAL TENDER AMOUNT Including VAT (SUM TAKEN FORWARD TO FORM C1 OF THE TENDER):	

SCHEDULE 1: PRELIMINARY AND GENERAL

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
A1		PRELIMINARY AND GENERAL				
	SANS 1200A 8.3 (as amended)	FIXED-CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
A1.001	8.3.1	Contractual Requirements	Sum	1.00		
	8.3.2	Establishment of Facilities on the Site				
	8.3.2.1	Facilities for Engineer (see SANS 1200 AB)				
A1.002	8.3.2.1 a)	Furnished offices (See Clause 3.2 of SANS 1200 AB, as amended in the Particular Specification)	Sum	1.00		
A1.003	8.3.2.1 b)	Telephone (See Clause 4.1 of SANS 1200 AB, as amended in the Particular Specification)	Sum	1.00		
A1.004	8.3.2.1 c)	Nameboards (2 No.) (See Clause 3.1 of SANS 1200 AB, as amended in the Particular Specification)	Sum	1.00		
	8.3.2.2	Facilities for Contractor				
A1.005	8.3.2.2 a)	Offices and storage sheds	Sum	1.00		
A1.006	8.3.2.2 b)	Workshops	Sum	1.00		
A1.007	8.3.2.2 c)	Laboratories	Sum	1.00		
A1.008	8.3.2.2 d)	Living accommodation	Sum	1.00		
A1.009	8.3.2.2 e)	Ablution and latrine facilities	Sum	1.00		
A1.010	8.3.2.2 f)	Tools and equipment	Sum	1.00		
A1.011	8.3.2.2 g)	Water supplies, electric power and communications	Sum	1.00		
A1.012	8.3.2.2 h)	Dealing with water (see SANS 1200 A Subclause 5.5)	Sum	1.00		
A1.013	8.3.2.2 i)	Access (See SANS 1200 A Subclause 5.8)	Sum	1.00		
	PS 8.3.3	Other Fixed-charge Obligations				
A1.014	PS 8.3.3 a)	Health & Safety Obligations	Sum	1.00		
A1.015	PS 8.3.3 b)	Environmental Obligations	Sum	1.00		
A1.016	PS 8.3.3 c)	EPWP Obligations and Labour-intensive Requirements	Sum	1.00		
A1.017	PS 8.3.3 d)	Safety PPE for EPWP Workers	Sum	1.00		
A1.018	PS 8.3.3 e)	All Other Fixed-charge Obligations	Sum	1.00		
A1.019	8.3.4	Removal of Site Establishment	Sum	1.00		
	SANS 1200A 8.4 (as amended)	TIME-RELATED ITEMS (FOR DURATION OF CONSTRUCTION PERIOD)				
A1.020	8.4.1	Contractual Requirements	Month	24.00		
Total Carried Forward						

SCHEDULE 1: PRELIMINARY AND GENERAL

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.4.2	Operation and Maintenance of Facilities on Site				
	8.4.2.1	Facilities for Engineer				
A1.021	8.4.2.1 a)	Furnished offices (See Clauses 3.2 and 5.2 of SANS 1200 AB, as amended in the Particular Specification)	Month	24.00		
A1.022	8.4.2.1 b)	Telephone (See Clauses 4.1 and 5.4 of SANS 1200 AB, as amended in the Particular Specification)	Month	24.00		
A1.023	8.4.2.1 c)	Nameboards (2 No.) (See Clauses 3.1 and 5.1 of SANS 1200 AB, as amended in the Particular Specification)	Month	24.00		
A1.024	PS 8.4.2.1 d)	Survey Assistants	Month	24.00		
A1.025	PS 8.4.2.1 e)	Survey Equipment (See Clause 4.2 of SANS 1200 AB in the Particular Specification)	Month	24.00		
	8.4.2.2	Facilities for Contractor				
A1.026	8.4.2.2 a)	Offices and storage sheds	Month	24.00		
A1.027	8.4.2.2 b)	Workshops	Month	24.00		
A1.028	8.4.2.2 c)	Laboratories	Month	24.00		
A1.029	8.4.2.2 d)	Living accommodation	Month	24.00		
A1.030	8.4.2.2 e)	Ablution and latrine facilities	Month	24.00		
A1.031	8.4.2.2 f)	Tools and equipment	Month	24.00		
A1.032	8.4.2.2 g)	Water supplies, electric power and communications	Month	24.00		
A1.033	8.4.2.2 h)	Dealing with water (see SANS 1200 A Subclause 5.5)	Month	24.00		
A1.034	8.4.2.2 i)	Access (See SANS 1200 A Subclause 5.8)	Month	24.00		
A1.035	8.4.3	Supervision for Duration of Construction	Month	24.00		
A1.036	8.4.4	Company and Head Office Overhead Costs for the Duration of Construction	Month	24.00		
	PS 8.4.5	Other Time-related Obligations				
A1.037	PS 8.4.5 a)	Health and Safety Obligations	Month	24.00		
A1.038	PS 8.4.5 b)	Security Services Costs	Month	24.00		
A1.039	PS 8.4.5 c)	Environmental Obligations	Month	24.00		
A1.040	PS 8.4.5 d)	EPWP Obligations and Labour-intensive Requirements	Month	24.00		
A1.041	PS 8.4.5 e)	Safety PPE for EPWP Workers	Month	24.00		
A1.042	PS8.4.5 f)	All Other Time-related Obligations	Month	24.00		
Total Carried Forward						

SCHEDULE 1: PRELIMINARY AND GENERAL

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	C3.3.6 Clause 10.1	FIXED-CHARGE AND VALUE-RELATED ITEMS (RELATED TO COMMISSIONING PERIOD AND DEFECTS NOTIFICATION PERIOD; EXCL MECHANICAL AND ELECTRICAL SUBCONTRACTOR/S)				
A1.043	10.1.1	Commissioning Period	Sum	1.00		
A1.044	10.1.2	Defects Notification Period	Sum	1.00		
A1.045	10.1.3	As Built Records	Sum	1.00		
A1.043	10.1.4	Operation and Maintenance Manuals	Sum	1.00		
A1.046	10.1.5	Training of Employer's Personnel	Sum	1.00		
	C3.3.6 Clause 10.2	TIME-RELATED ITEMS (RELATED TO COMMISSIONING PERIOD AND DEFECTS NOTIFICATION PERIOD; EXCL MECHANICAL AND ELECTRICAL SUBCONTRACTOR/S)				
A1.043	10.2.1	Commissioning Period	Sum	1.00		
A1.047	10.2.2	Defects Notification Period	Sum	1.00		
	SANS 1200A PS 8.5	SUMS STATED PROVISIONALLY BY ENGINEER				
A1.048		Community liaison officer salary (R4,500/month)	Prov Sum	1.00	108,000.00	108,000.00
A1.049		Overheads, charges and profit on Community liaison officer salary	%	108,000.00		
A1.050		Community liaison officer cellular costs (R500/month p/m)	Prov Sum	1.00	12,000.00	12,000.00
A1.051		Overheads, charges and profit on Community liaison officer cellular costs	%	12,000.00		
A1.052		Accredited training for EPWP workers in terms of SED Particular Specification C3.3.7.3 Clause 2.5.	Prov Sum	1.00	565,000.00	565,000.00
A1.053		Overheads, charges and profit on formal training for EPWP workers	%	565,000.00		
A1.054		PSC Meetings (R140 per member per sitting for minimum 6 - max 10 members per sitting for a maximum of 36 Sittings)	Prov Sum	1.00	33,600.00	33,600.00
A1.055		Overheads, charges and profit on PSC Meetings	%	33,600.00		
A1.056		Engineer's Residential Accommodation	Prov Sum	1.00	2,520,000.00	2,520,000.00
A1.057		Overheads, charges and profit on Engineer's Residential Accommodation during the Construction Period	%	2,520,000.00		
A1.058		Transportation of Local Labourers from Surrounding Settlements Daily to Site for 24 months	Prov Sum	1.00	6,480,000.00	6,480,000.00
A1.059		Overheads, charges and profit on Local Labourers Transport Costs	%	6,480,000.00		
Total Carried Forward						

SCHEDULE 1: PRELIMINARY AND GENERAL

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
A1.060		Relocation of Existing Services	Prov Sum	1.00	2,260,000.00	2,260,000.00
A1.061		Overheads, charges and profit on Relocation of Existing Services	%	2,260,000.00		
A1.062		DAAB Members (Employer contribution)	Prov Sum	1.00	1,808,000.00	1,808,000.00
A1.063		Overheads, charges and profit on DAAB Members (Employer contribution)	%	1,808,000.00		
A1.064		Additional Landscaping and Environmental Rehabilitation	Prov Sum	1.00	1,695,000.00	1,695,000.00
A1.065		Overheads, charges and profit on Additional Landscaping and Environmental Rehabilitation	%	1,695,000.00		
A1.060		Connections of the Outfall Sewers at all ends (upstream and downstream)	Prov Sum	1.00	1,204,000.00	1,204,000.00
A1.066		Overheads, charges and profit on Connections of the Outfall Sewers at all ends	%	1,204,000.00		
A1.067		Final surfacing of the access road post-construction	Prov. Sum	1.00	1,695,000.00	1,695,000.00
A1.068		Overheads, charges and profit on final surfacing of the access road post-construction	%	1,695,000.00		
A1.069		Odour control for the duration of the works	Prov. Sum	1.00	4,520,000.00	4,520,000.00
A1.070		Overheads, charges and profit on Odour control for the duration of the works	%	4,520,000.00		
	SANS 1200A 8.8 (as amended)	TEMPORARY WORKS				
A1.071	8.8.2	Dealing with Traffic	Sum	1.00		
A1.072	8.8.3	Protection of Eskom overhead power lines until Construction in Vicinity is Complete	Sum	1.00		
	PS 8.8.4	Existing services				
A1.073	PS 8.8.4 a)	Establishment of specialist equipment	No.	2.00		
A1.074	PS 8.8.4 b)	Use of specialist equipment	Days	5.00		
A1.075	PS 8.8.4 c)	Excavation by hand in soft material to expose existing services	m ³	50.00		
	8.8.5	Cost of Survey in Terms of the Land Survey Act				
A1.076	8.8.5 a)	a) Search for and record trigonometrical survey beacons, bench marks and plot boundary pegs, and expose on completion of Works	Sum	1.00		
A1.077	8.8.5 b)	b) Protect beacons, etc., located under a) and reposition or re-establish, as instructed, by a Registered Land Surveyor on completion of the Works	Sum	1.00		
Total Carried Forward To Summary						

SCHEDULE 2: CIDB B.U.I.L.D ALLOWANCES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
A2	Pricing Assumptions paragraph 15.1	CIDB B.U.I.L. D				
		(a) Enterprise Development of Targeted Enterprise or JV partners				
A2.001		(a.1) Needs Analysis and Enterprise Development Plan per Targeted Enterprise	Item	1.00		
A2.002		(a.2) Monitoring and Interim Reporting per Targeted Enterprise	Per Quarter	10.00		
		(a.3) Project Completion Report per Targeted Enterprise				
A2.003		Contract Participation Goal (CPG) in relation to Subcontracting / Supplier Development of Targeted Enterprises as a Condition of Tender to be In Accordance With Indirect Targeting for Enterprise Development though Construction Works Contracts, Gazette Notice No.36190 of 25 February 2013 It is required that the contractor shall achieve a CPG of 30% (by value) via sub-contracting. The value is determined as the contract value (Excluding VAT, Escalation, Contingencies) of the contract including labour and material to EME's and QSE's. This amount is to include all costs associated with the management of all subcontractors associated with the Contract Participation Goal (CPG)	Item	1.00		
		Tender Process for Targeted Enterprises				
		Contractor's charge for the management and execution of the Targeted Enterprises procurement process:				
A2.004		Procurement process for the totality of all tenders concluded for the appointment of Targeted Enterprise sub contractors of cidb 1 & cidb 2 contractor grading	No.	15.00		
A2.005		Procurement process for the totality of all tenders concluded for the appointment of Targeted Enterprise sub contractors of cidb 3 & cidb 4 contractor grading	No.	10.00		
A2.006		Procurement process for the totality of all tenders concluded for the appointment of Targeted Enterprise sub contractors of cidb 5 and higher contractor grading	No.	5.00		
		Responsibilities of the Contractor towards Targeted Enterprises				
A2.007		Contractor's establishment, management, management support, assistance, coaching, guidance, mentoring and supervision of Targeted Enterprises	Month	24.00		
A2.008		Targeted Enterprise Construction Manager	Person.Mon th	24.00		
A2.009		Targeted Enterprise Site Supervisors	Person.Mon th	24.00		
	Construction works by Targeted Enterprises					
A2.010	Payment associated with the construction works executed by Targeted Enterprise sub contractors of cidb 1 and cidb 2 contractor grading designation appointed in terms of section 1.3 above	PC Sum	1.00	15,000,000.00	15,000,000.00	
A2.011	Handling costs and profit in respect of payment associated with sub item 1.4.1	Percentage (%)	15,000,000.00			
A2.012	Fluctuation between the main contractor's rates and that of the Targeted Enterprise sub contractors	Lump sum	1.00			
A2.013	Preliminaries and General Obligations of Targeted Enterprise sub contractors appointed in terms of 1.3 above	Lump sum	1.00			
Total Carried Forward						

SCHEDULE 2: CIDB B.U.I.L.D ALLOWANCES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Training, Coaching, Guidance, Mentoring and Assistance				
		<i>Accredited occupational qualification training</i>				
A2.014		Stipend/wages for unemployed learners (2 Students per year)	PC Sum	1.00	806,400.00	806,400.00
A2.015		Handling costs and profit in respect of payment associated with sub item A2.014	Percentage (%)	806,400.00		
A2.016		Mentorship and other costs	Person.Mon th	48.00		
		TVET College Graduates and Apprenticeships				
A2.017		Stipend/ wages for unemployed graduates and apprenticeships (2 Students per year)	PC Sum	1.00	806,400.00	806,400.00
A2.018		Handling costs and profit in respect of payment associated with sub item A2.017	Percentage (%)	806,400.00		
A2.019		Mentorship and other costs	Person.Mon th	48.00		
		P1 & P2 Learners and Learners with a 240 Credits Qualification				
A2.020		Stipend/wages for P1 & P2 unemployed learners (2 Students per year)	PC Sum	1.00	1,142,400.00	1,142,400.00
A2.021		Handling costs and profit in respect of payment associated with sub item A2.020	Percentage (%)	1,142,400.00		
A2.022		Mentorship and other costs	Person.Mon th	48.00		
A2.023		Travel and Accommodation	PC Sum	1.00	384,000.00	384,000.00
A2.024		Handling costs and profit in respect of payment associated with sub item A2.023	Percentage (%)	384,000.00		
		Candidates with 360 Credits or More Qualification				
A2.025		Stipend/wages for 360 credits qualification unemployed learners (2 Students per year)	PC Sum	1.00	1,276,800.00	1,276,800.00
A2.026		Handling costs and profit in respect of payment associated with sub item A2.026	Percentage (%)	1,276,800.00		
A2.027		Mentorship and other costs	Person.Mon th	48.00		
A2.028		Travel and Accommodation	PC Sum	1.00	384,000.00	384,000.00
A2.029		Handling costs and profit in respect of payment associated with sub item A2.028	Percentage (%)	384,000.00		
		Generic Skill Training				
A2.030		Stipend/wages for unemployed learners/workers (2 Persons per year)	PC Sum	1.00	604,800.00	604,800.00
A2.031		Handling costs and profit in respect of payment associated with sub item A2.030	Percentage (%)	604,800.00		
A2.032		Mentorship and other costs	Person.Mon th	48.00		
		Community Training				
A2.033		Stipend/ wages for unemployed learners / workers (2 Persons per year)	PC Sum	1.00	604,800.00	604,800.00
A2.034		Handling costs and profit in respect of payment associated with sub item A2.033	Percentage (%)	604,800.00		
A2.035		Mentorship and other costs	Person.Mon th	48.00		
Total Carried Forward To Summary						

SCHEDULE 1: HEAD OF WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B1	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough:				
		Vertical formwork to:				
B1.001		Sides of walls	m ²	400.00		
		Vertical curved formwork to:				
B1.002		Sides of walls	m ²	35.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B1.003		Sides of walls	m ²	1,867.00		
		Vertical curved formwork :				
B1.004		Sides of walls	m ²	184.00		
		Horizontal formwork :				
B1.005		Soffits of bridges or walkways propped up not exceeding 5 m high	m ²	680.00		
		Conical formwork :				
B1.006		Top of degritter floors (if required as back shuttering)	m ²	4.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B1.007		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	860.00		
B1.004		Curved floor slab edges	m	32.00		
	8.2.5	Box out holes/form voids				
		a) small, circular, of dia. up to and including 0.35m				
		1) over 0.0m up to 0.5m deep				
B1.006		Ø150mm Through 250mm floor	No.	2.00		
B1.006		Ø400mm Through 300mm wall	No.	3.00		
		4) over 1.0m up to 2.0m				
B1.007		Ø1600mm Through 300mm wall	No.	3.00		
		b) Small, other than circular, of area up to and including 0.1m²				
B1.008		120mmx80mm wall recess for channel gate	No.	35.00		
B1.008		80mmx1500mm wall recess for mechanical screen	No.	6.00		
		c) Large, other than circular, of area over 0.1m² up to an including 0.5m²				
B1.008		200mmx900mm Through 300mm wall	No.	1.00		
Total Carried Forward						

SCHEDULE 1: HEAD OF WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Mild steel bars				
B1.009		a) 8 mm	t	10.00		
	8.3.1	High-tensile steel bars				
B1.010		a) 8 mm	t	5.00		
B1.011		b) 10 mm	t	10.00		
B1.012		c) 12 mm	t	10.00		
B1.013		d) 16 mm	t	40.00		
B1.014		e) 20 mm	t	25.00		
	8.3.2	High-tensile welded mesh reinforcement				
B1.015		Type reference 888 in aprons etc	m ²	1,262.00		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Mass concrete: 20 MPa/20mm				
B1.016		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	26.00		
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B1.017		75 mm minimum thickness	m ²	804.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B1.018		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B1.019		Floors, footings, walls, slabs etc	m ³	1,011.00		
	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures				
B1.020		Floors, footings, walls, slabs etc	m ³	-		Rate Only
	8.4.4	UNFORMED SURFACE FINISHES				
		Wood-floated finish				
B1.021		Top of floors, walls, slabs, etc.	m ²	1,171.00		
		Steel-floated finish				
B1.022		Top of floors, walls, slabs, etc.	m ²	1,497.00		
Total Carried Forward						

SCHEDULE 1: HEAD OF WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.7	GROUTING				
		Proprietary shrinkage compensate grout with minimum 50 MPa compression:				
B1.023		a) 20 mm Thick non-shrink grouting under base plates	m ²	7.00		
B1.024		b) HD bolts, etc (Filling pockets around HD bolts)	No.	54.00		
B1.025		c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	3.00		
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK:				
B1.026		Ø50mm x 300 mm long uPVC sleeves cast-in specific pattern into dished slabs at screens	No.	15.00		
B1.027		Form and finish 200X200 wall chamfering	m	20.00		
B1.028		Pre-cast concrete bollards	No.	25.00		
B1.029		Breakout of Filled Voids	No.	3.00		
B1.030	PSG 8.10	Testing for watertightness:	Sum	1.00		
	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete:				
		Over 300mm and up to 400mm nominal bore:				
B1.031		Through 300 mm thick wall	No.	3.00		
		Over 600mm and up to 800mm nominal bore:				
B1.032		Through 250 mm thick wall	No.	2.00		
		Over 1000mm and up to 1200mm nominal bore:				
B1.033		Through 250 mm thick wall	No.	3.00		
		Over 1400mm and up to 1600mm nominal bore:				
B1.034		Through 300 mm thick wall	No.	1.00		
B1.035	PSG 8.13	SOILCRETE				
		Soilcrete filling under and around structures	m ³	0.75		
	SANS 1200H	STRUCTURAL STEELWORK				
	8.3.7	Handrails:				
		c) Handrails, HDG, 1 m high standard ball type, top or side mounted:				
		Rails only (hand and knee rails):				
B1.036		Horizontal	m	139.00		
B1.037		Stanchions only	No.	97.00		
		Bends, end closures and accessories:				
B1.038		90 deg bends or corners	No.	46.00		
B1.039		90 deg end closure	No.	25.00		
B1.040		HD bolts, nuts and washers for each stanchion	Sets	97.00		
Total Carried Forward						

SCHEDULE 1: HEAD OF WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B1.041	PSH 8.3.9	Flooring, complete and installed with frames: b) Floorplate floors: Solid FGR/GRP panels capable of 2.0kN/m ² loading SANS 558 type 14b grey iron manhole cover and frame 450mmx450mm SANS 1115 stormwater grating and frame	m ² No. No.	99.00 5.00 1.00		
B1.044		c) Frames and kerbs for flooring: GRF angle section fixed to or cast into concrete: 50 x 50 x 5 mm	m	237.00		
	SANS 1200LE	STORMWATER				
B1.045	8.2.9	Brickwork (14 MPa solid clay bricks) 230 mm thick	m ²	17.00		
B1.046		Waterproofing. ABE flintcoat 3 or similar approved	m ²	33.00		
B1.047	8.2.10	Accessories 32 mm x 3,5 mm thick x 400 mm long galvanized hoop iron wall anchors, shot fixed to concrete and build into brickwork joints	No.	40.00		
	SANS 1200DB	EARTHWORKS (PIPE TRENCHES)				
B1.048	8.3.1	Site Clearance c) Removal of top soil	m ²	30.00		
B1.049	8.3.2	Excavations a) excavate in all materials for trenches, backfill, compact and dispose of surplus material Exceeding 3.0m up to 4.0m	m ³	110.00		
B1.050		b) Extra-over item (8.3.1) above for: 2) Hard rock excavations	m ³	110.00		
B1.051	8.3.3 8.3.3.1	Excavation Ancillaries Make up deficiency in backfill material c) imported from commercial sources (G5 material classification)	m ³	55.00		
	SANS 1200LB	BEDDING (PIPES)				
B1.052	8.2.1	Provision of bedding from trench excavation a) Selected granular material	m ³	55.00		
B1.053		b) Selected fill material	m ³	110.00		
Total Carried Forward						

SCHEDULE 1: HEAD OF WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.2	Supply only of bedding by importation				
		a) From other necessary excavations or existing stock piles on site				
B1.054		1) Selected granular material	m ³	50.00		
B1.055		2) Selected fill blanket	m ³	50.00		
		c) From commercial sources				
B1.056		1) Selected granular material	m ³	50.00		
B1.057		2) Selected fill material	m ³	50.00		
	SANS 1200LD	SEWERS				
	8.2.1	Supply, lay Joint bed (Class 100D with spigot and socket SANS 677), and test pipeline				
B1.058		Ø1500mm nominal dia. R.C. pipe HDPE with lining	m	15.00		
	8.2.1	Supply, lay Joint bed (Class 100D), and test pipeline				
B1.059		Ø700mm nominal dia. Corrugated HDPE pipe	m	10.00		
B1.060		Ø300mm nominal dia. Corrugated HDPE pipe	m	30.00		
	8.2.2	Extra over item 8.2.1 for specials:				
		Rocker pipes (1.22m in length) of the following diameter:				
B1.061		Ø1500mm nominal dia. R.C. pipe HDPE with lining	No.	1.00		
B1.062		Ø1050mm nominal dia. R.C. pipe HDPE with lining	No.	1.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 2: PRIMARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B2	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough:				
		Vertical curved formwork to:				
B2.001		Sides of walls	m ²	33.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B2.002		Sides of walls	m ²	162.00		
B2.003		Sides of columns in top of centre column inlet structure (250 x 250 mm columns with two sides curved)	m ²	13.00		
		Vertical curved formwork :				
B2.004		Sides of sump perimeter walls	m ²	63.00		
B2.005		Sides of tank perimeter walls	m ²	1,591.00		
B2.006		Sides of launder channel walls	m ²	192.00		
		Horizontal formwork :				
B2.007		Soffits of launder channel floor propped up not exceeding 5.0 m high, curved on plan	m ²	142.00		
		Conical formwork:				
B2.008		Sides or surfaces to form circular conical shaped channel in tank bottom	m ²	97.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B2.009		Curved edge to No Fines concrete	m	203.00		
B2.010		Curved launder channel floor edge	m	602.00		
B2.011		Curved sides of centre column top	m	19.00		
B2.012		Curved sides of apron	m	710.00		
B2.013		Curved sides of Floors	m	848.00		
	8.2.5	Box out holes/form voids				
		a) small, circular, of dia. up to and including 0.35m				
		1) over 0.0m up to 0.5m deep				
B2.014		Ø150mm Through 300mm wall	No.	2.00		
B2.015		Ø150mm Through 300mm wall	No.	2.00		
		2) over 0.5m up to 1.0m				
B2.016		Ø500mm Through 450mm floor	No.	2.00		
B2.017		Ø600mm Through 300mm wall	No.	2.00		
Total Carried Forward						

SCHEDULE 2: PRIMARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B2.018		b) Small, other than circular, of area up to and including 0.1m ² 1000mmx500mm through 150mm floor	No.	2.00		
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Mild steel bars				
B2.019		a) 8 mm	t	3.85		
	8.3.1	High-tensile steel bars				
B2.020		a) 8 mm	t	3.85		
B2.021		b) 10 mm	t	7.69		
B2.022		c) 12 mm	t	3.85		
B2.023		d) 16 mm	t	13.45		
B2.024		e) 20 mm	t	9.61		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Mass concrete: 15 MPa/20mm				
B2.025		Encasing around pipes	m ³	99.00		
	8.4.1	Mass concrete: 20 MPa/20mm				
B2.026		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	8.00		
B2.027		Screed to launder channel average 75 mm thickness including steel float finish to top	m ²	3.00		
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B2.028		75 mm minimum thickness	m ²	43.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B2.029		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B2.030		Floors, footings, walls, slabs, etc.	m ³	667.00		
Total Carried Forward						

SCHEDULE 2: PRIMARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		UNFORMED SURFACE FINISHES				
		Wood-floated finish				
B2.031		Apron Slab	m ²	344.00		
B2.032		Top of launder channel floors	m ²	123.00		
		Steel-floated finish				
B2.033		Top of walls	m ²	52.00		
B2.034		Top of floors	m ²	1,106.00		
		Special surface finish				
B2.035	PSG 8.4.4	Extra-over steel-floated finish to top of walls for special finishing tolerances measured by lazer to top of outside ringwalls as specified	m ²	52.00		
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK:				
		Electrical service duct pipes cast into concrete or soilcrete:				
B2.036		63 mm Diameter HDPE class 6 continuous sleeve pipe cast into concrete under tank floor and into centre column structure	m	194.00		
B2.037		Extra-over 63 mm diameter HDPE sleeve for butt welded bends	No.	10.00		
		Groundwater pressure-relief valves cast into concrete floors:				
B2.038		110 mm diameter (ID) x 125mm long GREG ENGINEERING type S or equal approved cast iron groundwater pressure-relief valve cast into concrete floor, including minimum 150mm long x 110mm diameter uPVC sleeve with non-woven type AG300 or equal approved geotextile wrapping around bottom, complete as shown on the drawings	No.	48.00		
B2.039	PSG 8.10	Testing for watertightness:	Sum	1.00		
	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete:				
		a) Up to 300 mm nominal bore:				
B2.040		Through 300 mm thick wall	No.	4.00		
		b) Over 300 mm up to 600 mm nominal bore:				
B2.041		Through 300 mm thick wall	No.	2.00		
B2.042		Through 450 mm high tank bottom	No.	2.00		
B2.043		In 5 700 mm high centre column structure	No.	2.00		
	PSG 8.12	NO FINES CONCRETE				
		100 mm NF 19 layer including unformed surface finishes:				
B2.044		Under sloping floors and perimeter footing of tank	m ³	108.00		
		Dry mortar layer:				
B2.045		Extra-over NF layer for 10 mm dry mortar layer to top of NF concrete	m ³	11.00		
Total Carried Forward						

SCHEDULE 2: PRIMARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B2.046	PSG 8.13	SOILCRETE Soilcrete filling under and around structures	m ³	3.00		
	SANS 1200DK	GABIONS AND PITCHING				
B2.047	8.2.4	Geotextile (Bidim U14) a) Below NF concrete under floors	m ²	1,054.00		
	SANS 1200L	MEDIUM PRESSURE PIPELINES				
	8.2	SCHEDULED ITEMS				
	8.2.5	Supply, lay and bed pipes complete with welded joints: a) 304L Stainless steel pipe				
B2.048		Ø150mm Sch5S-304L S.S pipe segment 1 604mm long flanged one end and welded the other.	No.	2.00		
B2.049		Ø150mm Sch5S-304L S.S pipe segment 9 114mm welded both ends.	No.	2.00		
B2.050		Ø150mm Sch5S-304L S.S pipe segment 1 034mm long plain one end, one end welded and with a P.F 600mm from plain end.	No.	2.00		
B2.051		Ø500mm Sch10-304L S.S pipe segment 1 921mm welded both ends.	No.	2.00		
B2.052		Ø500mm Sch10-304L S.S pipe segment 9 913mm welded both ends.	No.	2.00		
B2.053		Ø500mm Sch10-304L S.S pipe segment 6 450mm long plain one end and welded the other.	No.	2.00		
B2.054		Ø500mm Sch10-304L S.S pipe segment 1 194mm long flanged one end and welded the other. c) SANS 719 Grade C, Fusion Bonded Epoxy (FBE) coated and lined, steel flanged pipes, valves and specials, drilled to SANS 1123 Table 1600/3 : Ø600mm mild steel pipe segment 13 871mm long plain both ends, with a P.F 175mm from plain end.	No.	2.00		
	8.2.6	Extra-over item 8.2.5 for supplying and installing joints with machined collar and steel specials couplings: Bends over 11.25 degree up to 22.5 degree:				
B2.056		Ø150mm 12.0° Sch5S-304L S.S welded bends	No.	4.00		
B2.057		Ø500mm 15.5° Sch10-304L S.S welded bends	No.	4.00		
		90° bends:				
B2.058		Ø500mm 90° Sch10-304L S.S welded bends	No.	2.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 3: PRIMARY SLUDGE PUMP STATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B3	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
B3.001	8.2.5	Narrow widths up to 300 mm wide or high: Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	44.00		
B3.002	8.2.6	Box out holes/form voids a) small, circular, of dia. up to and including 0.35m 1) over 0.0m up to 0.5m deep Ø100mm Through 200mm floor	No.	3.00		
B3.003		Ø150mm Through 200mm floor	No.	5.00		
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
B3.004	8.3.2	High-tensile welded mesh reinforcement Type reference 888 in ground slab	m ²	110.00		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
B3.005	8.4.1	Mass concrete: 20 MPa/20mm Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	22.00		
B3.006	8.4.2	Blinding layer in 15 MPa/20mm concrete 75 mm minimum thickness	m ²	110.00		
	8.4.4	UNFORMED SURFACE FINISHES				
B3.007		Steel-floated finish Top of slabs, floors, sump floors, plinths etc.	m ²	110.00		
B3.008	8.7	GROUTING Proprietary shrinkage compensate grout with minimum 50 MPa compression: c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	0.50		
B3.009	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Up to 200 mm nominal bore: Through 200mm floor	No.	7.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 4: BALANCING TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B4	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough:				
		Vertical formwork to:				
B4.001		Sides of walls (external under channels and chambers)	m ²	10.00		
B4.002		Sides of walls	m ²	25.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B4.003		Sides of walls	m ²	515.00		
B4.004		Sides of chamber walls	m ²	160.00		
B4.005		Sides of columns	m ²	213.00		
		Horizontal formwork :				
B4.006		Soffits of bridges or walkways propped up not exceeding 5 m high	m ²	347.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B4.007		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	201.00		
B4.008		Edge to No Fines concrete	m	344.00		
	8.2.5	Grooves, chases and splays:				
B4.009		150 mm x 150 mm deep cable recess in top of floors or bridges	m	231.00		
	8.2.6	Box out holes/form voids				
		Small, circular up to 0,35m diameter, depths over 0.0m and up to 0.5m:				
B4.010		300 mm diameter through 350 mm thick slabs for mechanical equipment	No.	4.00		
		Small, other than circular up to 0,1m² in area, depths over 0.0m and up to 0,5m:				
B4.011		Up to 150 x 150 x 150 mm deep pockets in top of floors or slabs (various shapes)	No.	21.00		
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Mild steel bars				
B4.012		a) 8 mm	t	5.00		
	8.3.1	High-tensile steel bars				
B4.013		a) 8 mm	t	8.00		
B4.014		b) 10 mm	t	15.00		
B4.015		c) 12 mm	t	29.00		
Total Carried Forward						

SCHEDULE 4: BALANCING TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B4.016		d) 16 mm	t	44.00		
B4.017		e) 20 mm	t	22.00		
B4.018		f) 32 mm	t	15.00		
B4.019		g) 40 mm	t	15.00		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Mass concrete: 20 MPa/20mm				
B4.020		Encasing around pipes	m ³	28.00		
B4.021		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	7.00		
	8.4.2	Blinding layer in 15 MPa/20mm concrete				
B4.022		75 mm minimum thickness	m ²	33.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B4.023		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B4.024		Footings under walls including wall kickers	m ³	47.00		
B4.025		Walls	m ³	250.00		
B4.026		Sloping floor slabs including wall kickers	m ³	473.00		
B4.027		Raking floor slabs including wall kickers	m ³	75.00		
B4.028		Column bases	m ³	25.00		
B4.029		Columns	m ³	19.00		
B4.030		Bridges and walkways	m ³	65.00		
B4.031		Stairs and landings	m ³	15.00		
	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures				
B4.032		Floors, footings, walls, slabs etc	m ³	-		Rate Only
	8.4.4	UNFORMED SURFACE FINISHES				
		Wood-floated finish				
B4.033		Top of chamber floors	m ²	119.00		
B4.034		Top of stairs and landings including brushed finish	m ²	7.00		
		Steel-floated finish				
B4.035		Top of walls	m ²	69.00		
B4.036		Top of wall footings	m ²	153.00		
B4.037		Top of column bases (above floor slab level)	m ²	120.00		
B4.038		Top of platforms and bridges or walkways	m ²	228.00		
Total Carried Forward						

SCHEDULE 4: BALANCING TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT	
Total Brought Forward							
B4.039	PSG 8.4.5	Power-floated finish Top of sloping floors	m²	1,562.00			
B4.040		Extra-over items 8.4.2 and 8.4.3 for aggregate of dolomitic origin in concrete mixes Coarse aggregate: 15 MPa 20 MPa 45 MPa No Fines concrete	m³	3.00			
B4.041			m³	34.00			
B4.042			m³	966.00			
B4.043			m³	191.00			
B4.044			Fine aggregate: 15 MPa 20 MPa 45 MPa	m³	3.00		
B4.045				m³	34.00		
B4.046		m³		966.00			
B4.047		PSG 8.10	Testing for watertightness:	Sum	1.00		
B4.048		PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Over 600 mm and up to 800 mm nominal bore: Through 300 mm thick wall	No.	7.00		
B4.049	PSG 8.12	NO FINES CONCRETE 100 mm NF 19 layer including unformed surface finishes: Under wall footings of tank	m³	16.00			
B4.050		Under slightly sloping floors of tank	m³	157.00			
B4.051		Under raking floors of tank	m³	19.00			
B4.052		Dry mortar layer: Extra-over NF layer for 10 mm dry mortar layer to top of NF concrete	m²	1,899.00			
B4.053		SOILCRETE Soilcrete filling under and around structures	m³	52.00			
B4.054		SANS 1200DK 8.2.4 SANS 1200H	GABIONS AND PITCHING				
	Geotextile (Bidim U14) a) Below NF concrete under floors		m²	1,899.00			
	STRUCTURAL STEELWORK						
Total Carried Forward							

SCHEDULE 4: BALANCING TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.3.6	Holding down (HD) bolts: c) Handrails, HDG, 1 m high standard ball type, top or side mounted: Rails only (hand and knee rails):				
B4.055		Horizontal	m	327.00		
B4.056		Stanchions only	No.	171.00		
		Bends, end closures and accessories:				
B4.057		90 deg bends or corners	No.	115.00		
B4.058		90 deg end closure	No.	9.00		
B4.059		135 deg end closure	No.	9.00		
B4.060		HD bolts, nuts and washers for each stanchion	Sets	341.00		
	8.3.8	Ladders, complete and installed: Staircases, complete and installed, HDG: Staircase with seven treads, (six risers), overall size 1,75 m long x 1,3 m high, complete with handrailing to both sides of staircase				
B4.061			No.	9.00		
	PSH 8.3.9	Flooring, complete and installed with frames: c) Frames and kerbs for flooring: GRF angle section fixed to or cast into concrete: 50 x 50 x 5 mm				
B4.062			m	231.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 5: BIOLOGICAL REACTOR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B5	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough:				
		Vertical formwork to:				
B5.001		Sides of wall footings (external edges exceeding 300 mm high or wide)	m ²	979.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B5.002		Sides of walls	m ²	5,676.00		
B5.003		Sides of chamber walls	m ²	828.00		
B5.004		Sides of channel walls	m ²	1,380.00		
B5.005		Sides of columns	m ²	861.00		
B5.006		Sides of pillars between gate openings	m ²	35.00		
B5.007		Sides of platforms, walkways and bridges exceeding 300mm high	m ²	248.00		
		Horizontal formwork :				
B5.008		Soffits of channel floors propped up not exceeding 5 m high	m ²	201.00		
B5.009		Soffits of chamber floors propped up not exceeding 5 m high	m ²	139.00		
B5.010		Soffits of bridges or walkways propped up exceeding 6m and not exceeding 7m high	m ²	302.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B5.011		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	774.00		
	8.2.5	Grooves, chases and splays:				
B5.012		150 mm x 150 mm deep cable recess in top of floors or bridges	m	125.00		
	8.2.6	Box out holes/form voids				
		Small, other than circular up to 0,1m² in area, depths over 0.0m and up to 0,5m:				
B5.013		Up to 150 x 150 x 150 mm deep pockets in top of floors or slabs (various shapes)	No.	60.00		
		Large, circular, diameter 0,35 - 0,7m, depths over 0.0m and up to 0,5m:				
B5.014		400 mm diameter through 250 mm thick slabs for mechanical equipment	No.	18.00		
B5.015		650 mm diameter through 350 mm thick slabs for mechanical equipment	No.	21.00		
Total Carried Forward						

SCHEDULE 5: BIOLOGICAL REACTOR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Mild steel bars				
B5.017		a) 8 mm	t	1.28		
	8.3.1	High-tensile steel bars				
B5.018		a) 8 mm	t	15.16		
B5.019		b) 10 mm	t	50.52		
B5.020		c) 12 mm	t	126.29		
B5.021		d) 16 mm	t	161.65		
B5.022		e) 20 mm	t	90.93		
B5.023		f) 32 mm	t	50.52		
B5.024		g) 40 mm	t	50.52		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Mass concrete: 20 MPa/20mm				
B5.025		Encasing around pipes	m ³	17.00		
B5.026		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	17.00		
	8.4.2	Blinding layer in 15 MPa/20mm concrete				
B5.027		75 mm minimum thickness	m ²	3,910.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B5.028		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B5.029		Footings under walls including wall kickers	m ³	512.00		
B5.030		Walls	m ³	1,622.00		
B5.031		Chamber walls	m ³	101.00		
B5.032		Channel walls	m ³	106.00		
B5.033		Floor slabs including wall kickers	m ³	898.00		
B5.034		Chamber floors including wall kickers	m ³	37.00		
B5.035		Channel floors including wall kickers	m ³	105.00		
B5.036		Columns	m ³	100.00		
B5.037		Pillars between gate openings	m ³	44.00		
B5.038		Platforms	m ³	94.00		
B5.039		Stairs and landings	m ³	18.00		
Total Carried Forward						

SCHEDULE 5: BIOLOGICAL REACTOR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B5.040	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures Floors, footings, walls, slabs etc	m ³	-		Rate Only
	8.4.4	UNFORMED SURFACE FINISHES Wood-floated finish				
B5.041		Top of chamber floors	m ²	165.00		
B5.042		Top of channel floors	m ²	349.00		
B5.043		Top of stairs and landings including brushed finish	m ²	15.00		
		Steel-floated finish				
B5.044		Top of walls	m ²	343.00		
B5.045		Top of platforms and bridges or walkways	m ²	297.00		
		Power-floated finish				
B5.046		Top of floors and wall footings	m ²	3,592.00		
	PSG 8.4.5	Extra-over items 8.4.2 and 8.4.3 for aggregate of dolomitic origin in concrete mixes Coarse aggregate:				
B5.047		15 MPa	m ³	293.25		
B5.048		20 MPa	m ³	34.00		
B5.049		45 MPa	m ³	3,637.00		
		Fine aggregate:				
B5.050		15 MPa	m ³	293.25		
B5.051		20 MPa	m ³	34.00		
B5.052		45 MPa	m ³	3,637.00		
B5.053	PSG 8.10	Testing for watertightness:	Sum	1.00		
	SANS 1200H	STRUCTURAL STEELWORK				
	8.3.7	Handrails: c) Handrails, HDG, 1 m high standard ball type, top or side mounted: Rails only (hand and knee rails):				
B5.054		Horizontal	m	1,444.00		
B5.055		Sloping	m	115.44		
B5.056		Stanchions only	No.	432.00		
		Bends, end closures and accessories:				
B5.057		90 deg bends or corners	No.	162.00		
B5.058		135 deg bends or knees	No.	62.00		
B5.059		90 deg end closure	No.	-		Rate Only
B5.060		135 deg end closure	No.	-		Rate Only
B5.061		HD bolts, nuts and washers for each stanchion	Sets	432.00		
Total Carried Forward						

SCHEDULE 5: BIOLOGICAL REACTOR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B5.063	PSH 8.3.9	Flooring, complete and installed with frames: a) Open grid floors: Heavy duty Fibre Glass Reinforced (FGR) open grid floors: Banded panels with 45 x 5 mm bearer bars	m ²	322.00		
B5.064		c) Frames and kerbs for flooring: GRF angle section fixed to or cast into concrete: 50 x 50 x 5 mm	m	509.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 6: DIVIDING CHAMBER NO 2

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B6	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
	8.2.2	Smooth:				
		Vertical formwork to:				
B6.001		Sides of walls	m ²	59.00		
		Vertical curved formwork to:				
B6.002		Wall Bullnose	m ²	1.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B6.003		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	37.00		
	8.2.6	Box out holes/form voids				
		Small, other than circular up to 0,1m² in area, depths over 0.0m and up to 0,5m:				
B6.004		120mm x 80mm recess in top of floors for channel gates etc.	m	4.00		
B6.005		120mm x 80mm recess side of walls for channel gates etc.	m	17.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B6.006		a) 8 mm	t	0.26		
	8.3.1	High-tensile steel bars				
B6.007		a) 8 mm	t	0.26		
B6.008		b) 10 mm	t	0.26		
B6.009		c) 12 mm	t	0.26		
B6.010		d) 16 mm	t	1.03		
B6.011		e) 20 mm	t	0.78		
	8.4	CONCRETE				
	8.4.1	Mass concrete: 20 MPa/20mm				
B6.012		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	2.00		
	8.4.2	Blinding layer in 15 MPa/20mm concrete				
B6.013		75 mm minimum thickness	m ²	27.00		
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B6.014		Floors, footings, walls, slabs etc	m ³	31.00		
Total Carried Forward						

SCHEDULE 6: DIVIDING CHAMBER NO 2

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B6.015	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures Floors, footings, walls, slabs etc	m ³	-		Rate Only
B6.016	8.4.4	UNFORMED SURFACE FINISHES Wood-floated finish Stairs	m ²	5.00		
B6.017		Steel-floated finish Top of walls	m ²	7.00		
B6.018		Top of floors	m ²	20.00		
B6.019	PSG 8.7	GROUTING Proprietary shrinkage compensate grout with minimum 50 MPa compression: c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	1.00		
B6.020	PSG 8.10	Testing for watertightness:	Sum	1.00		
B6.021	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Over 800 mm and up to 1000 mm nominal bore: Through 250 mm thick Floor	No.	3.00		
B6.022	SANS 1200H 8.3.7	STRUCTURAL STEELWORK Handrails: c) Handrails, HDG, 1.0m high standard ball type, top or side mounted: Rails only (hand and knee rails): Horizontal	m	33.00		
B6.023		Stanchions only	No.	22.00		
B6.024		Bends, end closures and accessories: 90 deg bends or corners	No.	11.00		
B6.025		HD bolts, nuts and washers for each stanchion	Sets	22.00		
B6.026	PSH 8.3.9	Flooring, complete and installed with frames: a) Open grid floors: Heavy duty Fibre Glass Reinforced (FGR) open grid floors: Banded panels with 45 x 5 mm bearer bars	m ²	5.00		
B6.027		c) Frames and kerbs for flooring: HDG angle section with fishtail anchors cast into concrete: 45 x 45 x 5 mm	m	11.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 7: SECONDARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B7	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.1	Rough:				
		Vertical curved formwork to:				
B7.001		Sides or edges of wall footings (350 mm high)	m ²	146.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B7.002		Sides of columns in top of centre column inlet structure (250 x 250 mm columns with two sides curved)	m ²	3.00		
		Vertical curved formwork :				
B7.003		Sides or edges of centre column head (350 mm high)	m ²	3.00		
B7.004		Sides or edges of Wall (450 mm high)	m ²	6.00		
B7.005		Side wall of tank	m ²	2,284.00		
		Horizontal Curved formwork :				
B7.006		Soffits of launder channel floor propped up not exceeding 5.0m high, curved on plan	m ²	150.00		
B7.007		Soffit of centre column top and openings, curved on plan	m ²	4.00		
		Conical formwork :				
B7.008		Centre column (Ø1400mm)	m ²	71.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B7.009		Curved edge to No Fines concrete	m	82.00		
B7.010		Curved sides of walls	m	48.00		
	8.2.6	Box out holes/form voids				
		Large, other than circular, area 0,1m² - 0,5m², depths over 0.0m and up to 0,5m:				
B7.011		1000 x 500 mm through 300 mm thick curved wall	No.	3.00		
	8.3	REINFORCEMENT				
		Mild steel bars				
B7.012		a) 8 mm	t	10.26		
	8.3.1	High-tensile steel bars				
B7.013		a) 8 mm	t	10.26		
B7.014		b) 10 mm	t	10.26		
B7.015		c) 12 mm	t	10.26		
B7.016		d) 16 mm	t	41.02		
B7.017		e) 20 mm	t	30.76		
Total Carried Forward						

SCHEDULE 7: SECONDARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.4	CONCRETE				
B7.018	8.4.1	Mass concrete: 15 MPa/20mm Encasing around pipes	m ³	143.00		
B7.019	8.4.1	Mass concrete: 20 MPa/20mm Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	25.00		
B7.020		Screed to launder channel average 75mm thickness including steel float finish to top	m ²	8.00		
B7.021	8.4.2	Blinding layer in 15 MPa/20mm concrete 75 mm minimum thickness	m ²	33.00		
B7.022	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	789.00		
	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures Floors, footings, walls, slabs etc	m ³	-		Rate Only
	8.4.4	UNFORMED SURFACE FINISHES				
		Wood-floated finish				
		Top of Sump floors	m ²	39.00		
		Top of launder channel floors	m ²	172.00		
		Steel-floated finish				
		Top of Ground slab	m ²	1,498.00		
		Top of walls	m ²	97.00		
		Top of centre column inlet structure openings between columns	m ²	4.00		
		Top of centre column	m ²	4.00		
		Top of launder conical baffle slab	m ²	150.00		
		Special surface finish				
	PSG 8.4.4	Extra-over steel-floated finish to top of walls for special finishing tolerances measured by laser to top of outside ringwalls as specified	m ²	65.00		
Total Carried Forward						

SCHEDULE 7: SECONDARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B7.033	8.7	GROUTING Proprietary shrinkage compensate grout with minimum 50 MPa compression: d) Approved waterproof grouting in grouting up 50 mm diameter x 550 mm long sleeve pipes in bottom of tank prior to filling tank with water	No.	1.00		
B7.034	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Drainage or service duct pipes cast into concrete or soilcrete: 80 mm Diameter HDPE class 10 continuous sleeve pipe cast into concrete under tank floor and into centre column structure	m	214.00		
B7.035		Extra-over 80 mm diameter HDPE sleeve for butt welded bends	No.	22.00		
B7.036		Groundwater pressure-relief valves cast into concrete floors: 110 mm diameter (ID) x 125 mm long GREG ENGINEERING type S or equal approved cast iron groundwater pressure-relief valve cast into concrete floor, including minimum 150 mm long x 110 mm diameter uPVC sleeve with non-woven type AG300 or equal approved geotextile wrapping around bottom, complete as shown on the drawings	No.	52.00		
B7.037	PSG 8.10	Testing for watertightness:	Sum	1.00		
B7.038	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Up to 300 mm nominal bore: Through 300 mm thick wall	No.	3.00		
B7.039		Over 600mm and up to 800mm nominal bore: Through 450 mm thick floor In 7300mm centre column	No.	3.00		
B7.040	PSG 8.12	NO FINES CONCRETE 100 mm NF 19 layer including unformed surface finishes: Under sloping floors and perimeter footing of tank	m ³	161.00		
B7.041		Dry mortar layer: Extra-over NF layer for 10 mm dry mortar layer to top of NF concrete	m ²	18.00		
Total Carried Forward						

SCHEDULE 7: SECONDARY SETTLING TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B7.042	PSG 8.13	SOILCRETE Soilcrete filling under and around structures	m ³	1.00		
B7.043	SANS 1200DK 8.2.4	GABIONS AND PITCHING Geotextile (Bidim U14) a) Below NF concrete under floors	m ²	1,498.00		
B7.044	SANS 1200L 8.2.5	MEDIUM PRESSURE PIPELINES Supply and place pipes, valves and specials (short pipe runs) complete with couplings: a) Stainless steel welded pipes and specials, flanges drilled to SANS 1123 Table 1600/3 : Ø300mm Sch5S-304L S.S pipe segment 1 815mm long flanged one end and welded the other.	No.	2.00		
B7.045		Ø300mm Sch5S-304L S.S pipe segment 11 074mm welded both ends.	No.	2.00		
B7.046		Ø300mm Sch5S-304L S.S pipe segment 1 025mm long plain one end, one end welded and with a P.F 600mm from plain end.	No.	2.00		
B7.047		Ø750mm Sch10-304L S.S pipe segment 2 896mm welded both ends.	No.	2.00		
B7.048		Ø750mm Sch10-304L S.S pipe segment 10 952mm welded both ends.	No.	2.00		
B7.049		Ø750mm Sch10-304L S.S pipe segment 6 450mm long plain one end and welded the other.	No.	2.00		
B7.050	8.2.6	Extra-over item 8.2.5 for supplying and installing joints with machined collar and steel specials couplings: Bends over 11.25 degree up to 22.5 degree: Ø300mm 8.0° Sch5S-304L S.S welded bends	No.	4.00		
B7.051		Ø750mm 12.5° Sch10-304L S.S welded bends	No.	4.00		
B7.052		90° bends: Ø750mm 90° Sch10-304L S.S welded bends	No.	2.00		
B7.053		Concentric reducers: Ø500mm-750mm Sch10-304L S.S 550mm concentric reducer welded one end, flanged the other	No.	2.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 8: RAS PUMP STATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B8	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
B8.001	8.2.5	Narrow widths up to 300 mm wide or high: Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	198.00		
B8.002	8.2.6	Box out holes/form voids Small, other than circular up to 0,1 m2 in area, depths over 0 m and up to 0,5 m: Ø500mm in 200mm floor	No.	5.00		
	8.3	REINFORCEMENT				
B8.003	8.3.2	High-tensile welded mesh reinforcement Type reference 888 in ground slab	m ²	35.00		
	8.4	CONCRETE				
B8.004	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	34.00		
	8.4.4	UNFORMED SURFACE FINISHES				
B8.005		Steel-floated finish Top of Floor	m ²	180.00		
B8.006	8.7	GROUTING Proprietary shrinkage compensate grout with minimum 50 MPa compression: c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	1.00		
B8.007	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Over 400mm and up to 600mm nominal bore: Through 200 mm thick slab	No.	5.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 9: SLUDGE DAY TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B9	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.1	Rough:				
		Vertical formwork to:				
B9.001		Sides of walls	m ²	2.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B9.002		Sides of walls	m ²	457.00		
B9.003		Sides of columns	m ²	81.00		
		Horizontal formwork :				
B9.004		Soffits of bridges or walkways propped up not exceeding 5.0m high	m ²	61.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B9.005		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	513.00		
	8.2.6	Box out holes/form voids				
B9.006		300mm x 125mm electrical floor recess	m	33.00		
		Small, circular up to 0,35 m diameter, depths over 0 m and up to 0,5 m:				
B9.007		Ø150mm diameter through 200 mm thick slabs for mechanical equipment	No.	2.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B9.008		a) 8 mm	t	1.96		
	8.3.1	High-tensile steel bars				
B9.009		a) 8 mm	t	1.96		
B9.010		b) 10 mm	t	1.96		
B9.011		c) 12 mm	t	7.82		
B9.012		d) 16 mm	t	3.91		
B9.013		e) 20 mm	t	3.91		
	8.3.2	High-tensile welded mesh reinforcement				
B9.014		Type reference 888 in ground slab	m ²	11.00		
	8.4	CONCRETE				
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B9.015		75 mm minimum thickness	m ²	225.00		
Total Carried Forward						

SCHEDULE 9: SLUDGE DAY TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B9.016	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
B9.017	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	166.00		
B9.018	8.4.4	UNFORMED SURFACE FINISHES Wood-floated finish Top of floors	m ²	11.00		
B9.019		Steel-floated finish Top of floors	m ²	293.00		
B9.020		Top of wall	m ²	18.00		
B9.021	PSG 8.10	Testing for watertightness:	Sum	1.00		
	SANS 1200H	STRUCTURAL STEELWORK				
B9.022	8.3.7	Handrails: c) Handrails, HDG, 1 m high standard ball type, top or side mounted: Rails only (hand and knee rails): Horizontal	m	119.00		
B9.023		Stanchions only	No.	81.00		
B9.024		Bends, end closures and accessories: 90 deg bends or corners	No.	28.00		
B9.025		HD bolts, nuts and washers for each stanchion	Sets	81.00		
B9.026	PSH 8.3.9	Flooring, complete and installed with frames: b) Floorplate floors: 20mm Solid FGR/GRP panels	m ²	124.00		
B9.027		c) Frames and kerbs for flooring: GRF angle section fixed to or cast into concrete: 50 x 50 x 5 mm	m	118.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 10: THICK SLUDGE TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B10	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.1	Rough: Vertical formwork to:				
B10.001		Sides of walls	m ²	5.00		
	8.2.2	Smooth: Vertical formwork to:				
B10.002		Sides of walls	m ²	201.00		
B10.003		Sides of columns	m ²	42.00		
		Horizontal formwork :				
B10.004		Soffits of slabs propped up not exceeding 5.0m high	m ²	41.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B10.005		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	200.00		
	8.2.6	Box out holes/form voids Small, circular up to 0,35 m diameter, depths over 0 m and up to 0,5 m:				
B10.006		Ø150mm diameter through 200 mm thick slabs for mechanical equipment	No.	3.00		
		Large, other than circular over 0.1m² up to 0,5m² in area, depths over 0.0m and up to 0,5m:				
B10.007		750mmx650mm	No.	2.00		
B10.008		200mmx125mm electrical floor recess	m	22.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B10.009		a) 8 mm	t	1.69		
	8.3.1	High-tensile steel bars				
B10.010		a) 8 mm	t	1.69		
B10.011		b) 10 mm	t	1.69		
B10.012		c) 12 mm	t	6.74		
B10.013		d) 16 mm	t	2.53		
B10.014		e) 20 mm	t	2.53		
	8.3.2	High-tensile welded mesh reinforcement				
B10.015		Type reference 888 in ground slab	m ²	110.00		
Total Carried Forward						

SCHEDULE 10: THICK SLUDGE TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.4	CONCRETE				
B10.016	8.4.1	Mass concrete: 20 MPa/20mm Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	2.00		
B10.017	8.4.2	Blinding layer in 15 MPa/20 mm concrete 75 mm minimum thickness	m ²	143.00		
B10.018	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
B10.019	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	256.00		
B10.020	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures Floors, footings, walls, slabs etc	m ³	-		Rate Only
	8.4.4	UNFORMED SURFACE FINISHES				
B10.021		Wood-floated finish Top of floors	m ²	252.00		
B10.022		Steel-floated finish Top of slabs and roof slabs	m ²	177.00		
	8.7	GROUTING				
B10.023		Proprietary shrinkage compensate grout with minimum 50 MPa compression: c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	1.00		
B10.024	PSG 8.10	Testing for watertightness:	Sum	1.00		
B10.025	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Up to 300 mm nominal bore: Through 300 mm thick slab	No.	2.00		
B10.026	PSG 8.13	SOILCRETE Soilcrete filling under and around structures	m ³	1.00		
Total Carried Forward						

SCHEDULE 10: THICK SLUDGE TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	SANS 1200H	STRUCTURAL STEELWORK				
	8.3.7	Handrails:				
		c) Handrails, HDG, 1 m high standard ball type, top or side mounted:				
		Rails only (hand and knee rails):				
B10.027		Horizontal	m	84.00		
B10.028		Stanchions only	No.	56.00		
		Bends, end closures and accessories:				
B10.029		90 deg bends or corners	No.	43.00		
B10.030		HD bolts, nuts and washers for each stanchion	Sets	56.00		
	PSH 8.3.9	b) Floorplate floors:				
B10.031		20mm thick solid FGR panels	m ²	74.00		
		c) Frames and kerbs for flooring:				
		GRF angle section fixed to or cast into concrete:				
B10.032		40 x 40 x 5 mm	m	95.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 11: FERRIC CHLORIDE BULK TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B11	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.2	Smooth:				
		Vertical formwork to:				
B11.001		Sides of walls	m ²	24.00		
	8.2.5	Narrow widths up to 300mm wide or high:				
B11.002		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	44.00		
	8.2.6	Box out holes/form voids				
		Small, circular up to 0,35m diameter, depths over 0m and up to 0,5m:				
B11.003		Ø150mm diameter through 200 mm thick slabs for mechanical equipment	No.	5.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B11.004		a) 8 mm	t	0.24		
	8.3.1	High-tensile steel bars				
B11.005		a) 8 mm	t	0.24		
B11.006		b) 10 mm	t	0.24		
B11.007		c) 12 mm	t	1.19		
B11.008		d) 16 mm	t	0.48		
	8.1.3	CONCRETE				
	8.4.1	Mass concrete: 20 MPa/20mm				
B11.009		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	1.00		
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B11.010		75 mm minimum thickness	m ²	88.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B11.011		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B11.012		Floors, footings, walls, slabs, etc.	m ³	19.00		
	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures				
B11.013		Floors, footings, walls, slabs etc	m ³	-		Rate Only
Total Carried Forward						

SCHEDULE 11: FERRIC CHLORIDE BULK TANKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.4.4	UNFORMED SURFACE FINISHES				
		Steel-floated finish				
B11.014		Top of walls	m ²	36.00		
B11.015		Top of floors	m ²	39.00		
B11.016	PSG 8.10	Testing for watertightness:	Sum	1.00		
	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete:				
		Up to 300 mm nominal bore:				
B11.017		Through 200 mm thick wall	No.	4.00		
	8.7	GROUTING				
		Proprietary shrinkage compensate grout with minimum 50 MPa compression:				
B11.018		c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	1.00		
	PSG 8.16	Protective treatment or application to concrete:				
B11.019		c) Gehopon or equal approved acid resistant paint application to concrete surfaces	m ²	97.00		
	SANS 1200H	STRUCTURAL STEELWORK				
	PSH 8.3.9	Flooring, complete and installed with frames:				
		b) Floorplate floors:				
B11.020		SANS 558 type 14b grey iron manhole cover and frame	No.	2.00		
B11.021		Corregated roof allowance	PS	1.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 12: PRECIPITATION TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B12	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.2	Smooth:				
		Vertical formwork to:				
B12.001		Sides of walls	m ²	19.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B12.002		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	9.00		
	8.2.6	Box out holes/form voids				
		Small, circular up to 0,35m diameter, depths over 0m and up to 0,5m:				
B12.003		Ø100, Through 300mm Wall	No.	2.00		
		Ø350, Through 300mm Wall				
		Small, other than circular, up to 0,1m ² , depths over 0m and up to 0,5m:				
B12.004		20mmx20MM GRP/FRP V-nothc wier plate recess	No.	3.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B12.005		a) 8 mm	t	0.04		
	8.3.1	High-tensile steel bars				
B12.006		a) 8 mm	t	0.04		
B12.007		b) 10 mm	t	0.30		
	8.4	CONCRETE				
	8.4.1	Mass concrete: 20 MPa/20mm				
B12.008		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	1.00		
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B12.009		75 mm minimum thickness	m ²	5.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B12.010		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B12.011		Floors, footings, walls, slabs, etc.	m ³	4.00		
Total Carried Forward						

SCHEDULE 12: PRECIPITATION TANK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.4.4	UNFORMED SURFACE FINISHES				
		Steel-floated finish				
B12.012		Floor	m ²	5.00		
B12.013		Top of walls	m ²	3.00		
	8.7	GROUTING				
		Proprietary shrinkage compensate grout with minimum 50 MPa compression:				
B12.014		c) Grouting up voids, grooves or recesses after Mechanical equipment installations	m ³	1.00		
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK:				
B12.015		Supply and Install Precast- concrete bollards	No.	13.00		
B12.016		FRP/GRP V-Notch weir grouted in place as per detailing	No.	2.00		
B12.017	PSG 8.10	Testing for watertightness:	Sum	1.00		
	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete:				
		Up to 300mm nominal bore:				
B12.018		Through 300 mm thick wall	No.	3.00		
	SANS 1200H	STRUCTURAL STEELWORK				
	PSH 8.3.9	Flooring, complete and installed with frames:				
		b) Floorplate floors:				
B12.019		Solid FGR/GRP panels capable of 2.0kN/m ² loading	m ²	3.00		
		c) Frames and kerbs for flooring:				
		GRF angle section fixed to or cast into concrete:				
B12.020		50 x 50 x 5 mm	m	7.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 13: SLUDGE DIGESTERS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B13	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.1	Rough:				
		Vertical curved formwork to:				
B13.001		Sides or edges of wall footings (500 mm high)	m ²	23.00		
B13.002		Sides or edges of wall footings (350 mm high)	m ²	5.00		
		Conical formwork :				
B13.003		External sides of digester bottom	m ²	4.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B13.004		Sides of chamber walls	m ²	65.00		
		Vertical curved formwork :				
B13.005		Sides of walls	m ²	4,025.00		
B13.006		Sides of circular opening for gas dome in centre of dome roof slab 350 mm thick	m ²	56.00		
		Horizontal formwork :				
B13.007		Soffit of chambers inside digester propped up exceeding 8 m and not exceeding 9 m high (HDPE anchor knob sheet cladding to be casted into soffit of chambers. HDPE cladding measured elsewhere)	m ²	21.00		
B13.008		Soffit of gas dome in centre of digester dome roof propped up exceeding 17 m and not exceeding 18 m high (HDPE anchor knob sheet cladding to be casted into soffit of gas dome. HDPE cladding measured elsewhere)	m ²	7.00		
		Domical formwork :				
B13.009		Soffit of digester roof propped up exceeding 9m and up to 18m high (HDPE anchor knob sheet cladding to be casted into soffit of dome roof. HDPE cladding measured elsewhere)	m ²	1,944.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B13.010		Floor slab edges, end of walls, sides of openings, stair risers, sides of stairs, edges of column bases etc	m	220.00		
B13.011		Curved edges to slabs, stairs, gas dome, sides of openings etc	m	462.00		
	8.2.6	Box out holes/form voids				
		Small, circular up to 0,35 m diameter, depths over 0 m and up to 0,5 m:				
B13.012		250mm diameter openings in 250mm wall	No.	5.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B13.013		a) 8 mm	t	29.15		
Total Carried Forward						

SCHEDULE 13: SLUDGE DIGESTERS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B13.014		High-tensile steel bars a) 8 mm	t	29.15		
B13.015		b) 10 mm	t	29.15		
B13.016		c) 12 mm	t	29.15		
B13.017		d) 16 mm	t	116.57		
B13.018		e) 20 mm	t	29.15		
B13.019		f) 32 mm	t	29.15		
	8.4	CONCRETE				
	8.4.1	Mass concrete: 20 MPa/20mm Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	5.00		
	8.4.2	Blinding layer in 15 MPa/20 mm concrete 75 mm minimum thickness	m ²	1,555.00		
		Extra-over blinding layer for 10 mm skim/plaster coat to top of blinding concrete	m ²	1,555.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	2,429.00		
	8.4.4	UNFORMED SURFACE FINISHES Wood-floated finish Top of chamber floors	m ²	33.00		
		Top of stairs including brushed finish	m ²	33.00		
		Steel-floated finish Top of digester conical shaped floors	m ²	1,870.00		
		Top of chamber walls	m ²	11.00		
		Top of digester dome roof	m ²	1,870.00		
		Top of digester bottom	m ²	1,870.00		
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of skim/plaster coat and vertical to sides of structure bottom Precast Manhole as per detail drawing set PK278-SMEC-01-CIV-DRG-5000 Depth exceed 1,0m deep but not exceeding 2,0 m	m ²	1,870.00		
			No.	5.00		
Total Carried Forward						

SCHEDULE 13: SLUDGE DIGESTERS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Valve box cast in floor as per detail drawing set PK278-SMEC-01-CIV-DRG-5000 Depth exceed 1,0m deep but not exceeding 2,0 m	No.	5.00		
B13.034		2 mm Thick HDPE anchor knob sheet cladding with water-/gastight welded seem joints, fixed to inside of formwork and cast into concrete to: Vertical and horizontal to sides and soffits of chambers and gas domes inside digesters	m ²	242.00		
B13.035		Inside of digester dome roof slab	m ²	1,980.00		
		Supply and apply Sikagard 63 N two-part epoxy protective coating comprising surface preparation Sikagard 720 EPOCEM coating, 2 mm thick Sikafloor-161 primer and two coats Sikagard 63 N protective coats to:				
B13.036		Top of conical floors	m ²	55.00		
B13.037		Insides of conical bottom structures	m ²	1,980.00		
B13.038		Sides of internal walls	m ²	55.00		
	PSG 8.10	Testing for watertightness:				
B13.039		Sludge Digesters (watertightness and pressure testing)	Sum	2.00		
	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Up to 300 mm nominal bore:				
B13.040		Through 500 mm thick wall	No.	20.00		
		Over 800 mm and up to 1000 mm nominal bore:				
B13.041		Through 500 mm thick wall	No.	10.00		
	SANS 1200H	STRUCTURAL STEELWORK				
	8.3.7	Handrails: c) Handrails, HDG, 1 m high standard ball type, top or side mounted: Rails only (hand and knee rails):				
B13.042		Horizontal	m	80.00		
B13.043		Curved	m	11.00		
B13.044		Stanchions only	No.	60.00		
		Bends, end closures and accessories:				
B13.045		90 deg bends or corners	No.	11.00		
B13.046		135 deg bends or knees	No.	22.00		
B13.047		HD bolts, nuts and washers for each stanchion	Sets	60.00		
	8.3.12	Additional Items				
B13.048		Polypropylene coated step irons	No.	27.00		
Total Carried Forward						

SCHEDULE 13: SLUDGE DIGESTERS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B13.049	PSH 8.3.9	Flooring, complete and installed with frames: b) Floorplate floors: 20mm thick solid FGR panels	m ²	33.00		
B13.050		c) Frames and kerbs for flooring: GRF angle section fixed to or cast into concrete: 40 x 40 x 5 mm	m	51.00		
	SANS 1200DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material: Up to 200 mm nominal diameter for total trench depth:				
B13.051		Exceeding 0,0 m but not exceeding 1,0 m	m	18.00		
B13.052		Exceeding 1,0 m but not exceeding 2,0 m	m	42.00		
		Over 200mm up to 400mm nominal diameter for total trench depth:				
B13.053		Exceeding 0,0 m but not exceeding 1,0 m	m	125.00		
B13.054		Exceeding 1,0 m but not exceeding 2,0 m	m	292.00		
	SANS 1200LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B13.055		a) Selected granular material	m ³	22.00		
B13.056		b) Selected fill material	m ³	22.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B13.057		1) Selected granular material	m ³	22.00		
B13.058		2) Selected fill blanket	m ³	22.00		
	8.2.2.3	c) From commercial sources				
B13.059		1) Selected granular material	m ³	5.00		
B13.060		2) Selected fill material	m ³	5.00		
B13.061	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	2.00		
	SANS 1200L	MEDIUM PRESSURE PIPELINES				
	8.2.1	Supply, lay and bed pipes complete with couplings: a) HDPE pipes with butt welded joints:				
B13.062		Ø110mm SDR17 PE100	m	27.00		
B13.063		Ø250mm SDR26 PE100	m	112.00		
Total Carried Forward						

SCHEDULE 13: SLUDGE DIGESTERS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B13.064	8.2.2	Ø355mm SDR26 PE100	m	77.00		
		Extra-over item 8.2.1a for supplying, laying and bedding of HDPE specials complete with butt welded welded joints:				
		Bends over 45 degree up to 60 degree:				
B13.065		Ø250mm SDR26 PE100	No.	4.00		
		Equal tee:				
B13.066		Ø110mm SDR17 PE100	No.	2.00		
		Steel to HDPE coupling:				
B13.067		Ø100mm S.S to Ø110mm HDPE PN16	No.	2.00		
B13.068		Ø100mm C.I to Ø110mm HDPE PN10	No.	2.00		
		Blank Flange:				
B13.069	8.2.5	Ø150mm 304L S.S PN10	No.	4.00		
B13.070		Ø200mm 304L S.S PN10	No.	6.00		
B13.071		Ø900mm 304L S.S PN10	No.	4.00		
B13.072		Ø700mm 304L S.S PN10	No.	4.00		
		Supply, and place pipes valves, and specials.				
		a) Stainless Steel, flanges drilled to SANS 1123 Table 1600/3:				
B13.073		Ø100mm Sch10S-304L S.S pipe segment 10 483mm long flanged one end. One end plan with PF 625 from plain end.	No.	2.00		
B13.074		Ø100mm Sch10S-304L S.S pipe segment 1431mm long flanged both ends.	No.	2.00		
B13.075		Ø150mm Sch5S-304L S.S pipe segment 631mm long flanged one end. One end plan with PF 250 from plain end.	No.	4.00		
B13.076		Ø150mm Sch5S-304L S.S pipe segment 750mm long flanged one end. One end plan with PF 250 from plain end.	No.	2.00		
B13.077		Ø150mm Sch5S-304L S.S pipe segment 645mm long flanged one end. One end plan with PF 250 from plain end.	No.	2.00		
B13.078		Ø150mm Sch5S-304L S.S pipe segment 1 763mm long flanged both ends.	No.	2.00		
B13.079		Ø150mm Sch5S-304L S.S pipe segment 291mm long flanged one end. One end plan with PF 125mm from plain end.	No.	2.00		
B13.080		Ø200mm Sch5S-304L S.S pipe segment 10 483mm long flanged one end, with the other end plain with PF 625mm from plain end.	No.	2.00		
B13.081		Ø200mm Sch5S-304L S.S pipe segment 670mm long flanged one end, with the other end plain with PF 250mm from plain end.	No.	2.00		
B13.082		Ø200mm Sch5S-304L S.S pipe segment 646mm long flanged one end, with the other end plain with PF 250mm from plain end.	No.	2.00		
B13.083		Ø200mm Sch5S-304L S.S pipe segment 7 780mm long flanged one end and other end plain	No.	2.00		
B13.084		Ø150mm Sch5S-304L S.S pipe segment 4 789mm long flanged both ends	No.	2.00		
B13.085		Ø150mm Sch5S-304L S.S pipe segment 1 295mm long flanged one end and other end plain	No.	2.00		
Total Carried Forward						

SCHEDULE 13: SLUDGE DIGESTERS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B13.087		Ø150mm Sch5S-304L S.S pipe segment 1 511mm long flanged both ends	No.	2.00		
B13.088		Ø150mm Sch5S-304L S.S pipe segment 1 295mm long flanged one end and other end plain	No.	2.00		
B13.089		Ø900mm Sch10-304L S.S pipe segment 2 000mm long flanged one end. One end plain with PF 420mm from plain end.	No.	2.00		
B13.090		Ø900mm Sch10-304L S.S pipe segment 850mm long flanged one end. One end plain with PF 250mm from plain end.	No.	2.00		
B13.091	8.2.5	Ø700mm Sch10-304L S.S pipe segment 850mm long flanged one end. One end plain with PF 250mm from plain end.	No.	4.00		
B13.092		Ø150mm diameter SANS 664 S.S flanged RSV gate valve PN10	No.	6.00		
B13.093		Ø100mm diameter SANS 664 CI flanged RSV gate valve PN16	No.	2.00		
	8.2.6	Extra-over item 8.2.5 for supplying and installing joints with machined collar and steel specials couplings: 90° bends:				
B13.094		Ø150mm 90° Sch5S-304L S.S flanged	No.	4.00		
B13.095		Ø150mm 90° Sch5S-304L S.S flanged	No.	8.00		
B13.096		Ø200mm 90° Sch5S-304L S.S flanged	No.	4.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 14: STEEL STAIRCASES AND BRIDGES						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B14	SANS 1200 G	CONCRETE (STRUCTURAL)				
	8.1.1	FORMWORK				
	8.2	SCHEDULED FORMWORK ITEMS				
	8.2.5	Narrow widths up to 300 mm wide or high:				
B14.001		Edges of stair bases	m	37.00		
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Mild steel bars				
B14.002		a) 8 mm	t	0.04		
	8.3.1	High-tensile steel bars				
B14.003		a) 8 mm	t	0.06		
B14.004		b) 10 mm	t	0.19		
B14.005		c) 12 mm	t	0.47		
B14.006		d) 16 mm	t	0.60		
B14.007		e) 20 mm	t	0.33		
B14.008		f) 32 mm	t	0.19		
B14.009		g) 40 mm	t	0.19		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B14.010		75 mm minimum thickness	m ²	39.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B14.011		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B14.012		Stair bases	m ³	10.00		
	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures				
B14.013		Stair bases	m ³	1.00		
	8.4.4	UNFORMED SURFACE FINISHES				
		Steel-floated finish				
B14.014		Top of stair bases	m ²	39.00		
	PSG 8.4.5	Extra-over items 8.4.2 and 8.4.3 for aggregate of dolomitic origin in concrete mixes				
		Coarse aggregate:				
B14.015		15 MPa	m ³	4.00		
B14.016		45 MPa	m ³	10.00		
B14.017		50 MPa	m ³	1.00		
Total Carried Forward						

SCHEDULE 14: STEEL STAIRCASES AND BRIDGES						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B14.018		Fine aggregate: 15 MPa	m ³	4.00		
B14.019		45 MPa	m ³	10.00		
B14.020		50 MPa	m ³	1.00		
	8.7	GROUTING Proprietary shrinkage compensate grout with minimum 50 MPa compression: a) Under bases (or beds):				
B14.021		25 mm Thick under base plates	m ²	2.00		
	SANS 1200 H	STRUCTURAL STEELWORK Note: All steelwork and handrailing, etc to be Hot Dip Galvanized (HDG)				
	8.3.1	Supply and fabrication				
B14.022	8.3.1.1	Preparation of shop detail drawings	Sum	1.00		
	8.3.1.2	Supply and fabrication of steelwork complete with all the necessary cleats, brackets, gussets, packs, etc., as follows: b) Using steel to SANS 1431 Grade 300WA				
B14.023		254 x 254 x 73kg H- section columns	t	4.84		
B14.024		PC 300 x 100 Beams and stringers	t	4.51		
B14.025		100 x 8 mm Kick-flats welded to floor beams	t	0.28		
B14.026		Angle section bracing	t	0.54		
B14.027		Angle and flat section cleats	t	0.17		
B14.028		16 mm Thick base plates	t	0.20		
	8.3.2	Delivery to Site:				
B14.029	8.3.2.1	a) Normal delivery	t	10.54		
	8.3.3	Erection on Site:				
B14.030		Offloading, stacking on Site, and erection of steelwork	t	10.54		
	8.3.4	Erection bolts:				
B14.031		Grade 4.6 bolts including flat or tapered washers, as appropriate (plain)	kg	3.00		
B14.032		Grade 8.8 bolts including through hardened flat or tapered washers, as appropriate	kg	7.00		
B14.033		M16 U bolts suitable for up to 250 mm diameter pipes	No.	3.00		
B14.034		200 mm x 100 mm Neoprene padding below pipes	No.	3.00		
	8.3.6	Holding down (HD) bolts:				
B14.035		M16 HVA stainless steel anchors fixed into concrete	No.	60.00		
Total Carried Forward						

SCHEDULE 14: STEEL STAIRCASES AND BRIDGES						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.3.7	Handrails: c) Handrails, HDG, 1 m high standard ball type, top or side mounted: Rails only (hand and knee rails):				
B14.036		Horizontal	m	84.00		
B14.037		Sloping	m	93.00		
B14.038		Stanchions only	No.	178.00		
		Bends, end closures and accessories:				
B14.039		90 deg bends or corners	No.	32.00		
B14.040		135 deg bends or knees	No.	32.00		
B14.041		90 deg end closure	No.	6.00		
B14.042		135 deg end closure	No.	4.00		
B14.043		HD bolts, nuts and washers for each stanchion	Sets	178.00		
	PSH 8.3.9	Flooring, complete and installed with frames: b) Floorplate floors:				
B14.044		8 mm Thick plates	m ²	25.00		
B14.045		Purpose made treads 1000 mm wide formed of 325 mm x 8 mm thick Vastap tread plate with 6 x 40mm flat plate welded to front of tread complete with 40 x 40 x 6mm angle section supports on both sides, each support bolted with 2 x M12 bolts to stringers	No.	64.00		
	SANS 1200 HC	CORROSION PROTECTION OF STRUCTURAL STEELWORK				
	8.2.3	SURFACE PREPARATION AND COATING APPLICATION Shopwork. Prepare surface and apply coat(s) as specified:				
B14.046		Hot-rolled sections	t	10.54		
B14.047		Floor plates (painted area)	m ²	100.00		
B14.048		Handrailing (including knee rail and stanchions)	m	360.00		
B14.049		Kick plates	m	45.00		
B14.050		Bolts and nuts	kg	13.00		
		Sitework. Clean down surfaces, touch up damaged shop coats and apply finish coats as specified:				
B14.051		Hot-rolled sections	t	10.54		
B14.052		Floor plates (painted area)	m ²	100.00		
B14.053		Handrailing (including knee rail and stanchions)	m	360.00		
B14.054		Kick plates	m	45.00		
B14.055		Bolts and nuts	kg	13.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B15	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material: Up to 200 mm nominal diameter for total trench depth:				
B15.001		Exceeding 0,0 m but not exceeding 1,0 m	m	163.00		
B15.002		Exceeding 1,0 m but not exceeding 2,0 m	m	1,427.00		
B15.003		Exceeding 2,0 m but not exceeding 3,0 m	m	40.00		
B15.004		Exceeding 3,0 m but not exceeding 4,0 m	m	79.00		
B15.005		Exceeding 4,0 m but not exceeding 5,0 m	m	99.00		
B15.006		Exceeding 5,0 m but not exceeding 6,0 m	m	119.00		
B15.007		Exceeding 6,0 m but not exceeding 7,0 m	m	20.00		
		Over 200 up to 400 mm nominal diameter for total trench depth:				
B15.008		Exceeding 0,0 m but not exceeding 1,0 m	m	41.00		
B15.009		Exceeding 1,0 m but not exceeding 2,0 m	m	361.00		
B15.010		Exceeding 2,0 m but not exceeding 3,0 m	m	10.00		
B15.011		Exceeding 3,0 m but not exceeding 4,0 m	m	10.00		
B15.012		Exceeding 4,0 m but not exceeding 5,0 m	m	15.00		
B15.013		Exceeding 5,0 m but not exceeding 6,0 m	m	10.00		
B15.014		Exceeding 6,0 m but not exceeding 7,0 m	m	10.00		
		Over 400 up to 700 mm nominal diameter for total trench depth:				
B15.015		Exceeding 0,0 m but not exceeding 1,0 m	m	10.00		
B15.016		Exceeding 1,0 m but not exceeding 2,0 m	m	10.00		
B15.017		Exceeding 2,0 m but not exceeding 3,0 m	m	10.00		
B15.018		Exceeding 3,0 m but not exceeding 4,0 m	m	10.00		
B15.019		Exceeding 4,0 m but not exceeding 5,0 m	m	10.00		
B15.020		Exceeding 5,0 m but not exceeding 6,0 m	m	10.00		
B15.021		Exceeding 6,0 m but not exceeding 7,0 m	m	10.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Over 700 up to 1000 mm nominal diameter for total trench depth:				
B15.022		Exceeding 0,0 m but not exceeding 1,0 m	m	11.00		
B15.023		Exceeding 1,0 m but not exceeding 2,0 m	m	44.00		
B15.024		Exceeding 2,0 m but not exceeding 3,0 m	m	55.00		
B15.025		Exceeding 3,0 m but not exceeding 4,0 m	m	109.00		
B15.026		Exceeding 4,0 m but not exceeding 5,0 m	m	136.00		
B15.027		Exceeding 5,0 m but not exceeding 6,0 m	m	163.00		
B15.028		Exceeding 6,0 m but not exceeding 7,0 m	m	28.00		
		Service portal culverts for total trench depth:				
B15.029		Exceeding 1,0 m but not exceeding 2,0 m	m ³	66.00		
B15.030		Exceeding 2,0 m but not exceeding 3,0 m	m ³	366.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B15.031		Intermediate excavation	m ³	1,300.00		
B15.032		Hard rock excavation	m ³	4,880.00		
		Hand excavation where ordered by the Engineer:				
B15.033		Soft material	m ³	1,200.00		
B15.034		Intermediate material	m ³	225.00		
B15.035		Hard material	m ³	75.00		
B15.036		Backfill stabilized with 5% cement where directed by the Engineer	m ³	300.00		
B15.037		Soilcrete backfill where directed by the Engineer	m ³	600.00		
B15.038	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	250.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B15.039	8.3.3.1(a)	from other necessary excavations on site	m ³	100.00		
B15.040	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	150.00		
B15.041	8.3.3.3	Compaction in road reserves	m ³	300.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B15.042	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	450.00		
	SANS 1200 L	MEDIUM PRESSURE PIPELINES Pipe System Legend: DWFS: DEWATERING TO FILTRATE SUMP, FILTRATE TO HEAD OF WORKS ICP: INTERCONNECTING PIPEWORK PSP: PRIMARY SLUDGE PUMPING PSR: PRIMARY SLUDGE RETURN RASR: RAS RETURN TO BIOLOGICAL REACTOR SDSDT: SLUDGE DIGESTER TO SLUDGE DAY TANK SDTDW: SLUDGE DAY TANK TO DEWATERING TSD: THICK SLUDGE TO DIGESTERS WAS: WAS TO SLUDGE DAY TANK WASSDLS: WAS SLUDGE DAY TANK LINEAR SCREEN				
	8.2	SCHEDULED ITEMS				
	8.2.1	Supply, lay and bed pipes complete with couplings: a) HDPE pipes Class PN10 with butt welded joints:				
B15.043		Pipe system DWFS: 140 mm diameter	m	20.00		
B15.044		Pipe system ICP: 800 mm diameter	m	42.00		
B15.045		Pipe system PSP: 125 mm diameter	m	45.00		
B15.046		Pipe system PSR: 125 mm diameter	m	18.00		
B15.047		Pipe system RASR: 250 mm diameter	m	37.00		
B15.048		Pipe system SDSDT: 110 mm diameter	m	19.00		
B15.049		Pipe system SDSDT: 140 mm diameter	m	3.00		
B15.050		Pipe system SDTDW: 140 mm diameter	m	10.00		
B15.051		Pipe system TSD: 160 mm diameter	m	25.00		
B15.052		Pipe system WAS: 200 mm diameter	m	55.00		
B15.053		Pipe system WASSDLS: 315 mm diameter	m	5.00		
B15.054		SST and PST pipes: 200 mm diameter	m	3.00		
B15.055		SST and PST pipes: 400 mm diameter	m	3.00		
B15.056		SST and PST pipes: 630 mm diameter	m	10.00		
	8.2.2	Extra-over item 8.2.1a for supplying, laying and bedding of HDPE specials complete with butt welded welded joints: Bends 11.25 degree:				
B15.057		110 mm diameter	No.	1.00		
B15.058		125 mm diameter	No.	1.00		
B15.059		140 mm diameter	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B15.060		160 mm diameter	No.	1.00		
B15.061		200 mm diameter	No.	1.00		
B15.062		250 mm diameter	No.	1.00		
B15.063		315 mm diameter	No.	1.00		
B15.064		400 mm diameter SR bends	No.	1.00		
B15.065		630 mm diameter SR bends	No.	1.00		
B15.066		800 mm diameter	No.	1.00		
Bends over 11.25 degree up to 22.5 degree:						
B15.067		630 mm diameter SR bends	No.	1.00		
Bends 22.5 degree:						
B15.068		110 mm diameter	No.	1.00		
B15.069		125 mm diameter	No.	1.00		
B15.070		140 mm diameter	No.	1.00		
B15.071		160 mm diameter	No.	1.00		
B15.072		200 mm diameter	No.	1.00		
B15.073		250 mm diameter	No.	1.00		
B15.074		315 mm diameter	No.	1.00		
B15.075		800 mm diameter	No.	1.00		
Bends over 22.5 degree up to 44 degree:						
B15.076		110 mm diameter	No.	1.00		
B15.077		125 mm diameter	No.	1.00		
B15.078		140 mm diameter	No.	1.00		
B15.079		160 mm diameter	No.	1.00		
B15.080		200 mm diameter	No.	1.00		
B15.081		250 mm diameter	No.	1.00		
B15.082		315 mm diameter	No.	1.00		
B15.083		800 mm diameter	No.	1.00		
Bends 45 degree:						
B15.084		110 mm diameter	No.	1.00		
B15.085		125 mm diameter	No.	1.00		
B15.086		140 mm diameter	No.	1.00		
B15.087		160 mm diameter	No.	1.00		
B15.088		200 mm diameter	No.	1.00		
B15.089		250 mm diameter	No.	1.00		
B15.090		315 mm diameter	No.	1.00		
B15.091		800 mm diameter	No.	1.00		
Bends over 45 degree up to 60 degree:						
B15.092		110 mm diameter	No.	1.00		
B15.093		125 mm diameter	No.	1.00		
B15.094		140 mm diameter	No.	1.00		
B15.095		160 mm diameter	No.	1.00		
B15.096		200 mm diameter	No.	1.00		
B15.097		250 mm diameter	No.	1.00		
B15.098		315 mm diameter	No.	1.00		
B15.099		800 mm diameter	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Bends over 60 degree up to 89 degree:				
B15.100		110 mm diameter	No.	1.00		
B15.101		125 mm diameter	No.	1.00		
B15.102		140 mm diameter	No.	1.00		
B15.103		160 mm diameter	No.	1.00		
B15.104		200 mm diameter	No.	1.00		
B15.105		250 mm diameter	No.	1.00		
B15.106		315 mm diameter	No.	1.00		
B15.107		800 mm diameter	No.	1.00		
		Bends 90 degree:				
B15.108		110 mm diameter	No.	1.00		
B15.109		125 mm diameter	No.	1.00		
B15.110		140 mm diameter	No.	1.00		
B15.111		160 mm diameter	No.	1.00		
B15.112		200 mm diameter	No.	1.00		
B15.113		250 mm diameter	No.	1.00		
B15.114		315 mm diameter	No.	1.00		
B15.115		630 mm diameter SR bends	No.	1.00		
B15.116		800 mm diameter	No.	1.00		
		Bends over 100 degree up to 120 degree:				
B15.117		200 mm diameter SR bends	No.	1.00		
		Stub collar end complete with Copon coated steel loose flange, drilled to table 1600/3				
B15.118		110 mm diameter	No.	1.00		
B15.119		125 mm diameter	No.	1.00		
B15.120		140 mm diameter	No.	1.00		
B15.121		160 mm diameter	No.	1.00		
B15.122		200 mm diameter	No.	1.00		
B15.123		250 mm diameter	No.	1.00		
B15.124		315 mm diameter	No.	1.00		
B15.125		400 mm diameter	No.	1.00		
B15.126		630 mm diameter	No.	1.00		
B15.127		800 mm diameter	No.	1.00		
		Stub collar end complete with stainless steel loose flange, drilled to table 1600/3				
B15.128		110 mm diameter	No.	1.00		
B15.129		125 mm diameter	No.	1.00		
B15.130		140 mm diameter	No.	1.00		
B15.131		160 mm diameter	No.	1.00		
B15.132		200 mm diameter	No.	1.00		
B15.133		250 mm diameter	No.	1.00		
B15.134		315 mm diameter	No.	1.00		
B15.135		400 mm diameter	No.	1.00		
B15.136		630 mm diameter	No.	1.00		
B15.137		800 mm diameter	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		b) HDPE pipes Class PN12.5 with butt welded welded joints:				
B15.138		Pipe system DWFS: 140 mm diameter	m	10.00		
B15.139		Pipe system ICP: 800 mm diameter	m	20.00		
B15.140		Pipe system PSP: 125 mm diameter	m	24.00		
B15.141		Pipe system PSR: 125 mm diameter	m	9.00		
B15.142		Pipe system RASR: 250 mm diameter	m	18.00		
B15.143		Pipe system SDSDT: 110 mm diameter	m	10.00		
B15.144		Pipe system SDSDT: 140 mm diameter	m	2.00		
B15.145		Pipe system SDTDW: 140 mm diameter	m	4.00		
B15.146		Pipe system TSD: 160 mm diameter	m	12.00		
B15.147		Pipe system WAS: 200 mm diameter	m	28.00		
B15.148		Pipe system WASSDLS: 315 mm diameter	m	2.00		
B15.149		SST and PST pipes: 200 mm diameter	m	2.00		
B15.150		SST and PST pipes: 400 mm diameter	m	2.00		
B15.151		SST and PST pipes: 630 mm diameter	m	5.00		
	8.2.2	Extra-over item 8.2.1b for supplying, laying and bedding of HDPE specials complete with butt welded welded joints:				
		Bends 11.25 degree:				
B15.152		110 mm diameter	No.	1.00		
B15.153		125 mm diameter	No.	1.00		
B15.154		140 mm diameter	No.	1.00		
B15.155		160 mm diameter	No.	1.00		
B15.156		200 mm diameter	No.	1.00		
B15.157		250 mm diameter	No.	1.00		
B15.158		315 mm diameter	No.	1.00		
B15.159		400 mm diameter SR bends	No.	1.00		
B15.160		630 mm diameter SR bends	No.	1.00		
B15.161		800 mm diameter	No.	1.00		
		Bends over 11.25 degree up to 22.5 degree:				
B15.162		630 mm diameter SR bends	No.	1.00		
		Bends 22.5 degree:				
B15.163		110 mm diameter	No.	1.00		
B15.164		125 mm diameter	No.	1.00		
B15.165		140 mm diameter	No.	1.00		
B15.166		160 mm diameter	No.	1.00		
B15.167		200 mm diameter	No.	1.00		
B15.168		250 mm diameter	No.	1.00		
B15.169		315 mm diameter	No.	1.00		
B15.170		800 mm diameter	No.	1.00		
		Bends over 22.5 degree up to 44 degree:				
B15.171		110 mm diameter	No.	1.00		
B15.172		125 mm diameter	No.	1.00		
B15.173		140 mm diameter	No.	1.00		
B15.174		160 mm diameter	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B15.175		200 mm diameter	No.	1.00		
B15.176		250 mm diameter	No.	1.00		
B15.177		315 mm diameter	No.	1.00		
B15.178		800 mm diameter	No.	1.00		
		Bends 45 degree:				
B15.179		110 mm diameter	No.	1.00		
B15.180		125 mm diameter	No.	1.00		
B15.181		140 mm diameter	No.	1.00		
B15.182		160 mm diameter	No.	1.00		
B15.183		200 mm diameter	No.	1.00		
B15.184		250 mm diameter	No.	1.00		
B15.185		315 mm diameter	No.	1.00		
B15.186		800 mm diameter	No.	1.00		
		Bends over 45 degree up to 60 degree:				
B15.187		110 mm diameter	No.	1.00		
B15.188		125 mm diameter	No.	1.00		
B15.189		140 mm diameter	No.	1.00		
B15.190		160 mm diameter	No.	1.00		
B15.191		200 mm diameter	No.	1.00		
B15.192		250 mm diameter	No.	1.00		
B15.193		315 mm diameter	No.	1.00		
B15.194		800 mm diameter	No.	1.00		
		Bends over 60 degree up to 89 degree:				
B15.195		110 mm diameter	No.	1.00		
B15.196		125 mm diameter	No.	1.00		
B15.197		140 mm diameter	No.	1.00		
B15.198		160 mm diameter	No.	1.00		
B15.199		200 mm diameter	No.	1.00		
B15.200		250 mm diameter	No.	1.00		
B15.201		315 mm diameter	No.	1.00		
B15.202		800 mm diameter	No.	1.00		
		Bends 90 degree:				
B15.203		110 mm diameter	No.	1.00		
B15.204		125 mm diameter	No.	1.00		
B15.205		140 mm diameter	No.	1.00		
B15.206		160 mm diameter	No.	1.00		
B15.207		200 mm diameter	No.	1.00		
B15.208		250 mm diameter	No.	1.00		
B15.209		315 mm diameter	No.	1.00		
B15.210		630 mm diameter SR bends	No.	1.00		
B15.211		800 mm diameter	No.	1.00		
		Bends over 100 degree up to 120 degree:				
B15.212		200 mm diameter SR bends	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Stub collar end complete with Copon coated steel loose flange, drilled to table 1600/3				
B15.213		110 mm diameter	No.	1.00		
B15.214		125 mm diameter	No.	1.00		
B15.215		140 mm diameter	No.	1.00		
B15.216		160 mm diameter	No.	1.00		
B15.217		200 mm diameter	No.	1.00		
B15.218		250 mm diameter	No.	1.00		
B15.219		315 mm diameter	No.	1.00		
B15.220		400 mm diameter	No.	1.00		
B15.221		630 mm diameter	No.	1.00		
B15.222		800 mm diameter	No.	1.00		
		Stub collar end complete with stainless steel loose flange, drilled to table 1600/3				
B15.223		110 mm diameter	No.	1.00		
B15.224		125 mm diameter	No.	1.00		
B15.225		140 mm diameter	No.	1.00		
B15.226		160 mm diameter	No.	1.00		
B15.227		200 mm diameter	No.	1.00		
B15.228		250 mm diameter	No.	1.00		
B15.229		315 mm diameter	No.	1.00		
B15.230		400 mm diameter	No.	1.00		
B15.231		630 mm diameter	No.	1.00		
B15.232		800 mm diameter	No.	1.00		
		c) HDPE pipes Class PN16 with butt welded joints:				
B15.233		Pipe system DWFS: 140 mm diameter	m	194.00		
B15.234		Pipe system ICP: 800 mm diameter	m	410.00		
B15.235		Pipe system ICP: 900 mm diameter	m	12.00		
B15.236		Pipe system PSP: 125 mm diameter	m	454.00		
B15.237		Pipe system PSR: 125 mm diameter	m	180.00		
B15.238		Pipe system RASR: 250 mm diameter	m	368.00		
B15.239		Pipe system SDSDT: 110 mm diameter	m	189.00		
B15.240		Pipe system SDSDT: 140 mm diameter	m	11.00		
B15.241		Pipe system SDTDW: 140 mm diameter	m	91.00		
B15.242		Pipe system TSD: 160 mm diameter	m	55.00		
B15.243		Pipe system TSD: 180 mm diameter	m	200.00		
B15.244		Pipe system WAS: 200 mm diameter	m	144.00		
B15.245		Pipe system WAS: 225 mm diameter	m	400.00		
B15.246		Pipe system WASSDLS: 315 mm diameter	m	13.00		
B15.247		Pipe system WASSDLS: 355 mm diameter	m	20.00		
B15.248		SST and PST pipes: 200 mm diameter	m	27.00		
B15.249		SST and PST pipes: 400 mm diameter	m	25.00		
B15.250		SST and PST pipes: 450 mm diameter	m	6.00		
B15.251		SST and PST pipes: 630 mm diameter	m	19.00		
B15.252		SST and PST pipes: 710 mm diameter	m	70.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.2	Extra-over item 8.2.1c for supplying, laying and bedding of HDPE specials complete with butt welded welded joints:				
		Bends 11.25 degree:				
B15.253		110 mm diameter	No.	1.00		
B15.254		125 mm diameter	No.	1.00		
B15.255		140 mm diameter	No.	1.00		
B15.256		160 mm diameter	No.	1.00		
B15.257		180 mm diameter	No.	1.00		
B15.258		200 mm diameter	No.	1.00		
B15.259		225 mm diameter	No.	1.00		
B15.260		250 mm diameter	No.	1.00		
B15.261		280 mm diameter	No.	1.00		
B15.262		315 mm diameter	No.	1.00		
B15.263		355 mm diameter	No.	1.00		
B15.264		400 mm diameter SR bends	No.	4.00		
B15.265		450 mm diameter SR bends	No.	1.00		
B15.266		630 mm diameter SR bends	No.	1.00		
B15.267		710 mm diameter SR bends	No.	4.00		
B15.268		800 mm diameter	No.	1.00		
B15.269		900 mm diameter	No.	1.00		
		Bends over 11.25 degree up to 22.5 degree:				
B15.270		630 mm diameter SR bends	No.	1.00		
B15.271		710 mm diameter SR bends	No.	4.00		
		Bends 22.5 degree:				
B15.272		110 mm diameter	No.	1.00		
B15.273		125 mm diameter	No.	1.00		
B15.274		140 mm diameter	No.	1.00		
B15.275		160 mm diameter	No.	1.00		
B15.276		180 mm diameter	No.	1.00		
B15.277		200 mm diameter	No.	1.00		
B15.278		225 mm diameter	No.	1.00		
B15.279		250 mm diameter	No.	1.00		
B15.280		280 mm diameter	No.	1.00		
B15.281		315 mm diameter	No.	1.00		
B15.282		355 mm diameter	No.	1.00		
B15.283		800 mm diameter	No.	1.00		
B15.284		900 mm diameter	No.	1.00		
		Bends over 22.5 degree up to 44 degree:				
B15.285		110 mm diameter	No.	1.00		
B15.286		125 mm diameter	No.	2.00		
B15.287		140 mm diameter	No.	1.00		
B15.288		160 mm diameter	No.	1.00		
B15.289		180 mm diameter	No.	1.00		
B15.290		200 mm diameter	No.	2.00		
B15.291		225 mm diameter	No.	1.00		
B15.292		250 mm diameter	No.	1.00		
B15.293		280 mm diameter	No.	1.00		
B15.294		315 mm diameter	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B15.295		355 mm diameter	No.	1.00		
B15.296		800 mm diameter	No.	1.00		
B15.297		900 mm diameter	No.	1.00		
		Bends 45 degree:				
B15.298		110 mm diameter	No.	1.00		
B15.299		125 mm diameter	No.	1.00		
B15.300		140 mm diameter	No.	1.00		
B15.301		160 mm diameter	No.	1.00		
B15.302		180 mm diameter	No.	1.00		
B15.303		200 mm diameter	No.	4.00		
B15.304		225 mm diameter	No.	1.00		
B15.305		250 mm diameter	No.	1.00		
B15.306		280 mm diameter	No.	1.00		
B15.307		315 mm diameter	No.	1.00		
B15.308		355 mm diameter	No.	1.00		
B15.309		800 mm diameter	No.	1.00		
B15.310		900 mm diameter	No.	1.00		
		Bends over 45 degree up to 60 degree:				
B15.311		110 mm diameter	No.	1.00		
B15.312		125 mm diameter	No.	1.00		
B15.313		140 mm diameter	No.	1.00		
B15.314		160 mm diameter	No.	1.00		
B15.315		180 mm diameter	No.	1.00		
B15.316		200 mm diameter	No.	1.00		
B15.317		225 mm diameter	No.	1.00		
B15.318		250 mm diameter	No.	1.00		
B15.319		280 mm diameter	No.	1.00		
B15.320		315 mm diameter	No.	1.00		
B15.321		355 mm diameter	No.	1.00		
B15.322		800 mm diameter	No.	1.00		
B15.323		900 mm diameter	No.	1.00		
		Bends over 60 degree up to 89 degree:				
B15.324		110 mm diameter	No.	1.00		
B15.325		125 mm diameter	No.	1.00		
B15.326		140 mm diameter	No.	1.00		
B15.327		160 mm diameter	No.	1.00		
B15.328		180 mm diameter	No.	1.00		
B15.329		200 mm diameter	No.	1.00		
B15.330		225 mm diameter	No.	1.00		
B15.331		250 mm diameter	No.	1.00		
B15.332		280 mm diameter	No.	1.00		
B15.333		315 mm diameter	No.	1.00		
B15.334		355 mm diameter	No.	1.00		
B15.335		800 mm diameter	No.	1.00		
B15.336		900 mm diameter	No.	1.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Bends 90 degree:				
B15.337		110 mm diameter	No.	16.00		
B15.338		125 mm diameter	No.	7.00		
B15.339		140 mm diameter	No.	9.00		
B15.340		160 mm diameter	No.	6.00		
B15.341		180 mm diameter	No.	1.00		
B15.342		200 mm diameter	No.	3.00		
B15.343		225 mm diameter	No.	1.00		
B15.344		250 mm diameter	No.	6.00		
B15.345		280 mm diameter	No.	1.00		
B15.346		315 mm diameter	No.	3.00		
B15.347		355 mm diameter	No.	1.00		
B15.348		630 mm diameter SR bends	No.	4.00		
B15.349		710 mm diameter SR bends	No.	1.00		
B15.350		800 mm diameter	No.	4.00		
B15.351		900 mm diameter	No.	1.00		
		Bends over 100 degree up to 120 degree:				
B15.352		200 mm diameter SR bends	No.	2.00		
B15.353		225 mm diameter SR bends	No.	1.00		
		Stub collar end complete with Copon coated steel loose flange, drilled to table 1600/3				
B15.354		110 mm diameter	No.	4.00		
B15.355		125 mm diameter	No.	8.00		
B15.356		140 mm diameter	No.	10.00		
B15.357		160 mm diameter	No.	2.00		
B15.358		180 mm diameter	No.	1.00		
B15.359		200 mm diameter	No.	6.00		
B15.360		225 mm diameter	No.	1.00		
B15.361		250 mm diameter	No.	4.00		
B15.362		280 mm diameter	No.	1.00		
B15.363		315 mm diameter	No.	2.00		
B15.364		355 mm diameter	No.	1.00		
B15.365		400 mm diameter	No.	2.00		
B15.366		450 mm diameter	No.	1.00		
B15.367		630 mm diameter	No.	4.00		
B15.368		710 mm diameter	No.	1.00		
B15.369		800 mm diameter	No.	22.00		
B15.370		900 mm diameter	No.	1.00		
		Stub collar end complete with stainless steel loose flange, drilled to table 1600/3				
B15.371		110 mm diameter	No.	4.00		
B15.372		125 mm diameter	No.	8.00		
B15.373		140 mm diameter	No.	10.00		
B15.374		160 mm diameter	No.	2.00		
B15.375		180 mm diameter	No.	1.00		
B15.376		200 mm diameter	No.	6.00		
B15.377		225 mm diameter	No.	1.00		
B15.378		250 mm diameter	No.	4.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B15.379		280 mm diameter	No.	1.00		
B15.380		315 mm diameter	No.	2.00		
B15.381		355 mm diameter	No.	1.00		
B15.379		400 mm diameter	No.	2.00		
B15.382		450 mm diameter	No.	1.00		
B15.383		630 mm diameter	No.	4.00		
B15.384		710 mm diameter	No.	1.00		
B15.385		800 mm diameter	No.	22.00		
B15.386		900 mm diameter	No.	1.00		
	8.2.1	d) Stainless steel pipes complete with couplings:				
B15.387		PST pipes: 200 mm diameter, t = 5mm	m	27.00		
	8.2.2	Extra-over item 8.2.1d for supplying, laying and bedding of stainless steel specials complete with couplings:				
		Bends over 100 degree up to 120 degree:				
B15.388		200 mm diameter SR flanged bends, drilled to table 1600/3	No.	2.00		
	8.2.5	Supply and place pipes, valves and specials (short pipe runs) complete with couplings:				
		a) Stainless steel flanged pipes and specials (t = minimum 5mm), flanges drilled to SANS 1123 Table 1600/3 :				
B15.389		200 mm diameter x 13200 mm long pipe, flanged one end	No.	2.00		
B15.390		200 mm diameter x 1200 mm long pipe, flanged both ends	No.	2.00		
B15.391		200 mm diameter x 110 degree flanged bend	No.	2.00		
B15.392		150 mm diameter x 1500 mm long pipe, flanged one end	No.	10.00		
B15.393		150 mm diameter x 2900 mm long pipe, flanged both ends	No.	4.00		
B15.394		150 mm diameter x 4400 mm long pipe, flanged both ends	No.	4.00		
B15.395		150 mm diameter x 5900 mm long pipe, flanged both ends	No.	4.00		
B15.396		150 mm diameter x 1000 mm long puddle pipe, flanged one end	No.	18.00		
B15.397		150 mm diameter x 90 degree flanged bend	No.	10.00		
B15.398		Blank flange for 150 mm diameter flanged pipe	No.	6.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.5	b) SANS 62 heavy duty, Copon coated and lined, steel flanged pipes, valves and specials, drilled to SANS 1123 Table 1600/3 :				
B15.399		80 mm diameter x 1000 mm long puddle pipe, flanged both ends	No.	2.00		
B15.400		100 mm diameter x 500 mm long puddle pipe, flanged one end	No.	6.00		
B15.401		100 mm diameter x 4200 mm long pipe, flanged both ends	No.	12.00		
B15.402		100 mm diameter x 90 degree flanged bend	No.	6.00		
B15.403		125 mm diameter x 500 mm long puddle pipe, flanged both ends	No.	1.00		
B15.404		150 mm diameter x 250 mm long pipe, flanged one end	No.	8.00		
B15.405		150 mm diameter x 500 mm long pipe, flanged both ends	No.	2.00		
B15.406		150 mm diameter x 800 mm long pipe, flanged both ends	No.	1.00		
B15.407		150 mm diameter x 1800 mm long pipe, flanged both ends	No.	2.00		
B15.408		150 mm diameter x 3000 mm long pipe, flanged both ends	No.	4.00		
B15.409		150 mm diameter x 5900 mm long pipe, flanged both ends	No.	4.00		
B15.410		150 mm diameter x 1000 mm long puddle pipe, flanged both ends	No.	11.00		
B15.411		150 mm diameter x 1200 mm long puddle pipe, flanged one end	No.	8.00		
B15.412		150 mm diameter x 1200 mm long puddle pipe, flanged both ends	No.	19.00		
B15.413		150 mm diameter x 2200 mm long puddle pipe, flanged both ends	No.	1.00		
B15.414		150 mm diameter x 4200 mm long puddle pipe, flanged one end	No.	1.00		
B15.415		150 mm diameter x 90 degree flanged bend	No.	18.00		
B15.416		150 mm diameter x 90 degree flanged puddle bend with one end extended by 400mm, both ends flanged and with puddle flange on extended piece	No.	4.00		
B15.417		150 mm x 100 mm diameter flanged reducer	No.	6.00		
B15.418		150 mm diameter equal tee, all ends flanged	No.	2.00		
B15.419		150 mm x 250 mm diameter bellmouth with 150 mm diameter end flanged	No.	2.00		
B15.420		150 mm diameter Viking Johnson flange adaptor	No.	2.00		
B15.421		150 mm diameter holderbats fixed to concrete	No.	50.00		
B15.422		150 mm diameter SANS 664 CI flanged RSV gate valve	No.	17.00		
B15.423		150 mm diameter flanged non-return valve	No.	2.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.5	c) SANS 719 Grade C, Fusion Bonded Epoxy (FBE) coated and lined, steel flanged pipes, valves and specials, drilled to SANS 1123 Table 1600/3 :				
B15.424		200 mm diameter x 500 mm long puddle pipe, flanged one end (t = 5mm)	No.	6.00		
B15.425		250 mm diameter x 800 mm long puddle pipe, flanged both ends (t = 5mm)	No.	2.00		
B15.426		300 mm diameter x 500 mm long puddle pipe, flanged one end (t = 5mm)	No.	11.00		
B15.427		400 mm diameter x 1800 mm long puddle pipe, flanged both ends (t = 5mm)	No.	2.00		
B15.428		500 mm diameter x 1800 mm long puddle pipe, flanged both ends (t = 5mm)	No.	1.00		
B15.429		500 mm diameter x 1250 mm long puddle pipe, both ends plain (t = 5mm)	No.	3.00		
B15.430		600 mm diameter x 6000 mm long puddle pipe, flanged one end with purpose made puddle flange for raking floor including one raking cut end to pipe (t = 6mm)	No.	4.00		
B15.431		700 mm diameter x 1500 mm long puddle pipe, both ends plain (t = 8mm)	No.	4.00		
B15.432		700 mm diameter x 1500 mm long pipe, flanged both ends (t = 8mm)	No.	4.00		
B15.433		700 mm diameter x 2300 mm long pipe, flanged both ends (t = 8mm)	No.	4.00		
B15.434		700 mm diameter x 9000 mm long pipe, flanged both ends (t = 8mm)	No.	4.00		
B15.435		700 mm diameter x 1400 mm long puddle pipe, flanged one end (t = 8mm)	No.	4.00		
B15.436		700 mm diameter x 5650 mm long puddle pipe, flanged one end (t = 8mm)	No.	2.00		
B15.437		700 mm x 500 mm diameter reducer, both ends plain (t = 8mm)	No.	3.00		
B15.438		700 mm diameter x 90 degree flanged bend (t = 8mm)	No.	4.00		
B15.439		700 mm diameter SANS 664 CI flanged RSV gate valve	No.	2.00		
B15.440		1000 mm diameter x 1000 mm long access/inspection opening puddle pipe, flanged one end (t = 10mm)	No.	4.00		
B15.441		Blank flange for 1000 mm diameter flanged pipe	No.	4.00		
B15.442		500 mm diameter x 1250 mm long pipe, both ends flanged (t = 5mm)	No.	4.00		
B15.443		500 mm diameter x 2250 mm long pipe, both ends flanged (t = 5mm)	No.	4.00		
B15.444		500 mm diameter x 8700 mm long pipe, both ends flanged (t = 5 mm)	No.	1.00		
B15.445		500 mm diameter x 9200 mm long pipe, both ends flanged (t = 5 mm)	No.	2.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B15.446		500 mm diameter x 9300 mm long pipe, both ends flanged (t = 5 mm)	No.	4.00		
B15.447		500 mm diameter equal tee piece, flanged on all ends (t = 5 mm)	No.	3.00		
B15.448		500 mm diameter 90 degree elbow, flanged both ends (t = 5mm)	No.	5.00		
B15.449		500 mm diameter PN 10 dismantling joint.	No.	4.00		
B15.450		500 mm diameter PN 10 butterfly valve.	No.	4.00		
B15.451		500 mm diameter special: flange, 90 degree elbow, puddle flange, with 300mm pipe extension with plain end (t = 5 mm)	No.	4.00		
B15.452		600 mm diameter x 6700 mm long pipe, flanged both ends (t = 5 mm)	No.	1.00		
B15.453		600 mm diameter x 7600 mm long pipe, flanged both ends (t = 5 mm)	No.	2.00		
B15.454		600 mm diameter 90 degree elbow, flanged both ends (t = 5 mm)	No.	2.00		
B15.455		600 mm diameter PN 10 EagleBurgmann metal expansion joints or similar approved.	No.	2.00		
B15.456		600 mm diameter equal tee piece, flanged on all ends (t = 5 mm)	No.	3.00		
B15.457		600 mm diameter PN 10 dismantling joint.	No.	5.00		
B15.458		600 mm diameter PN 10 butterfly valve.	No.	5.00		
B15.459		600 mm diameter special: flange, 1000 mm long pipe, puddle flange, 90 degree elbow, bellmouth	No.	4.00		
	8.2.11	Anchor/Thrust blocks and pedestals				
B15.460		Concrete Class 20/20 MPa	m ³	100.00		
B15.461		Formwork	m ²	300.00		
B15.462		Reinforcement	t	3.00		
	8.2.12	Concrete casing				
B15.463		Concrete Class 20/20 MPa	m ³	60.00		
	8.2.13	Valve and hydrant chambers				
B15.464		Valve chamber complete for pipes up to 200mm diameter	No.	7.00		
B15.465	PSL 8.2.16	Marker blocks	No.	84.00		
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B15.466		a) Selected granular material	m ³	780.00		
B15.467		b) Selected fill material	m ³	320.00		
Total Carried Forward						

SCHEDULE 15: INTERCONNECTING PIPEWORK

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B15.469		1) Selected granular material	m ³	880.00		
B15.470		2) Selected fill blanket	m ³	205.00		
	8.2.2.3	c) From commercial sources				
B15.471		1) Selected granular material	m ³	290.00		
B15.472		2) Selected fill material	m ³	60.00		
B15.473	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	30.00		
	SANS 1200 LE	STORMWATER DRAINAGE				
	8.2.2	Supply and lay portal and rectangular culverts:				
		a) Complete with precast invert slabs, size (for service road crossings):				
B15.474		900 x 1200 mm	m	10.00		
B15.475		1200 x 1200 mm	m	10.00		
B15.476		1200 x 1500 mm	m	60.00		
B15.477		1200 x 1800 mm	m	25.00		
	8.2.8	Supply and install manholes, catchpits, and the like				
		d) Culvert in- and outlet structures suitable for culvert size:				
B15.478		900 x 1200 mm	No.	2.00		
B15.479		1200 x 1200 mm	No.	2.00		
B15.480		1200 x 1500 mm	No.	10.00		
B15.481		1200 x 1800 mm	No.	4.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B16	SANS 1200 DB 8.3.2	POTABLE WATER				
		PIPE TRENCHES				
	8.3.2(a)	Excavation				
		Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material:				
		Up to 200 mm nominal diameter for total trench depth:				
B16.001		Exceeding 0,0 m but not exceeding 1,0 m	m	493.00		
B16.002		Exceeding 1,0 m but not exceeding 2,0 m	m	1,551.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.003		Intermediate excavation	m ³	280.00		
B16.004		Hard rock excavation	m ³	280.00		
		Hand excavation where ordered by the Engineer:				
B16.005		Soft material	m ³	170.00		
B16.006		Intermediate material	m ³	80.00		
B16.007		Hard material	m ³	60.00		
B16.008		Backfill stabilized with 5% cement where directed by the Engineer	m ³	100.00		
B16.009		Soilcrete backfill where directed by the Engineer	m ³	100.00		
B16.010	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	50.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.011	8.3.3.1(a)	from other necessary excavations on site	m ³	30.00		
B16.012	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	20.00		
B16.013	8.3.3.3	Compaction in road reserves	m ³	100.00		
	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces				
B16.014		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	70.00		
	SANS 1200 DB 8.3.2	SERVICE WATER				
		PIPE TRENCHES				
	8.3.2(a)	Excavation				
		Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material:				
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.015		Up to 200 mm nominal diameter for total trench depth: Exceeding 0,0 m but not exceeding 1,0 m	m	187.00		
B16.016		Exceeding 1,0 m but not exceeding 2,0 m	m	1,893.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.017		Intermediate excavation	m ³	330.00		
B16.018		Hard rock excavation	m ³	330.00		
		Hand excavation where ordered by the Engineer:				
B16.019		Soft material	m ³	200.00		
B16.020		Intermediate material	m ³	100.00		
B16.021		Hard material	m ³	65.00		
B16.022		Backfill stabilized with 5% cement where directed by the Engineer	m ³	100.00		
B16.023		Soilcrete backfill where directed by the Engineer	m ³	100.00		
B16.024	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	50.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.025	8.3.3.1(a)	from other necessary excavations on site	m ³	30.00		
B16.026	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	20.00		
B16.027	8.3.3.3	Compaction in road reserves	m ³	100.00		
	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces				
B16.028		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	70.00		
		FIRE WATER				
	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material: Up to 200 mm nominal diameter for total trench depth:				
B16.029		Exceeding 0,0 m but not exceeding 1,0 m	m	35.00		
B16.030		Exceeding 1,0 m but not exceeding 2,0 m	m	1,617.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.031		Intermediate excavation	m ³	300.00		
B16.032		Hard rock excavation	m ³	300.00		
		Hand excavation where ordered by the Engineer:				
B16.033		Soft material	m ³	180.00		
B16.034		Intermediate material	m ³	90.00		
B16.035		Hard material	m ³	60.00		
B16.036		Backfill stabilized with 5% cement where directed by the Engineer	m ³	100.00		
B16.037		Soilcrete backfill where directed by the Engineer	m ³	100.00		
B16.038	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	50.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.039	8.3.3.1(a)	from other necessary excavations on site	m ³	30.00		
B16.040	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	20.00		
B16.041	8.3.3.3	Compaction in road reserves	m ³	100.00		
	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces				
B16.042		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	70.00		
		SEWER				
	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material: Up to 200 mm nominal diameter for total trench depth:				
B16.043		Exceeding 0,0 m but not exceeding 1,0 m	m	-		Rate Only
B16.044		Exceeding 1,0 m but not exceeding 2,0 m	m	77.00		
B16.045		Exceeding 2,0 m but not exceeding 3,0 m	m	70.00		
B16.046		Exceeding 3,0 m but not exceeding 4,0 m	m	89.00		
B16.047		Exceeding 4,0 m but not exceeding 5,0 m	m	29.00		
B16.048		Exceeding 5,0 m but not exceeding 6,0 m	m	9.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.049		Intermediate excavation	m ³	70.00		
B16.050		Hard rock excavation	m ³	280.00		
		Hand excavation where ordered by the Engineer:				
B16.051		Soft material	m ³	35.00		
B16.052		Intermediate material	m ³	18.00		
B16.053		Hard material	m ³	12.00		
B16.054		Backfill stabilized with 5% cement where directed by the Engineer	m ³	50.00		
B16.055		Soilcrete backfill where directed by the Engineer	m ³	50.00		
B16.056	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	20.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.057	8.3.3.1(a)	from other necessary excavations on site	m ³	15.00		
B16.058	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	5.00		
B16.059	8.3.3.3	Compaction in road reserves	m ³	20.00		
		Finishing				
		Reinstate road surfaces				
B16.060		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	30.00		
		STORMWATER				
	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material:				
		Over 400 up to 700 mm nominal diameter for total trench depth:				
B16.061		Not exceeding 1,0 m	m	70.00		
B16.062		Exceeding 1,0 m but not exceeding 2,0 m	m	400.00		
B16.063		Exceeding 2,0 m but not exceeding 3,0 m	m	20.00		
		Over 700 up to 1000 mm nominal diameter for total trench depth:				
B16.064		Not exceeding 1,0 m	m	124.00		
B16.065		Exceeding 1,0 m but not exceeding 2,0 m	m	327.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.066		Exceeding 2,0 m but not exceeding 3,0 m	m	150.00		
B16.067		Exceeding 3,0 m but not exceeding 4,0 m	m	45.00		
B16.068		Exceeding 4,0 m but not exceeding 5,0 m	m	33.00		
B16.069		Exceeding 5,0 m but not exceeding 6,0 m	m	26.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.070		Intermediate excavation	m ³	220.00		
B16.071		Hard rock excavation	m ³	880.00		
		Hand excavation where ordered by the Engineer:				
B16.072		Soft material	m ³	250.00		
B16.073		Intermediate material	m ³	150.00		
B16.074		Hard material	m ³	100.00		
B16.075		Backfill stabilized with 5% cement where directed by the Engineer	m ³	80.00		
B16.076		Soilcrete backfill where directed by the Engineer	m ³	100.00		
B16.077	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	150.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.078	8.3.3.1(a)	from other necessary excavations on site	m ³	75.00		
B16.079	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	75.00		
B16.080	8.3.3.3	Compaction in road reserves	m ³	80.00		
	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces				
B16.081		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	120.00		
		SUBSURFACE DRAINAGE				
	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material:				
		Trench of width up to 450 mm for total depth:				
B16.082		Not exceeding 1,0 m	m	160.00		
B16.083		Exceeding 1,0 m but not exceeding 2,0 m	m	160.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.084		Exceeding 2,0 m but not exceeding 3,0 m	m	40.00		
B16.085		Exceeding 3,0 m but not exceeding 4,0 m	m	20.00		
B16.086		Exceeding 4,0 m but not exceeding 5,0 m	m	20.00		
B16.087		Exceeding 5,0 m but not exceeding 6,0 m	m	20.00		
B16.088		Exceeding 6,0 m but not exceeding 7,0 m	m	20.00		
B16.089		Exceeding 7,0 m but not exceeding 8,0 m	m	20.00		
		Trench of width over 450 mm and up to 600 mm for total depth:				
B16.090		Not exceeding 1,0 m	m	20.00		
B16.091		Exceeding 1,0 m but not exceeding 2,0 m	m	20.00		
B16.092		Exceeding 2,0 m but not exceeding 3,0 m	m	20.00		
B16.093		Exceeding 3,0 m but not exceeding 4,0 m	m	20.00		
B16.094		Exceeding 4,0 m but not exceeding 5,0 m	m	20.00		
B16.095		Exceeding 5,0 m but not exceeding 6,0 m	m	20.00		
B16.096		Exceeding 6,0 m but not exceeding 7,0 m	m	20.00		
B16.097		Exceeding 7,0 m but not exceeding 8,0 m	m	20.00		
		Trench of width over 600 mm and up to 750 mm for total depth:				
B16.098		Not exceeding 1,0 m	m	13.00		
B16.099		Exceeding 1,0 m but not exceeding 2,0 m	m	440.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.100		Intermediate excavation	m ³	300.00		
B16.101		Hard rock excavation	m ³	870.00		
		Hand excavation where ordered by the Engineer:				
B16.102		Soft material	m ³	300.00		
B16.103		Intermediate material	m ³	100.00		
B16.104		Hard material	m ³	150.00		
B16.105		Backfill stabilized with 5% cement where directed by the Engineer	m ³	150.00		
B16.106		Soilcrete backfill where directed by the Engineer	m ³	140.00		
B16.107	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	100.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.108	8.3.3.1(a)	from other necessary excavations on site	m ³	60.00		
B16.109	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	40.00		
B16.110	8.3.3.3	Compaction in road reserves	m ³	24.00		
	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces				
B16.111		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	40.00		
		DUCTS				
	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material:				
		Trench of width up to 450 mm for total depth:				
B16.112		Not exceeding 1,0 m	m	180.00		
B16.113		Exceeding 1,0 m but not exceeding 2,0 m	m	135.00		
		Trench of width over 450 mm and up to 600 mm for total depth:				
B16.114		Not exceeding 1,0 m	m	5.00		
B16.115		Exceeding 1,0 m but not exceeding 2,0m	m	50.00		
		Trench of width over 600 mm and up to 750 mm for total depth:				
B16.116		Not exceeding 1,0 m	m	2.00		
B16.117		Exceeding 1,0 m but not exceeding 2,0m	m	8.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B16.118		Intermediate excavation	m ³	40.00		
B16.119		Hard rock excavation	m ³	50.00		
		Hand excavation where ordered by the Engineer:				
B16.120		Soft material	m ³	20.00		
B16.121		Intermediate material	m ³	10.00		
B16.122		Hard material	m ³	5.00		
B16.123		Backfill stabilized with 5% cement where directed by the Engineer	m ³	10.00		
B16.124		Soilcrete backfill where directed by the Engineer	m ³	10.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.125	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	10.00		
	8.3.3	Excavation ancillaries				
	8.3.3.1	Make up deficiency in backfill material				
B16.126	8.3.3.1(a)	from other necessary excavations on site	m ³	5.00		
B16.127	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	5.00		
B16.128	8.3.3.3	Compaction in road reserves	m ³	5.00		
	8.3.6	Finishing				
	8.3.6.1	Reinstate road surfaces				
B16.129		a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	50.00		
	SANS 1200 DK	GABIONS AND PITCHING				
		Gabions				
B16.130	8.2.1	Surface preparation for bedding of gabions	m ²	100.00		
	8.2.2	Construct gabions using PVC coated wire mesh				
B16.131		a) Toe mattresses of depth 170 mm with diaphragms providing 2 m x 1 m cells	m ³	20.00		
B16.132		b) Foundation mattresses of depth 300 mm with diaphragms providing 2 m x 1 m cells	m ³	80.00		
B16.133		c) Gabions of section 1,5 m x 1,0 m for walls	m ³	100.00		
B16.134	8.2.3	Extra-over item 8.2.2 for packing selected stone for exposed face	m ²	30.00		
	8.2.4	Geotextile (U14)				
B16.135		a) below foundation mattresses	m ²	100.00		
B16.136		b) on slope behind wall	m ²	60.00		
		Pitching				
B16.137	8.2.5	Ordinary pitching of thickness at least 300 mm on slope of bank where shown on drawings	m ²	40.00		
B16.138	8.2.7	Weepholes	No.	15.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		POTABLE WATER				
	SANS	MEDIUM PRESSURE PIPELINES				
	1200 L	Supply, lay and bed pipes complete with couplings, test and disinfect				
	8.2.1	HDPE pipes Class PN10 with butt welded joints				
B16.139		50 mm diameter	m	1,140.00		
B16.140		75 mm diameter	m	905.00		
	8.2.2	Extra-over item 8.2.1 for supplying, laying and bedding of specials complete with butt welded joints				
		Bends 11.25 degree:				
B16.141		50 mm diameter	No.	2.00		
B16.142		75 mm diameter	No.	2.00		
		Bends 22.5 degree:				
B16.143		50 mm diameter	No.	3.00		
B16.144		75 mm diameter	No.	6.00		
		Bends 45 degree:				
B16.145		50 mm diameter	No.	4.00		
B16.146		75 mm diameter	No.	7.00		
		Bends 90 degree:				
B16.147		50 mm diameter	No.	4.00		
B16.148		75 mm diameter	No.	8.00		
		Tees:				
B16.149		50 x 50 mm diameter	No.	2.00		
B16.150		75 x 75 mm diameter	No.	2.00		
		Reducing tees:				
B16.151		75 x 50 mm diameter	No.	2.00		
B16.152		50 x 20 mm diameter	No.	2.00		
		Stub ends with FBE coated mild steel backing flanges:				
B16.153		50 mm diameter	No.	40.00		
B16.154		75 mm diameter	No.	20.00		
		HDPE/Cu adaptors:				
B16.155		20 mm diameter	No.	6.00		
		End caps:				
B16.156		50 mm diameter	No.	6.00		
B16.157		75 mm diameter	No.	2.00		
		Reducers:				
B16.158		50 x 20 mm diameter	No.	6.00		
B16.159		75 x 50 mm diameter	No.	2.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.3	Extra-over item 8.2.1 for supplying, fixing and bedding of valves:				
		RSV Class 16 CI flanged gate valves:				
B16.160		50 mm diameter	No.	20.00		
B16.161		75 mm diameter	No.	10.00		
	8.2.11	Anchor/Thrust blocks and pedestals				
B16.162		Concrete Class 20/20 MPa	m ³	50.00		
B16.163		Formwork	m ²	50.00		
B16.164		Reinforcement	t	1.50		
	8.2.12	Concrete casing				
B16.165		Concrete Class 20/20 MPa	m ³	15.00		
	8.2.13	Valve and hydrant chambers				
B16.166		Valve chamber complete for pipes up to 200mm diameter	No.	30.00		
B16.167	PSL 8.2.16	Marker blocks	No.	33.00		
B16.168	PSL 8.2.17	Supply and install approved 10,000 litre storage tank on and including 6 m high steel tank stand complete with concrete footings, platform, access ladder, handrailing and all connection pipework above ground including float and isolation valves etc	No.	1.00		
		SERVICE WATER				
	SANS 1200 L	MEDIUM PRESSURE PIPELINES				
	8.2.1	Supply, lay and bed pipes complete with couplings, test and disinfect				
		HDPE pipes Class PN10 with butt welded joints				
B16.169		50 mm diameter	m	1,221.00		
B16.170		90 mm diameter	m	860.00		
	8.2.2	Extra-over item 8.2.1 for supplying, laying and bedding of specials complete with butt weld joints:				
		Bends 11.25 degree:				
B16.171		50 mm diameter	No.	2.00		
B16.172		90 mm diameter	No.	2.00		
		Bends 22.5 degree:				
B16.173		50 mm diameter	No.	5.00		
B16.174		90 mm diameter	No.	4.00		
		Bends 45 degree:				
B16.175		50 mm diameter	No.	8.00		
B16.176		90 mm diameter	No.	4.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.177		Bends 90 degree: 20 mm diameter	No.	27.00		
B16.178		50 mm diameter	No.	19.00		
B16.179		90 mm diameter	No.	2.00		
		Tees:				
B16.180		50 x 50 mm diameter	No.	14.00		
B16.181		90 x 90 mm diameter	No.	3.00		
		Reducing tees:				
B16.182		50 x 20 mm diameter	No.	11.00		
B16.183		90 x 50 mm diameter	No.	15.00		
		Stub ends with FBE coated, mild steel backing flanges:				
B16.184		50 mm diameter	No.	40.00		
B16.185		90 mm diameter	No.	20.00		
		HDPE/GMS adaptors:				
B16.186		20 mm diameter	No.	27.00		
		End caps:				
B16.187		50 mm diameter	No.	8.00		
B16.188		90 mm diameter	No.	2.00		
		Reducers:				
B16.189		50 x 20 mm diameter	No.	36.00		
B16.190		90 x 50 mm diameter	No.	10.00		
	8.2.3	Extra-over item 8.2.1 for supplying, fixing and bedding of valves:				
		RSV Class 16 CI flanged gate valves:				
B16.191		50 mm diameter	No.	20.00		
B16.192		90 mm diameter	No.	10.00		
	8.2.11	Anchor/Thrust blocks and pedestals				
B16.193		Concrete Class 20/20 MPa	m ³	50.00		
B16.194		Formwork	m ²	50.00		
B16.195		Reinforcement	t	1.50		
	8.2.12	Concrete casing				
B16.196		Concrete Class 20/20 MPa	m ³	15.00		
	8.2.13	Valve and hydrant chambers				
B16.197		Valve chamber complete for pipes up to 200 mm diameter	No.	31.00		
B16.198	PSL 8.2.16	Marker blocks	No.	35.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.199	PSL 8.2.18	Standpipes complete: 20mm Brass heavy duty garden tap with standpipe including pipe support, hose connection, bends, fittings etc.	No.	16.00		
B16.200	PSL 8.2.19	Emergency showers	No.	3.00		
		FIRE WATER				
	SANS 1200 L	MEDIUM PRESSURE PIPELINES				
	8.2.1	Supply, lay and bed pipes complete with couplings, test and disinfect HDPE pipes Class PN10 with butt welded joints				
B16.201		140 mm diameter	m	433.00		
B16.202		200 mm diameter	m	244.00		
B16.203		250 mm diameter	m	44.00		
B16.204		315 mm diameter	m	1,652.00		
	8.2.2	Extra-over item 8.2.1 for supplying, laying and bedding of specials complete with couplings Pulled bends 11.25 degree:				
B16.205		200 mm diameter	No.	1.00		
B16.206		250 mm diameter	No.	1.00		
		Pulled bends 22.5 degree:				
B16.207		200 mm diameter	No.	1.00		
B16.208		250 mm diameter	No.	3.00		
B16.209		315 mm diameter	No.	2.00		
		Pulled bends 45 degree:				
B16.210		140 mm diameter	No.	2.00		
B16.211		200 mm diameter	No.	1.00		
B16.212		315 mm diameter	No.	5.00		
		Pulled bends 90 degree:				
B16.213		140 mm diameter	No.	1.00		
B16.214		200 mm diameter	No.	2.00		
B16.215		315 mm diameter	No.	2.00		
		Tees:				
B16.216		140 x 140 mm diameter	No.	2.00		
B16.217		200 x 200 mm diameter	No.	3.00		
B16.218		315 x 315 mm diameter	No.	1.00		
		Reducing tees:				
B16.219		200 x 140 mm diameter	No.	1.00		
B16.220		250 x 200 mm diameter	No.	1.00		
B16.221		315 x 200 mm diameter	No.	1.00		
B16.222		315 x 250 mm diameter	No.	1.00		
B16.223		315 x 140 mm diameter	No.	7.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.224		Fire hydrant tees: 140 x 80 mm diameter	No.	13.00		
B16.225		200 x 80 mm diameter	No.	5.00		
		Stub-end with mild steel, FBE coated backing flange:				
B16.226		140 mm diameter	No.	26.00		
B16.227		200 mm diameter	No.	16.00		
B16.228		250 mm diameter	No.	6.00		
B16.229		315 mm diameter	No.	22.00		
		Stub-end with mild steel, FBE coated backing flange:				
B16.230		80 mm diameter	No.	18.00		
		End caps:				
B16.231		140 x 80 mm diameter	No.	13.00		
B16.232		200 x 80 mm diameter	No.	5.00		
		Reducers:				
B16.233		200 x 140 mm diameter	No.	2.00		
B16.234		250 x 200 mm diameter	No.	2.00		
B16.235		315 x 250 mm diameter	No.	1.00		
B16.236		315 x 200 mm diameter	No.	1.00		
	8.2.3	Extra-over item 8.2.1 for supplying, fixing and bedding of valves: RSV Class 16 CI flanged gate valves:				
B16.237		140 mm diameter	No.	13.00		
B16.238		200 mm diameter	No.	8.00		
B16.239		250 mm diameter	No.	3.00		
B16.240		315 mm diameter	No.	11.00		
B16.241	8.2.7	Extra-over item 8.2.1 for encasing joints with mastic putty and protective wrapping.	No.	90.00		
	8.2.11	Anchor/Thrust blocks and pedestals				
B16.242		Concrete Class 20/20 MPa	m ³	60.00		
B16.243		Formwork	m ²	60.00		
B16.244		Reinforcement	t	1.80		
	8.2.12	Concrete casing				
B16.245		Concrete Class 20/20 MPa	m ³	15.00		
	8.2.13	Valve and hydrant chambers				
B16.246		Valve chamber complete for pipes up to 315mm diameter	No.	35.00		
B16.247		Hydrant above ground level including pyramid concrete encasement	No.	18.00		
B16.248	PSL 8.2.16	Marker blocks	No.	20.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		POTABLE WATER				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B16.249		a) Selected granular material	m ³	140.00		
B16.250		b) Selected fill material	m ³	110.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.251		1) Selected granular material	m ³	100.00		
B16.252		2) Selected fill blanket	m ³	110.00		
	8.2.2.3	c) From commercial sources				
B16.253		1) Selected granular material	m ³	110.00		
B16.254		2) Selected fill material	m ³	55.00		
B16.255	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	5.00		
	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B16.256		a) 50 mm diameter	m ³	5.00		
B16.257		b) 75 mm diameter	m ³	5.00		
		SERVICE WATER				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B16.258		a) Selected granular material	m ³	145.00		
B16.259		b) Selected fill material	m ³	110.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.260		1) Selected granular material	m ³	145.00		
B16.261		2) Selected fill blanket	m ³	110.00		
	8.2.2.3	c) From commercial sources				
B16.262		1) Selected granular material	m ³	110.00		
B16.263		2) Selected fill material	m ³	60.00		
B16.264	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	5.00		
	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B16.265		a) 50 mm diameter	m ³	5.00		
B16.266		b) 90 mm diameter	m ³	5.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		FIRE WATER				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B16.267		a) Selected granular material	m ³	150.00		
B16.268		b) Selected fill material	m ³	100.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.269		1) Selected granular material	m ³	110.00		
B16.270		2) Selected fill blanket	m ³	100.00		
	8.2.2.3	c) From commercial sources				
B16.271		1) Selected granular material	m ³	110.00		
B16.272		2) Selected fill material	m ³	40.00		
B16.273	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	10.00		
	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B16.274		a) 90 mm diameter	m ³	5.00		
B16.275		b) 110 mm diameter	m ³	20.00		
B16.276		c) 140 mm diameter	m ³	30.00		
		SEWER				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B16.277		a) Selected granular material	m ³	25.00		
B16.278		b) Selected fill material	m ³	16.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.279		1) Selected granular material	m ³	20.00		
B16.280		2) Selected fill blanket	m ³	16.00		
	8.2.2.3	c) From commercial sources				
B16.281		1) Selected granular material	m ³	20.00		
B16.282		2) Selected fill material	m ³	8.00		
B16.283	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	3.00		
	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B16.284		a) 110 mm diameter	m ³	3.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		STORMWATER				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B16.285		a) Selected granular material	m ³	380.00		
B16.286		b) Selected fill material	m ³	120.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.287		1) Selected granular material	m ³	285.00		
B16.288		2) Selected fill blanket	m ³	120.00		
	8.2.2.3	c) From commercial sources				
B16.289		1) Selected granular material	m ³	285.00		
B16.290		2) Selected fill material	m ³	60.00		
B16.291	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	10.00		
	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B16.292		a) 450 mm diameter	m ³	20.00		
B16.293		b) 500 mm diameter	m ³	25.00		
B16.294		c) 600 mm diameter	m ³	35.00		
B16.295		d) 700 mm diameter	m ³	20.00		
B16.296		e) 800 mm diameter	m ³	25.00		
		SUB-SURFACE DRAINS				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B16.297		a) Selected granular material	m ³	100.00		
B16.298		b) Selected fill material	m ³	65.00		
B16.299		c) Permeable backfill material above sub-surface drains	m ³	30.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.300		1) Selected granular material	m ³	15.00		
B16.301		2) Selected fill blanket	m ³	10.00		
B16.302		3) Permeable backfill material above sub-surface drains	m ³	30.00		
	8.2.2.3	c) From commercial sources				
B16.303		1) Selected granular material	m ³	30.00		
B16.304		2) Selected fill material	m ³	20.00		
B16.305		3) Permeable backfill material above sub-surface drains	m ³	315.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.306	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	5.00		
		DUCTS				
	SANS	BEDDING (PIPES)				
	1200 LB					
	8.2.1	Provision of bedding from trench excavation				
B16.307		a) Selected granular material	m ³	45.00		
B16.308		b) Selected fill material	m ³	30.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B16.309		1) Selected granular material	m ³	35.00		
B16.310		2) Selected fill blanket	m ³	30.00		
	8.2.2.3	c) From commercial sources				
B16.311		1) Selected granular material	m ³	35.00		
B16.312		2) Selected fill material	m ³	20.00		
B16.313	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	2.00		
	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B16.314		a) 110 mm diameter	m ³	5.00		
B16.315		b) 160 mm diameter	m ³	5.00		
B16.316		c) Set of two 110 mm diameter pipes	m ³	8.00		
B16.317		d) Set of three 110 mm diameter pipes	m ³	7.00		
B16.318		e) Set of four 110 mm diameter pipes	m ³	7.00		
	SANS	CABLE DUCTS				
	1200 LC					
	8.2.5	Supply, lay, bed and prove duct				
B16.319		110 mm diameter uPVC pipes	m	80.00		
B16.320		160 mm diameter uPVC pipes	m	110.00		
B16.321		Set of two 110 mm diameter uPVC pipes	m	135.00		
B16.322		Set of three 110 mm diameter uPVC pipes	m	55.00		
B16.323		Set of four 110 mm diameter uPVC pipes	m	10.00		
		Extra-over ducts for closed and sealed ends:				
B16.324		110 mm diameter pipes	No.	66.00		
B16.325		160 mm diameter pipes	No.	10.00		
	8.2.7	Draw pits/manholes				
B16.326		Draw pit 600 mm x 600 mm x up to 1000mm deep complete with covers	No.	28.00		
	8.2.8	Cable markers				
B16.327		a) Route marker for cables, water etc	No.	28.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.328	SANS 1200 LD 8.2.1	SEWERS Supply, lay, joint, bed (flexible pipe bedding) and test pipeline HDPE pipes Class PN10 with butt welded joints 110 mm diameter	m	272.00		Rate Only
B16.329	8.2.2	Extra-over item 8.2.1 for butt welded welded specials 110 mm diameter x 45 degree bends	No.	6.00		
B16.330		110 mm diameter end caps	No.	2.00		
B16.331	8.2.5	Inspection chambers, etc. 1000mm diameter precast concrete, complete with Type 4 cover and frame, for depths Up to 1,0 m	No.	-		
B16.332		Over 1,0 m and up to 2,0 m	No.	2.00		
B16.333		Over 2,0 m and up to 3,0 m	No.	1.00		
B16.334		Over 3,0 m and up to 4,0 m	No.	3.00		
B16.335		Over 4,0 m and up to 5,0 m	No.	1.00		
B16.336		Over 5,0 m and up to 6,0 m	No.	2.00		
B16.337		Extra-over item 8.2.5 for Type 2A cover and frame in road areas	No.	4.00		
B16.338	8.2.7	Encasing of pipes in concrete Class 20/20 MPa a) 110 mm diameter	m ³	15.00		
B16.339	8.2.8	Anchor blocks, concrete Class 20/20 MPa	m ³	5.00		
B16.340	8.2.9	Marker posts, complete and installed	No.	5.00		
B16.341	SANS 1200 LE PSLE 8.2.1	STORMWATER DRAINAGE Supply and lay HDPE Class PN10 pipes with butt welded joints a) 450 mm diameter	m	274.00		
B16.342		b) 500 mm diameter	m	195.00		
B16.343		c) 600 mm diameter	m	22.00		
B16.344		d) 700 mm diameter	m	368.00		
B16.345		e) 800 mm diameter	m	337.00		
B16.346	8.2.8	Supply and install manholes, catchpits, and the like complete with covers and frames a) 1000 mm diameter precast concrete manhole, standard depth 1,0 m	No.	29.00		Rate Only
B16.347		c) Extra-over item 8.2.8a above for variation in depth of manhole from the standard depth (standard depth 1,0 m)	m	15.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.348		d) Kerb inlets in the following depths: Up to 1,0 m deep	No.	3.00		
B16.349		Over 1,0 m and up to 2,0 m deep	No.	1.00		
B16.350		Over 2,0 m and up to 3,0 m deep	No.	1.00		
B16.351		e) Outlet structure	No.	1.00		
B16.352		f) 1000 mm diameter precast concrete subsurface drain sump or manhole, standard depth 2,0 m including 450 x 450 x 450 mm deep concrete sump in bottom	No.	1.00		
B16.353		g) 1200 mm diameter precast concrete sub-surface drain sump or manhole, standard depth 2,0m including 450 x 450 x 450 mm deep concrete sump in bottom	No.	2.00		
B16.354		h) Extra-over item 8.2.8g above for variation in depth of subsurface drain sump or manhole from the standard depth (standard depth 2,0 m)	m	10.00		
SUBSURFACE DRAINS						
PSLE 8.2.14 Pipes in subsurface drains:						
B16.355		a) Megaflo MEG150 perforated drainage panel system complete with joints, underneath structures	m	460.00		
B16.356		b) Normal duty uPVC or similar approved pipes complete with couplings, underneath structures: 100 mm internal diameter, perforated	m	330.00		
B16.357		100 mm internal diameter, perforated, curved	m	130.00		
B16.358		c) HDPE PN 10 pipes with butt welded joints: 110 mm internal diameter	m	453.00		
B16.359		d) Extra-over uPVC perforated pipes for specials and fittings, 100mm diameter: Tees or junctions 45 degree	No.	6.00		
B16.360		Bends 11,25 degree	No.	40.00		
B16.361		e) Extra-over HDPE PN10 pipes for specials and fittings (butt welded jointed), 110 mm diameter: Tees or junctions 45 degree	No.	6.00		
B16.362		Bends 45 degree	No.	4.00		
B16.363		Bends 22,5 degree	No.	2.00		
B16.364		Cleaning eye / inspection eye complete with access lid, precast concrete surround, CI cover and frame as well as all junctions, bends, pipes etc. for connection to sub-surface drains	No.	40.00		
Total Carried Forward						

SCHEDULE 16: SERVICES - WATER, SEWER, STORMWATER, ETC.

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B16.365	PSLE 8.2.15	A4 Bidim	m ²	1,035.00		
B16.366	PSLE 8.2.16	Crushed stone in subsurface drains	m ³	90.00		
B16.367	PSLE 8.2.17	Class 20/20 MPa concrete outlet structures for subsurface drains (including formwork)	m ³	10.00		
B16.368	PSLE 8.2.18	Concrete caps for subsurface drain pipes	No.	10.00		
	SANS 1200 LE PSLE 8.2.1	FERRIC CHLORIDE BUND AREA STORMWATER DRAINAGE Supply and lay uPVC acid resistant pipes with welded or screwed joints:				
B16.369		a) 50 mm diameter Extra-over item 8.2.1a for screw ended specials:	m	10.00		
B16.370		50 mm diameter x 45 degree bends	No.	2.00		
B16.371		50 mm diameter x 90 degree bends	No.	2.00		
B16.372		50 mm diameter flange or screw adaptors Extra-over item 8.2.1a for supplying, fixing and bedding of valves:	No.	4.00		
B16.373		50 mm diameter acid resistant PVC female screw-end gate valve with handwheel lock	No.	1.00		
B16.374		50 mm diameter acid resistant PVC flanged gate valve with handwheel lock	No.	1.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 17: LANDSCAPING

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B17		SECTION 5800				
		This schedule is based on COLTO Specifications				
	5800	LANDSCAPING AND PLANTING PLANTS				
	58.01	Trimming:				
B17.001		(a) Machine trimming	m ²	16,920.50		
B17.002		(b) Hand trimming (provisional)	m ²	100.00		
	58.02	Using machines for trimming or shaping:				
B17.003		(b) Motor grader	hour	28.00		
B17.004		(c) TLB	hour	65.00		
	PS58.03	Preparing the areas for grassing:				
B17.005		(a) Ripping	ha	11.00		
B17.006		(b) Scarifying for loosening topsoil	ha	26.00		
		(c) Topsoiling within the road reserve, where the following materials are used:				
B17.007		(i) Topsoil obtained from existing stock piles including unlimited free-haul distance	m ³	4,538.00		
		(e) Providing and applying chemical fertilisers and/or soil-improvement material:				
B17.008		(ii) Superphosphate	t	20.00		
B17.009		(iv) 3:2:1(25)	t	20.00		
		(f) Stockpiling of topsoil:				
B17.010		(i) including unlimited free-haul distance	m ³	500.00		
	58.04	Grassing:				
		(c) Hydroseeding:				
B17.011		(i) Providing an approved seed mixture for hydroseeding	kg	900.00		
B17.012		(iii) Hydroseeding	ha	35.00		
B17.013	58.06	Watering the already planted grass, trees and shrubs during periods of drought experienced during the growing season	kl	3,000.00		
B17.014	58.07	Mowing the grass	ha	35.00		
B17.015	PS58.12	Eco-friendly bio-degradable erosion protection fabric (soil Saver or similar)	m ²	35,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B18	SANS 1200 G	CONCRETE (STRUCTURAL) HEAD OF WORKS				
	PSG 8.5	JOINTS				
		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in:				
B18.001		Walls up to 300 mm thick	m ²	108.00		
B18.002		Walls exceeding 400 mm and up to 500 mm thick	m ²	20.00		
		b) Construction joints as detailed on the drawings and/or specified in the project specifications:				
B18.003		Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	29.00		
B18.004		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	374.00		
		c) Movement joints as detailed on the drawings and/or specified in the project specifications:				
		Joint Type 3 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape in:				
B18.005		Floors up to 300 mm thick	m	20.00		
B18.006		Slabs up to 300 mm thick	m	2.00		
		Joint Type 4 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape in:				
B18.007		Walls up to 300 mm thick	m	22.00		
B18.008		Walls exceeding 300 mm and up to 500mm thick	m	7.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	537.00		
B18.009		Straight to walls up to 300 mm thick (both sides of walls measured)	m	14.00		
B18.010		Straight to walls exceeding 400 mm and up to 500 mm thick (both sides of walls measured)	m	1.00		
B18.011		Curved on plan to not exceeding 300 mm radius to walls	m	98.00		
B18.012		Curved on plan to exceeding 300 mm radius to walls up to 300 mm thick (both sides of walls measured)	m			
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m²	1,244.00		
B18.013						
	PSG 8.5	PRIMARY SETTLING TANKS JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m²	85.00		
B18.014		Columns	m²	2.00		
B18.015						
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.016	PSG 8.9	b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	9.00		
B18.017		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	238.00		
		Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
B18.018		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	50.00		
B18.019		Curved on plan to exceeding 300 mm radius to walls up to 300 mm thick (both sides of walls measured)	m	380.00		
B18.020		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	52.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		PRIMARY SLUDGE PUMP STATION				
	PSG 8.5	JOINTS				
B18.021		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	11.00		
B18.022		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	48.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
		3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
B18.023		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	72.00		
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK:				
		Polyethylene sheeting under floor slabs:				
B18.024		250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	49.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		BALANCING TANK				
	PSG 8.5	JOINTS				
B18.025		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	61.00		
B18.026		Columns	m ²	5.00		
		b) Construction joints as detailed on the drawings and/or specified in the project specifications:				
B18.027		Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	67.00		
B18.028		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	273.00		
		c) Movement joints as detailed on the drawings and/or specified in the project specifications:				
B18.029		Joint Type 3 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape in: Floors up to 300 mm thick	m	82.00		
B18.030		Joint Type 4 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape in: Walls up to 300 mm thick	m	6.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.031	PSG 8.9	3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured) and columns	m	486.00		
B18.032		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	25.00		
	PSG 8.5	BIOLOGICAL REACTOR				
		JOINTS				
B18.033		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	200.00		
B18.034		Walls exceeding 400 mm and up to 500 mm thick	m ²	216.00		
B18.035		Columns	m ²	10.00		
B18.036		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	326.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.037		Joint Type 1 in slabs complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	13.00		
B18.038		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	490.00		
		c) Movement joints as detailed on the drawings and/or specified in the project specifications:				
		Joint Type 3 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape in:				
B18.039		Floors up to 300 mm thick	m	154.00		
B18.040		Floors exceeding 300 mm and up to 500mm thick	m	32.00		
B18.041		Slabs up to 300 mm thick	m	17.00		
		Joint Type 4 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape in:				
B18.042		Walls up to 300 mm thick	m	44.00		
B18.043		Walls exceeding 300 mm and up to 500 mm thick	m	38.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
		3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval:				
B18.044		Straight to walls up to 300 mm thick (both sides of walls measured)	m	286.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.045	PSG 8.9	Straight to walls exceeding 400 mm and up to 500 mm thick (both sides of walls measured)	m	509.00		
B18.046		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	4,453.00		
	PSG 8.5	DIVIDING CHAMBER NO 2				
		JOINTS				
		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in:				
B18.047		Walls up to 300 mm thick	m ²	13.00		
B18.048		Walls exceeding 400 mm and up to 500 mm thick	m ²	5.00		
		b) Construction joints as detailed on the drawings and/or specified in the project specifications:				
B18.049		Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	7.00		
B18.050		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	43.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.051	PSG 8.9	3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	72.00		
B18.052		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	76.00		
	PSG 8.5	SECONDARY SETTLING TANKS				
		JOINTS				
B18.053		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	96.00		
B18.054		Columns	m ²	2.00		
B18.055		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	4.00		
B18.056		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	257.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured) Curved on plan to exceeding 300 mm radius to walls up to 300 mm thick (both sides of walls measured)				
B18.057			m	20.00		
B18.058			m	444.00		
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete				
B18.059			m ²	48.00		
	PSG 8.5	RAS PUMP STATION JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick				
B18.060			m ²	15.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.061		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	55.00		
B18.062	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m	98.00		
B18.063		SLUDGE DAY TANK JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	97.00		
B18.064	PSG 8.5		m ²	41.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.065	PSG 8.9	b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	2.00		
B18.066		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	162.00		
		Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
B18.067		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	270.00		
B18.068		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	293.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		PINCH VALVE CHAMBER				
	PSG 8.5	JOINTS				
B18.069		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	9.00		
B18.070		Columns	m ²	1.00		
B18.071		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	42.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
		3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
B18.072		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured) and columns	m	69.00		
B18.073		Straight to columns projecting from wall line surface	m	3.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.074	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	77.00		
		WASHWATER DAY TANK				
	PSG 8.5	JOINTS				
B18.075		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	4.00		
B18.076		Walls exceeding 300 mm and up to 400 mm thick	m ²	29.00		
B18.077		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	8.00		
B18.078		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	110.00		
		Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.079	PSG 8.9	d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	26.00		
B18.080		Straight to walls exceeding 300 mm and up to 400 mm thick (both sides of walls measured)	m	152.00		
B18.081		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m²	226.00		
	PSG 8.5	THIN SLUDGE TANK				
		JOINTS				
B18.082		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m²	1.00		
B18.083		Walls exceeding 300 mm and up to 400 mm thick	m²	15.00		
B18.084		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	4.00		
B18.085		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	44.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.086	PSG 8.9	Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls exceeding 300 mm and up to 400 mm thick (both sides of walls measured)	m	87.00		
B18.087		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	51.00		
B18.088	PSG 8.5	THICK SLUDGE TANK JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls exceeding 300 mm and up to 400 mm thick	m ²	23.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.089	PSG 8.9	b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls exceeding 300 mm and up to 400 mm thick (both sides of walls measured)	m	66.00		
B18.090		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m	117.00		
B18.091			m²	163.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		FILTRATE SUMP				
	PSG 8.5	JOINTS				
B18.092		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	1.00		
B18.093		Walls exceeding 300 mm and up to 400 mm thick	m ²	21.00		
		b) Construction joints as detailed on the drawings and/or specified in the project specifications:				
B18.094		Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	4.00		
B18.095		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	69.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
		3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval:				
B18.096		Straight to walls up to 300 mm thick (both sides of walls measured)	m	3.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.097	PSG 8.9	Straight to walls exceeding 300 mm and up to 400 mm thick (both sides of walls measured)	m	122.00		
B18.098		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	132.00		
	PSG 8.5	FERRIC CHLORIDE BULK TANKS				
		JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in:				
B18.099		Walls up to 300 mm thick	m ²	7.00		
B18.100		Columns	m ²	1.00		
B18.101		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	9.00		
B18.102		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	33.00		
		Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.103	PSG 8.9	3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	59.00		
B18.104		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m²	74.00		
	PSG 8.5	PRECIPITATION TANK				
B18.105		JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m²	36.00		
B18.106		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	16.00		
B18.107		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	170.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.108	PSG 8.9	Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	240.00		
B18.109		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m²	208.00		
	PSG 8.5	WAS DAY TANK JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls exceeding 300 mm and up to 400 mm thick	m²	28.00		
B18.111		Columns	m²	2.00		
		b) Construction joints as detailed on the drawings and/or specified in the project specifications:				
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.112	PSG 8.9	Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval:	m	77.00		
B18.113		Straight to walls up to 300 mm thick (both sides of walls measured) and columns	m	24.00		
B18.114		Curved on plan to exceeding 300 mm radius to walls exceeding 300 mm and up to 400 mm thick (both sides of walls measured)	m	136.00		
B18.115		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m ²	410.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		SLUDGE DIGESTERS				
	PSG 8.5	JOINTS				
B18.116		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	7.00		
B18.117		Walls exceeding 400 mm and up to 500mm thick	m ²	99.00		
B18.118		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	489.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
		3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns				
B18.119		d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)	m	46.00		
B18.120		Curved on plan to exceeding 300 mm radius to walls exceeding 400 mm and up to 500mm thick (both sides of walls measured)	m	388.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B18.121		STEEL STAIRCASES AND BRIDGES				
	PSG 8.5	JOINTS				
	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concrete	m ²	39.00		
	SANS 1200 G	CONCRETE (STRUCTURAL) SCUM SEPARATING TANK				
B18.122	PSG 8.5	JOINTS a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 250 mm thick	m ²	3.00		
B18.123		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	6.00		
B18.124		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2mm thick tape	m	7.00		
Total Carried Forward						

SCHEDULE 18: STRUCTURAL JOINTS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		Kicker Joints Notes: 1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions 2. Kicker steel channel sections are not measured at upstand beams, kerbs etc 3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns c) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured)				
B18.125	PSG 8.9		m	12.00		
B18.126		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer or skim/plaster coat on top of No Fines concete	m²	8.50		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 19: RETAINING BLOCK WALLS AND PLATFORMS PAVING

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B19	PC	CONCRETE RETAINING BLOCK WALLS				
	5.001	Patented earth retaining systems:				
B19.001		Löffelstein precast concrete blocks of type L500	m ²	1,080.00		
	5.002	Excavation for patented earth retaining systems:				
		a) In soft material for:				
B19.002		Block wall foundation	m ³	30.00		
B19.003		Excavation at back of block wall to construct drainage system	m ³	510.00		
B19.004		b) Extra over sub-item 5.002(a) for excavation in hard material	m ³	270.00		
B19.005	5.003	Concrete bases for earth retaining systems, Class 30/Mpa, dolomitic aggregate	m ³	30.00		
B19.006	PSLE 8.2.15	A4 Bidim	m ²	2,155.00		
	PSD 8.3.4	Importing of materials:				
B19.007		Permeable material from commercial sources in filling behind earth retaining systems	m ³	520.00		
		PLATFORM PAVING				
	SANS 1200 D	EARTHWORKS				
	8.3.2	Bulk excavation				
	8.3.2(a)	Excavate in all materials and use for embankment or backfill or dispose, as ordered:				
B19.008		Embankments or berms (excavation to reduce levels under platform paving)	m ³	5,550.00		
B19.009		Dispose off-site at unspecified site selected by the Contractor	m ³	2,380.00		
	8.3.2(b)	Extra over item 8.3.2(a) for excavation in:				
B19.010		Intermediate material	m ³	3,170.00		
B19.011		Hard rock material	m ³	2,380.00		
B19.012	PSD 8.3.14	Extra over items 8.3.2(a) and 8.3.3(a) for temporary stockpiling	m ³	3,965.00		
B19.013	PSD 8.3.15	Extra over items 8.3.2(a) and 8.3.3(a) for disposing of spoil material on a site provided by the Contractor	m ³	2,380.00		
Total Carried Forward						

SCHEDULE 19: RETAINING BLOCK WALLS AND PLATFORMS PAVING

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B19.014	SANS 1200 DM	EARTHWORKS (ROADS, SUBGRADE)				
	8.3.3	Treatment of road-bed:				
	8.3.3(a)	Road-bed preparation and compaction of material				
		Compact to 90 % mod. AASHTO maximum density	m ³	3,000.00		
B19.015	8.3.3(b)	In-place treatment of road-bed in intermediate or hard material by Ripping	m ³	965.00		
B19.016	PSDM 8.3.5	Selected layer using material from designated borrow pits or excavation: Compacted to 90 % of modified AASHTO maximum density (G7 material from stockpiles using material from PSD 8.3.14 above)	m ³	200.00		
B19.017		Compacted to 93 % of modified AASHTO maximum density (G7 material from stockpiles using material from PSD 8.3.14 above)	m ³	3,765.00		
B19.018	PSDM 8.3.17	Extra over items 8.3.4, 8.3.5 and 8.3.16 for obtaining material from commercial sources	m ³	500.00		
B19.019	PSDM 8.3.18	Final finishing and cleaning up of the site of the works	Sum	1.00		
B19.020	SANS 1200 ME	SUBBASE				
	PSME 8.3.2	Construct the subbase course with material from designated excavations:				
		a) Construct subbase course with material from excavations, select and stockpile or place on the road	m ³	200.00		
		b) Construct subbase course with material from stockpile	m ³	200.00		
B19.022	PSME 8.3.3	Construct the subbase course with materials from commercial sources	m ³	3,565.00		
B19.023	8.3.5	Process material by the following processes: Stabilization	m ³	3,565.00		
B19.024	8.3.8	Stabilizing agent Portland cement	t	214.00		
Total Carried Forward						

SCHEDULE 19: RETAINING BLOCK WALLS AND PLATFORMS PAVING

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B19.025	PSME 8.3.11	Treatment of subbase or base with: Weed-killer	m ²	26,430.00		
B19.026		Insecticide	m ²	26,430.00		
	SANS 1200 MJ	SEGMENTED PAVING				
B19.027	8.2.1	Provision of edge restraints	m	200.00		
B19.028	PSMJ 8.2.2	Construction of paving complete: Type S-A blocks, 60 mm thick	m ²	26,430.00		
B19.029	8.2.4	Rolling to locked-up condition	m ²	26,430.00		
B19.030	8.2.5	Trial section	m ²	20.00		
	SANS 1200 MK	KERBING AND CHANNELLING				
	PSMK 8.2.1	Concrete kerbing				
B19.031		Precast concrete kerbing to SANS 927, Figure 8a, mountable: Radius up to 4 m	m	150.00		
B19.032		Radius over 4 m up to 20 m	m	105.00		
		Radius over 20 m and straight sections	m	2,300.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 20: SITE WORKS - EARTHWORKS AND ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B20	SANS 1200 C	SITE CLEARANCE CLEAR SITE				
B20.001	PSC8.2.1	Clear and grub	ha	1.57		
B20.002	8.2.4	Reclear surfaces (where ordered by Engineer)	ha	1.57		
	SANS 1200 D	EARTHWORKS				
	8.3.2	Bulk excavation				
	8.3.2(a)	Excavate in all materials and use for embankment or backfill or dispose, as ordered:				
B20.003		G5 material from existing stockpiles in backfill around new structures or buildings, compacted in 150 mm thick layers to 93% modified AASHTO density	m ³	74,050.00		
B20.004		Dispose off-site at unspecified site selected by the Contractor	m ³	-		Rate Only
	8.3.3	Restricted excavation				
	PSD 8.3.3(a)	Excavate for restricted foundations, footings and pipe trenches in all materials and use for backfill or embankment or dispose:				
B20.005		Structures	m ³	350.00		
B20.006		Trenches	m ³	130.00		
	8.3.3(b)	Extra over item 8.3.3(a) for excavation in:				
B20.007		Intermediate material	m ³	30.00		
B20.008		Hard rock material	m ³	30.00		
B20.009	PSD 8.3.3(b)(5)	Hard rock excavation without using explosives	m ³	250.00		
B20.010	PSD 8.3.3(c)	Extra over item 8.3.3(a) for hand excavation	m ³	170.00		
	PSD 8.3.4	Importing of materials:				
B20.011	PSD 8.3.4(a)	Extra over items 8.3.2 and 8.3.3 for materials from commercial sources (G5 material classification)	m ³	25,917.50		
B20.012	PSD 8.3.4(d)	Extra over items 8.3.2 and 8.3.3 for importation of material from other excavations on site	m ³	110.00		
B20.013	8.3.5	Extra excavation in all materials to provide working space around structures (for outside formwork)	m ²	330.00		
B20.014	PSD 8.3.10	Topsoiling (obtained from existing stockpiles)	m ³	700.00		
B20.015	PSD 8.3.14	Extra over items 8.3.2(a) and 8.3.3(a) for temporary stockpiling	m ³	-		Rate Only
Total Carried Forward						

SCHEDULE 20: SITE WORKS - EARTHWORKS AND ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B20.016	SANS 1200 A. 1200 H SANS 1200 H (Cl. 5.1) 1200 A (Cl. 7.1)	Demolition and Excavation of Concrete Demolishing unreinforced concrete manually or mechanically (e.g., in foundations, mass concrete) including breaking up and stacking serviceable material within a specified lead on-site.	m ³	1,000.00		
B20.016	SANS 1200 H (Cl. 5.1) 1200 A (Cl. 7.1)	Demolishing reinforced concrete (e.g., slabs, beams, walls) including cutting/stacking steel reinforcement bars and stacking/disposing of unserviceable concrete material within a specified lead on-site	m ³	2,000.00		
B20.017	SANS 1200 H (Cl.5.1) 1200 DA(Cl.7.1)	Breaking out existing concrete surface beds (specified thickness, e.g., 150mm deep) including mesh wire reinforcement and disposal of material.	m ²	500.00		
B20.018	SANS 1200 DM 8.3.3 PSDM 8.3.3(a)	EARTHWORKS (ROADS, SUBGRADE) Treatment of road-bed: Road-bed preparation and compaction of material Compact to 93 % mod. AASHTO maximum density	m ³	40.00		
B20.019		Compact to 95 % mod. AASHTO maximum density (existing 200 mm thick subbase compacted to 95% mod. AASHTO density to be ripped or scarified and re-compacted after stabilization as measured in 1200 ME)	m ³	2,354.00		
B20.020	PSDM 8.3.18	Final finishing and cleaning up of the site of the works	Sum	1.00		
B20.021	COLTO SECTION 3300 33.13	MASS EARTHWORKS Finishing-off cut and fill slopes, medians and interchange areas: Cut slopes	m ²	1,287.00		
B20.022		Fill slopes	m ²	322.00		
B20.023	SANS 1200 ME PSME 8.3.3	SUBBASE Construct the subbase course with materials from commercial sources (shortfall of material in existing subbase)	m ³	100.00		
B20.024	8.3.5	Process material by the following processes: Stabilization (existing 200 mm thick subbase constructed by others, ripped and scarified to enable stabilization processing. Ripping, scarifying and compaction measured in 1200 DM)	m ³	2,354.00		
B20.025		Stabilization (shortfall of material in existing subbase)	m ³	100.00		
B20.026	8.3.8	Stabilizing agent CEM II (as approved by the Engineer)	t	197.00		
Total Carried Forward						

SCHEDULE 20: SITE WORKS - EARTHWORKS AND ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	PSME 8.3.11	Treatment of subbase or base with:				
B20.027		Weed-killer	m²	15,692.00		
B20.028		Insecticide	m²	15,692.00		
	SANS 1200 MJ	SEGMENTED PAVING				
B20.029	8.2.1	Provision of edge restraints	m	150.00		
	PSMJ 8.2.2	Construction of paving complete:				
B20.030		Type S-A blocks, 60 mm thick	m²	15,692.00		
B20.031	8.2.4	Rolling to locked-up condition	m²	15,692.00		
B20.032	8.2.5	Trial section	m²	20.00		
	SANS 1200 MK	KERBING AND CHANNELLING				
	PSMK 8.2.1	Concrete kerbing				
		Precast concrete kerbing to SANS 927, Figure 7:				
B20.033		Radius up to 4 m	m	2.00		
B20.034		Radius over 4 m up to 20 m	m	10.00		
B20.035		Radius over 20 m and straight sections	m	20.00		
	8.2.2	Concrete kerbing and channelling combined				
		Precast concrete to SANS 927, Type battered, Figure 7 kerb with 600 mm wide cast-in-situ class 20/20 MPa concrete channel:				
B20.036		Radius up to 4 m	m	2.00		
B20.037		Radius over 4 m up to 20 m	m	45.00		
B20.038		Radius over 20 m and straight sections	m	3,975.00		
	8.2.5	Chutes, typical designs:				
B20.039		Prefabricated Class 20/20 MPa concrete chutes down side slopes	m	60.00		
		Cast-in-situ concrete chutes (measured by components) down side slopes:				
B20.040		Concrete class 25/20 MPa	m³	50.00		
B20.041		Formwork, smooth surface	m²	150.00		
Total Carried Forward						

SCHEDULE 20: SITE WORKS - EARTHWORKS AND ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B20.043	8.2.6 8.2.6.1	Ancillaries: Inlet, outlet, transition and similar structures (typical designs): Inlet structures for chutes down side slopes, class 20/20 MPa concrete, complete	No.	5.00		
B20.044		Outlet structures for chutes down side slopes, class 20/20 MPa concrete, complete with prefabricated reinforced-concrete blocks, class 20/20 MPa	No.	5.00		
B20.045	8.2.6.2	Inlet, outlet, transition and similar structures (measured by components): a) Excavations in soft and intermediate material	m ³	4.00		
B20.046	8.2.8	b) Concrete, specified strength 20 MPa	m ³	8.00		
B20.047	8.2.9	c) Formwork: 1) Internal face	m ²	15.00		
B20.048		2) External face	m ²	18.00		
B20.049	8.2.12	d) Steel reinforcement	t	0.50		
B20.050	8.2.13	e) Sprayed bitumen emulsion primer	m ²	20.00		
B20.051	8.2.11	Concrete screed below chute, where and as ordered only	m ³	3.00		
	SANS 1200 MM	ANCILLARY ROADWORKS				
	8.3	PERMANENT ROAD SIGNS Sign faces with painted or galvanized (as stated) background. Symbols, characters, legend and borders in engineering grade retro-reflective material with signboards constructed from:				
B20.052	8.3.1	c) Chromadek or approved painted galvanized sheet steel (1,6 mm thick), of area: Up to 2 m2	m ²	40.00		
B20.053		Over 2 m2 up to 10 m2	m ²	40.00		
B20.054		Over 10 m2 up to 15 m2	m ²	40.00		
B20.055	8.3.2	Extra over item 8.3.1 for using a) Engineering grade retro-reflective background (Class II)	m ²	10.00		
B20.056		b) High intensity grade retro-reflective background, characters, symbols, legend and borders (	m ²	10.00		
Total Carried Forward						

SCHEDULE 20: SITE WORKS - EARTHWORKS AND ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.3.3	Sign Supports				
B20.057		b) Steel tubing galvanized, with minimum wall thickness 3.5 mm:				
		Outside diameter of 50 mm	t	1.00		
B20.058		Outside diameter of 150 mm	m	50.00		
	8.3.4	Excavation for sign supports and backfilling with:				
B20.059		In-situ material	m ³	10.00		
B20.060		Soilcrete	m ³	10.00		
	8.4	ROAD MARKINGS				
	8.4.1	Non-reflectORIZED paint applied at nominal rate of 0,42 l/m2 (or proprietary brand roadmarking material applied at a nominal rate of 0.40 l/m2)				
		a) White lines (broken or unbroken):				
B20.061		100 mm wide	km	1.00		
B20.062		150 mm wide	km	1.00		
		b) Yellow lines (broken or unbroken):				
B20.063		100 mm wide	km	1.00		
B20.064		150 mm wide	km	1.00		
B20.065		c) White characters and symbols	m ²	50.00		
B20.066		d) Yellow characters and symbols	m ²	50.00		
B20.067		e) Traffic island markings (any colour)	m ²	5.00		
	8.4.2	Variation in rate of application from that stated for item 8.4.1				
B20.068		a) White paint	litre	20.00		
B20.069		b) Yellow paint	litre	20.00		
B20.070		d) Proprietary brand roadmarking material	litre	10.00		
	8.4.4	Setting out and premarking:				
B20.071		a) Lines (excluding traffic island markings, characters and symbols)	km	4.00		
B20.072		b) Special markings, lettering and symbols	Sum	1.00		
	PSA 8.5	SUMS STATED PROVISIONALLY BY ENGINEER				
		b) For work to be executed by the Employer or a nominated subcontractor:				
B20.073		Other special tests requested by the Engineer	Prov Sum	1.00	142,000.00	142,000.00
B20.074		Overheads, charges and profit on PS8.5(b) above	%	142,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 21: PARSHALL FLUMES AND CHANNELS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B21	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.2	Smooth:				
B21.001		Vertical formwork to: Sides of walls	m ²	829.00		
B21.002		Vertical curved formwork to: Sides of walls	m ²	29.00		
B21.003		Conical formwork : Sides of walls	m ²	6.00		
		Horizontal Soffit of Floors propped not exceeding 5.0m	m ²	38.00		
B21.005	8.2.5	Narrow widths up to 300 mm wide or high: Floor slab edges, end of walls, sides of openings, etc	m	479.00		
B21.006	8.2.5	Box out holes/form voids 80mmx120mm recess for channel gate	m	11.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B21.007		a) 8 mm	t	3.43		
		High-tensile steel bars				
B21.008		a) 8 mm	t	3.43		
B21.009		b) 10 mm	t	3.43		
B21.010		c) 12 mm	t	13.69		
B21.011		d) 16 mm	t	10.27		
B21.012	8.3.2	High-tensile welded mesh reinforcement Type reference 888 in aprons etc	m ²	66.00		
	8.4	CONCRETE				
B21.013	8.4.1	Mass concrete: 20 MPa/20mm Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	3.00		
B21.014	8.4.2	Blinding layer in 15 MPa/20 mm concrete 75 mm minimum thickness	m ²	425.00		
Total Carried Forward						

SCHEDULE 21: PARSHALL FLUMES AND CHANNELS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B21.015	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures Floors, footings, walls, slabs, etc.	m ³	286.00		
B21.016	8.4.4	UNFORMED SURFACE FINISHES Wood-floated finish Top of stairs including brushed finish	m ²	33.00		
B21.017		Steel-floated finish Top of walls	m ²	127.00		
B21.018		Top of floors	m ²	440.00		
B21.019	8.8	HD BOLTS AND MISCELLANEOUS METAL WORK: Supply and install Parshall Flumes, manufactured from minimum 4.5 mm thick stainless steel 304L sheeting, complete with floors, sides, throat, bracing, welding, fixing anchors etc and cast into concrete channel in exact position: Prefabricated 304L Stainless steel 1.0 Foot flume to fit structure as shown on the drawings	No.	3.00		
B21.020	PSG 8.9	MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting on top of concrete blinding layer	m ²	440.00		
B21.021	PSG 8.10	Testing for watertightness: BR Channel	Sum	1.00		
B21.022		SST Channels	Sum	1.00		
B21.023	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Up to 300mm nominal bore: Ø75mm uPVC stilling wells at flume	No.	3.00		
B21.024		Over 800 and up to 1000mm nominal bore: Ø1000mm HDPE	No.	3.00		
B21.025	PSG 8.13	SOILCRETE Soilcrete filling under and around structures	m ³	2.00		
B21.026	PSG 8.17	Supply and delivery of linear scale plates excluding pointers for parshall flumes	No.	3.00		
B21.027	PSG 8.18	Installation, calibration, testing, commissioning and maintenance of linear scale plates excluding pointers for parshall flumes	No.	3.00		
Total Carried Forward						

SCHEDULE 21: PARSHALL FLUMES AND CHANNELS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	SANS 1200H	STRUCTURAL STEELWORK				
		c) Handrails, HDG, 1m high standard ball type, top or side mounted:				
		Rails only (hand and knee rails):				
B21.028		Horizontal	m	465.00		
B21.029		Stanchions only	No.	255.00		
		Bends, end closures and accessories:				
B21.030		22.5 deg knees or corners	No.	22.00		
		135 deg knees or corners	No.	11.00		
B21.032		90 deg end closure	No.	61.00		
B21.033		HD bolts, nuts and washers for each stanchion	Sets	255.00		
	PSH 8.3.9	Flooring, complete and installed with frames:				
		a) Open grid floors:				
		Heavy duty Fibre Glass Reinforced (FGR) open grid floors:				
B21.034		Banded panels with 45 x 5mm bearer bars	m ²	10.00		
		c) Frames and kerbs for flooring:				
		GRF angle section fixed to or cast into concrete:				
B21.035		40 x 40 x 5 mm	m	27.00		
	SANS 1200L	MEDIUM PRESSURE PIPELINES				
	8.2.5	Supply and place pipes, valves and specials (short pipe runs) complete with couplings:				
		a) HDPE SDR17 PE100 pipes (short runs), valves and specials:				
B21.036		Ø75mm 1 000mm plain one end, butt welded the other end	No.	5.00		
B21.037		Ø75mm 2 000mm plain one end, butt welded the other end	No.	5.00		
	8.2.2	Extra-over item 8.2.5 for supplying, and installing joint with machined collars and special couplings				
		90.00 degree bends:				
B21.038		Ø75mm HDPE SDR17 PE100	No.	5.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 22: DAYWORKS						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B22	Chapter 2: Particular Specification PE: Dayworks	DAYWORKS Refer to Particular Specification PE: Dayworks applicable to this Schedule 28: Dayworks A. Labour (rates to include overheads, charges and profit): Unskilled Semi-skilled Skilled Supervisor Foremen Tradesmen Artisan B. Vehicles, plant and equipment (rates to include overheads, fuel, operator's costs, charges and profit) Motor grader: Over 100 kW and 12 ton mass Loader: Rubber tyred from 60 kW and up to 100 kW and 12 ton mass Loader: Rubber tyred, 127 kW Excavator, 20 ton Excavator, 30 ton Hydraulic excavator (backactor), more than 60 kW with bucket at least 500 mm wide Bulldozer more than 70 kW D7 crawler dozer, 179 kW Mobile crane 15 ton Smooth drum roller, 10 ton TLB, 1 m ³ Low-bed tractor and trailer, 30 ton Tipper truck, more than 12 m ³ capacity Tipper truck, more than 5 m ³ capacity Vibrating roller more than 80 kW and 10ton mass Water trucks up to 12 kilolitre capacity Vibrating plate compactor with minimum capacity of 2 kW Flat bed truck equipped with hydraulic crane of more than 2 t capacity Flat bed truck equipped with hydraulic crane of more than 6 t capacity Compressor: Up to 10 m ³ /minute Standby generator	hrs	700.00		
B22.001		Unskilled	hrs	700.00		
B22.002		Semi-skilled	hrs	400.00		
B22.003		Skilled	hrs	100.00		
B22.004		Supervisor	hrs	24.00		
B22.005		Foremen	hrs	36.00		
B22.006		Tradesmen	hrs	84.00		
B22.007		Artisan	hrs	84.00		
B22.008		Motor grader: Over 100 kW and 12 ton mass	hrs	8.00		
B22.009		Loader: Rubber tyred from 60 kW and up to 100 kW and 12 ton mass	hrs	16.00		
B22.010		Loader: Rubber tyred, 127 kW	hrs	16.00		
B22.011		Excavator, 20 ton	hrs	8.00		
B22.012		Excavator, 30 ton	hrs	8.00		
B22.013		Hydraulic excavator (backactor), more than 60 kW with bucket at least 500 mm wide	hrs	24.00		
B22.014		Bulldozer more than 70 kW	hrs	8.00		
B22.015		D7 crawler dozer, 179 kW	hrs	8.00		
B22.016		Mobile crane 15 ton	hrs	16.00		
B22.017		Smooth drum roller, 10 ton	hrs	24.00		
B22.018		TLB, 1 m ³	hrs	80.00		
B22.019		Low-bed tractor and trailer, 30 ton	hrs	12.00		
B22.020		Tipper truck, more than 12 m ³ capacity	hrs	8.00		
B22.021		Tipper truck, more than 5 m ³ capacity	hrs	24.00		
B22.022		Vibrating roller more than 80 kW and 10ton mass	hrs	16.00		
B22.023		Water trucks up to 12 kilolitre capacity	hrs	108.00		
B22.024		Vibrating plate compactor with minimum capacity of 2 kW	hrs	12.00		
B22.025		Flat bed truck equipped with hydraulic crane of more than 2 t capacity	hrs	6.00		
B22.026		Flat bed truck equipped with hydraulic crane of more than 6 t capacity	hrs	6.00		
B22.027		Compressor: Up to 10 m ³ /minute	hrs	120.00		
B22.028		Standby generator	hrs	240.00		
Total Carried Forward						

SCHEDULE 22: DAYWORKS						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B22.029		Concrete mixer: Over 400 kilolitre capacity	hrs	48.00		
B22.030		Heavy duty weld set, 100Amp	hrs	16.00		
B22.031		Light delivery vehicle, 2400cc	hrs	180.00		
B22.032		Batching plant, 40 m³/hr	hrs	40.00		
		C. Materials charges:				
B22.033		Percentage allowance on the net delivered cost of materials actually used in Dayworks	%	100,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B23	SANS 1200 C	SITE CLEARANCE CLEAR SITE				
B23.001	8.2.4	Reclear surfaces (where ordered by Engineer)	ha	3.00		
	SANS 1200 D	EARTHWORKS				
	8.3.3	Restricted excavation:				
	8.3.3(a)	Excavate for restricted foundations, footings and pipe trenches in all materials and use for backfill or embankment or dispose: Up to 2,0 m deep:				
B23.002		Channels and catch pits	m ³	400.00		
B23.003		Trench below subsoils to construct C4 subbase course	m ³	175.00		
		Exceeding 2,0 m but not exceeding 4,0 m deep:				
B23.004		Channels and catch pits	m ³	11.00		
	8.3.3(b)	Extra over item 8.3.3(a) for excavation in:				
B23.005		Intermediate material	m ³	117.00		
B23.006		Hard rock material	m ³	66.00		
B23.007	PSD 8.3.3(b)(5)	Hard rock excavation without using explosives	m ³	110.00		
B23.008	PSD 8.3.3(c)	Extra over item 8.3.3(a) for hand excavation	m ³	520.00		
	PSD 8.3.4	Importing of materials:				
B23.009	PSD 8.3.4(a)	Extra over items 8.3.2 and 8.3.3 for materials from commercial sources (G5 material classification)	m ³	-		Rate Only
B23.010	PSD 8.3.4(d)	Extra over items 8.3.2 and 8.3.3 for importation of material from other excavations on site	m ³	40.00		
B23.011	8.3.5	Extra excavation in all materials to provide working space around structures (for outside formwork)	m ²	485.00		
B23.012	8.3.9	Extra over for backfill or for fill material against structures	m ³	378.00		
B23.013	PSD 8.3.10	Topsoiling (obtained from existing stockpiles)	m ³	210.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.014	PSD 8.3.14	Extra over items 8.3.2(a) and 8.3.3(a) for temporary stockpiling	m ³	-		Rate Only
		BULK WASH WATER				
	SANS 1200 DB	PIPE TRENCHES				
	8.3.2	Excavation:				
	8.3.2(a)	Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material: Up to 200 mm nominal diameter for total trench depth:				
B23.015		Exceeding 0,0 m but not exceeding 1,0 m	m	160.00		
B23.016		Exceeding 1,0 m but not exceeding 2,0 m	m	1,160.00		
B23.017		Exceeding 2,0 m but not exceeding 3,0 m	m	17.00		
		Over 200 up to 400 mm nominal diameter for total trench depth:				
B23.018		Exceeding 1,0 m but not exceeding 2,0 m	m	727.00		
B23.019		Exceeding 2,0 m but not exceeding 3,0 m	m	18.00		
	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for:				
B23.020		Intermediate excavation	m ³	570.00		
B23.021		Hard rock excavation	m ³	570.00		
		Hand excavation where ordered by the Engineer:				
B23.022		Soft material	m ³	420.00		
B23.023		Intermediate material	m ³	232.00		
B23.024		Hard material	m ³	115.00		
B23.025		Backfill stabilized with 5% cement where directed by the Engineer	m ³	30.00		
B23.026		Soilcrete backfill where directed by the Engineer	m ³	30.00		
B23.027	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	10.00		
	8.3.3	Excavation ancillaries:				
	8.3.3.1	Make up deficiency in backfill material				
B23.028	8.3.3.1(a)	from other necessary excavations on site	m ³	5.00		
B23.029	8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	5.00		
B23.030	8.3.3.3	Compaction in road reserves	m ³	14.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.031	8.3.6 8.3.6.1	Finishing Reinstate road surfaces a) All courses (constructed by Earthworks Contractor to receive paving or other surface finish)	m ²	15.00		
B23.032	SANS 1200 DB 8.3.2	DRYING BED DRAINAGE PIPE TRENCHES Excavation: Excavate in all materials for trenches, backfill, compact and dispose of surplus/unsuitable material: Over 400 up to 600 mm nominal diameter for total trench depth: Exceeding 1,0 m but not exceeding 2,0 m	m	182.00		
B23.033	8.3.2(a)	Exceeding 2,0 m but not exceeding 3,0 m	m	132.00		
B23.034		Over 600 up to 800 mm nominal diameter for total trench depth: Exceeding 1,0 m but not exceeding 2,0 m	m	5.00		
B23.035		Exceeding 2,0 m but not exceeding 3,0 m	m	88.00		
B23.036		Exceeding 3,0 m but not exceeding 4,0 m	m	44.00		
B23.037	PSDB 8.3.2(b)	Extra-over item 8.3.2 above for: Intermediate excavation	m ³	275.00		
B23.038		Hard rock excavation	m ³	410.00		
B23.039		Hand excavation where ordered by the Engineer: Soft material	m ³	588.00		
B23.040		Intermediate material	m ³	100.00		
B23.041		Hard material	m ³	5.00		
B23.042		Backfill stabilized with 5% cement where directed by the Engineer	m ³	10.00		
B23.043		Soilcrete backfill where directed by the Engineer	m ³	20.00		
B23.044	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom	m ³	20.00		
B23.045	8.3.3 8.3.3.1	Excavation ancillaries: Make up deficiency in backfill material from other necessary excavations on site	m ³	10.00		
B23.046	8.3.3.1(a) 8.3.3.1(c)	by importation from commercial or off-site sources selected by the Contractor	m ³	10.00		
B23.047	8.3.3.3	Compaction in road reserves	m ³	30.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.048	SANS 1200 DM 8.3.3 8.3.3(a)	EARTHWORKS (ROADS, SUBGRADE) Treatment of road-bed: Road-bed preparation and compaction of material Compact to 90 % mod. AASHTO maximum density (bottom of structures)	m ³	72.00		
B23.049	PSDM 8.3.5	Selected layer using material from designated borrow pits or excavation: Compacted to 93 % of modified AASHTO maximum density (layer thickness 150mm - G6 material)	m ³	4,436.00		
B23.050	PSDM 8.3.17	Extra over items 8.3.4, 8.3.5 and 8.3.16 for obtaining material from commercial sources	m ³	4,436.00		
B23.051	PSDM 8.3.18	Final finishing and cleaning up of the site of the works	Sum	1.00		
B23.052	SANS 1200 G 8.1.1 8.2 8.2.1	CONCRETE (STRUCTURAL) FORMWORK SCHEDULED FORMWORK ITEMS Rough: Vertical formwork to: External sides of catch pit walls	m ²	134.00		
B23.053		External sides of channel walls (below pavement slabs)	m ²	97.00		
B23.054		Sides of chamber walls	m ²	90.00		
B23.055	8.2.2	Smooth: Vertical formwork to: Insides of catch pit walls	m ²	112.00		
B23.056		Sides of channel walls	m ²	558.00		
B23.057		Sides of ramps	m ²	3.00		
B23.058		Horizontal formwork : Soffits of ramp slab propped up not exceeding 5 m high	m ²	6.00		
B23.059	8.2.5	Narrow widths up to 300 mm wide or high: Floor slab edges, end of walls, sides of openings, etc	m	1,245.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.1.2	REINFORCEMENT				
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Mild steel bars				
B23.060		a) 8 mm	t	0.86		
	8.3.1	High-tensile steel bars				
B23.061		a) 8 mm	t	1.30		
B23.062		b) 10 mm	t	4.31		
B23.063		c) 12 mm	t	4.31		
B23.064		d) 16 mm	t	10.80		
B23.065		e) 20 mm	t	13.80		
B23.066		f) 25 mm	t	7.76		
B23.067		g) 32 mm	t	4.23		
	8.3.2	High-tensile welded mesh reinforcement				
B23.068		Type reference 888 in aprons etc	m ²	12.00		
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Mass concrete: 20 MPa/20mm				
B23.069		Benching in sumps, chambers, channels etc including steel float finish to exposed surfaces	m ³	41.00		
	8.4.2	Blinding layer in 15 MPa/20 mm concrete				
B23.070		75 mm minimum thickness	m ²	477.00		
	8.4.3	Strength concrete: Unreinforced concrete with 4.1 Flexural strength in:				
B23.071		190 mm Thick pavement slabs to falls	m ³	5,139.00		
B23.072		190 mm Thick x 2000 mm wide x 150 mm deep V - shaped drain channels to falls	m ³	180.00		
B23.073		190 mm Thick access road pavement slabs	m ³	233.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B23.074		Ramps	m ³	12.00		
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B23.075		Catch pit floors including wall kickers	m ³	18.00		
B23.076		Channel floors including wall kickers	m ³	115.00		
B23.077		Catch pit walls	m ³	47.00		
B23.078		Channel walls	m ³	78.00		
B23.079		Ramp slabs	m ³	2.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.080	8.4.3	Strength concrete: 50 MPa/20mm in water retaining structures Floors, footings, walls, slabs etc	m ³	27.00		
B23.081	8.4.4	UNFORMED SURFACE FINISHES Wood-floated finish Top of ramps	m ²	24.00		
B23.082		Steel-floated finish Top of walls	m ²	59.00		
B23.083		Top of catch pit and channel floors	m ²	374.00		
B23.084		Power-floated finish Top of pavement slabs to falls including special care curing as required by the Engineer	m ²	27,045.00		
B23.085		Top of 2000 mm wide V - shaped drain channels to falls including special care curing as required by the Engineer	m ²	943.00		
B23.086		Broom or brush non-slip finish Top of access road pavement slabs including special care curing as required by the Engineer	m ²	1,225.00		
	PSG 8.4.5	Extra-over items 8.4.2 and 8.4.3 for aggregate of dolomitic origin in concrete mixes Coarse aggregate:				
B23.087		15 MPa	m ³	36.00		
B23.088		20 MPa	m ³	41.00		
B23.088		35 MPa	m ³	12.00		
B23.089		45 MPa	m ³	260.00		
B23.090		50 MPa	m ³	27.00		
B23.091		4.1 Flexural strength concrete	m ³	5,552.00		
		Fine aggregate:				
B23.092		15 MPa	m ³	36.00		
B23.093		20 MPa	m ³	41.00		
B23.093		35 MPa	m ³	12.00		
B23.094		45 MPa	m ³	260.00		
B23.095		50 MPa	m ³	27.00		
B23.096		4.1 Flexural strength concrete	m ³	5,552.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	PSG 8.5	JOINTS				
		Joints in structures:				
B23.097		a) Preparation and levelling of horizontal concrete surfaces at top of kickers in concrete walls and columns (where steel kicker channel sections are used) to receive Type 2 construction joint (elsewhere measured), in: Walls up to 300 mm thick	m ²	112.00		
B23.098		b) Construction joints as detailed on the drawings and/or specified in the project specifications: Joint Type 1 in floors complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2 mm thick tape	m	10.00		
B23.097		Joint Type 2 in walls complete with Sika Swell S-2, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2 mm thick tape	m	8.00		
B23.099		c) Movement joints as detailed on the drawings and/or specified in the project specifications: Joint Type 3 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealer and 300 mm wide Sikadur-Combiflex SG-20P 2 mm thick tape: Floors up to 300 mm thick	m	5.00		
B23.100		Joint Type 4 complete with 20 mm Jointex filler, 20 x 20 mm Sikaflex PRO-3i sealers and 300 mm wide Sikadur-Combiflex SG-20P 2 mm thick tape: Walls up to 300 mm thick	m	4.00		
		Kicker Joints				
		Notes:				
		1. Kicker steel channel sections shall include all cutting to lengths to suit structure dimensions				
		2. Kicker steel channel sections are not measured at upstand beams, kerbs etc				
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.101	PSG 8.9	3. Kicker steel channel sections are only required at external walls and columns and certain internal walls (where required by the Engineer) for water retaining structures and are not measured for all internal walls or columns d) Steel channel sections (100 x 50 PFC) at kickers in walls and columns, placed with legs horizontal and secured fixed to the Engineer's approval: Straight to walls up to 300 mm thick (both sides of walls measured) Joints in pavement slabs, roads etc e) Construction joints as detailed on the drawings and/or specified in the project specifications: Diamond plate dowel joint between 190mm thick pavement slabs, complete with 6 x 115 mm diamond dowels at 450mm centres, pocket former with vertical tight fit, 10 x 35 mm reamed saw cut with polyurethane sealer along top, formwork etc	m	890.00		
B23.102		Key and tied toggle joint between 190 mm thick pavement slabs, V - shaped channels and road slabs, complete with Y12 x 950 mm long tie bars at 800 mm centres, 10 x 35 mm reamed saw cut with polyurethane sealer along top, formwork etc	m	3,685.00		
B23.103			m	1,450.00		
B23.104		f) Saw cut joints as detailed on the drawings and/or specified in the project specifications: Saw cut joint 3 x 50 mm deep complete with 10 x 35 mm deep reamed top and 10 x 35 mm deep polyurethane sealer	m	7,625.00		
B23.105		MISCELLANEOUS WORK OTHER THAN METAL WORK: Polyethylene sheeting under floor slabs: 250 Micron sheeting under concrete pavement slabs	m ²	29,225.00		
B23.106		Drainage or service duct pipes cast into concrete or soilcrete: 50 mm Diameter x 200 mm long uPVC drainage sleeve pipe cast vertically into concrete	No.	28.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.107	PSG 8.10	Testing for watertightness: Channels	Sum	1.00		
B23.108		Catch pits	Sum	1.00		
B23.109	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete: Up to 200 mm nominal bore: Through 250 mm thick wall	No.	18.00		
B23.110		Over 400 mm and up to 600 mm nominal bore: Through 250 mm thick wall	No.	12.00		
B23.111		Over 600 mm and up to 800 mm nominal bore: Through 250 mm thick wall	No.	6.00		
B23.112		Over 800 mm and up to 1000 mm nominal bore: Through up to 250 mm thick wall	No.	1.00		
B23.113	PSG 8.13	SOILCRETE Soilcrete filling under and around structures	m ³	20.00		
B23.114	SANS 1200 H 8.3.7	STRUCTURAL STEELWORK Handrails: c) Handrails, HDG, 1 m high standard ball type, top or side mounted: Rails only (hand and knee rails): Horizontal or raking	m	22.00		
B23.115		Stanchions only	No.	20.00		
B23.116		Bends, end closures and accessories: 22.5 deg knees or corners	No.	8.00		
B23.117		22.5 deg end closure	No.	4.00		
B23.118		HD bolts, nuts and washers for each stanchion	Sets	20.00		
B23.119		PSH 8.3.9 Flooring, complete and installed with frames: a) Open grid floors: RS 40 HDG banded panels with 40 x 4,5mm bearer bars	m ²	41.00		
B23.120		b) Frames and kerbs for flooring: HDG angle section with fishtail anchors cast into concrete: 45 x 45 x 5 mm	m	48.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.121	SANS 1200 L 8.2.1 8.2.1(a) 8.2.2	HDG angle section bolted to concrete: 45 x 45 x 5 mm	m	32.00		
		BULK WASH WATER				
		MEDIUM PRESSURE PIPELINES				
		Supply, lay and bed pipes complete with couplings, test and disinfect				
		HDPE pipes Class PN16 with compression joints and fittings				
B23.122		50 mm diameter	m	1,106.00		
		Extra-over item 8.2.1(a) for supplying, laying and bedding of specials complete with compression couplings				
		Bends 11.25 degree:				
B23.123		50 mm diameter	No.	2.00		
		Bends 22.5 degree:				
B23.124		50 mm diameter	No.	2.00		
		Bends 45 degree:				
B23.125		50 mm diameter	No.	3.00		
	Bends 90 degree:					
B23.126	50 mm diameter	No.	10.00			
	Tees:					
B23.127	50 x 50 mm diameter	No.	11.00			
	Coupling (for plain ended Tee or reducer to pipe)					
B23.128	50 mm diameter	No.	14.00			
	Flange adaptors:					
B23.129	50 mm diameter	No.	2.00			
	End caps:					
B23.130	50 mm diameter	No.	25.00			
	Reducers:					
B23.131	50 x 20 mm diameter	No.	25.00			
	HDPE/ GMS or Cu flange adaptors:					
B23.132	20 mm diameter	No.	25.00			
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.1(b)	HDPE pipes Class PN16 with butt welded joints:				
B23.133		140 mm diameter	m	28.00		
B23.134		180 mm diameter	m	204.00		
B23.135		225 mm diameter	m	745.00		
	8.2.2	Extra-over item 8.2.1(b) for supplying, laying and bedding of HDPE specials complete with butt welded welded joints:				
		Bends 11.25 degree:				
B23.136		180 mm diameter	No.	1.00		
		Bends 22.5 degree:				
B23.137		180 mm diameter	No.	5.00		
		Bends 45 degree:				
B23.138		180 mm diameter	No.	1.00		
B23.139		225 mm diameter	No.	4.00		
		Bends 90 degree:				
B23.140		180 mm diameter	No.	1.00		
B23.141		225 mm diameter	No.	2.00		
		Tees:				
B23.142		180 x 180 mm diameter	No.	2.00		
B23.143		225 x 225 mm diameter	No.	1.00		
		Reducing tees:				
B23.144		180 x 180 x 50 mm diameter branch	No.	5.00		
B23.145		225 x 225 x 140 mm diameter branch	No.	1.00		
B23.146		225 x 225 x 50 mm diameter branch	No.	7.00		
		End caps:				
B23.147		140 mm diameter	No.	1.00		
B23.148		180 mm diameter	No.	1.00		
		Reducers:				
B23.149		180 x 50 mm diameter	No.	2.00		
B23.150		225 x 180 mm diameter	No.	1.00		
		Stub collar end complete with Copon coated steel loose flange, drilled to table 1600/3				
B23.151		140 mm diameter	No.	2.00		
B23.152		180 mm diameter	No.	2.00		
B23.153		225 mm diameter	No.	9.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.3	Extra-over item 8.2.1(b) for supplying, fixing and bedding of valves:				
		RSV Class 16 CI flanged gate valves:				
B23.154		150 mm diameter	No.	1.00		
B23.155		175 mm diameter	No.	1.00		
B23.156		225 mm diameter	No.	4.00		
	8.2.11	Anchor/Thrust blocks and pedestals				
B23.157		Concrete Class 20/20 MPa	m ³	30.00		
B23.158		Formwork	m ²	25.00		
B23.159		Reinforcement	t	0.25		
	8.2.12	Concrete casing				
B23.160		Concrete Class 20/20 MPa	m ³	15.00		
	8.2.13	Valve and hydrant chambers				
B23.161		Valve chamber complete for pipes up to 225mm diameter	No.	6.00		
B23.154	PSL 8.2.16	Marker blocks	No.	84.00		
	PSL 8.2.18	Standpipes complete:				
B23.162		20mm Brass heavy duty garden tap with standpipe including pipe support, hose connection, bends, fittings etc.	No.	25.00		
		BULK WASH WATER				
	SANS 1200 LB	BEDDING (PIPES)				
	8.2.1	Provision of bedding from trench excavation				
B23.163		a) Selected granular material	m ³	165.00		
B23.164		b) Selected fill material	m ³	120.00		
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B23.165		1) Selected granular material	m ³	165.00		
B23.166		2) Selected fill blanket	m ³	120.00		
	8.2.2.3	c) From commercial sources				
B23.167		1) Selected granular material	m ³	142.00		
B23.168		2) Selected fill material	m ³	63.00		
B23.169	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	5.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.170	8.2.4	Encasing of pipes in concrete, Class 15/20 MPa				
B23.171		a) 140 mm diameter	m ³	5.00		
B23.172		b) 180 mm diameter	m ³	10.00		
B23.172		c) 225 mm diameter	m ³	10.00		
DRYING BED DRAINAGE						
SANS 1200 LB BEDDING (PIPES)						
B23.173	8.2.1	Provision of bedding from trench excavation				
B23.173		a) Selected granular material	m ³	64.00		
B23.174		b) Selected fill material	m ³	88.00		
8.2.2 Supply only of bedding by importation						
B23.175	8.2.2.1	a) From other necessary excavations or existing stock piles on site				
B23.175		1) Selected granular material	m ³	48.00		
B23.176		2) Selected fill blanket	m ³	66.00		
B23.177	8.2.2.3	c) From commercial sources				
B23.177		1) Selected granular material	m ³	48.00		
B23.178		2) Selected fill material	m ³	66.00		
B23.179	8.2.3	Concrete bedding cradle, Class 15/20 MPa	m ³	5.00		
SANS 1200 LE STORMWATER DRAINAGE						
B23.180	PSLE 8.2.1	Supply and lay concrete pipe culverts with spigot and socket joints (SANS 677) on class B bedding:				
B23.181		a) 450 mm nominal diameter class 100D	m	121.00		
B23.182		b) 525 mm nominal diameter class 100D	m	149.00		
B23.183		c) 600 mm nominal diameter class 100D	m	44.00		
B23.184		d) 675 mm nominal diameter class 100D	m	44.00		
B23.184		e) 750 mm nominal diameter class 100D	m	88.00		
B23.185	8.2.4	Extra over item 8.2.1 for cutting end units for culverts on site:				
B23.185		a) 450 mm nominal diameter straight cut	No.	2.00		
B23.186		b) 525 mm nominal diameter straight cut	No.	3.00		
B23.187		c) 600 mm nominal diameter straight cut	No.	1.00		
B23.188		d) 675 mm nominal diameter straight cut	No.	1.00		
B23.189		e) 750 mm nominal diameter straight cut	No.	2.00		
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.190	PSLE 8.2.14	SUBSURFACE DRAINS Pipes in subsurface drains: a) Normal duty uPVC or similar approved pipes complete with couplings, underneath V - shaped drain slabs: 100 mm internal diameter, perforated	m	648.00		
B23.191		b) Extra-over uPVC perforated pipes for specials and fittings, 100mm diameter: End caps	No.	5.00		
B23.192	PSLE 8.2.15	A4 Bidim (around subsoil pipes and stone filling)	m ²	972.00		
B23.193	PSLE 8.2.16	Crushed stone in subsurface drains, compacted	m ³	54.00		
B23.194	SANS 1200 ME PSME 8.3.3	Subsurface drainage systems: Flo-Drain or similar approved subsoil drainage system comprising Flownet 500 core with Bidim A2 filter jacket in 2 m widths, jointed together to form a continuous mat under concrete floor slabs	m ²	29,225.00		
B23.195		SUBBASE Construct the subbase course with material excavated in all materials from commercial sources: 150 mm Thick C4 stabilized material compacted to 95% of modified AASHTO density (including stabilization process, stabilizing agent etc): Under pavement slabs, access road and V - shaped drain channels	m ³	4,377.00		
B23.196		In bottom of subsoil trench	m ³	175.00		
B23.197		SANS 1200 MH ASPHALT BASE AND SURFACING PRIME COAT Prime coat using: Invert bitumen emulsion at a rate of 0.8/litre/m2	m ²	29,225.00		
B23.198	8.5.5	Variations in quantities of prime: Invert bitumen emulsion	litre	-		Rate Only
Total Carried Forward						

SCHEDULE 23: SLUDGE DRYING BEDS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B23.199	SANS 1200 MK PSMK 8.2.1	KERBING AND CHANNELLING Concrete kerbing Precast concrete mountable kerbing to SANS 927, Figure 8c: Radius over 20 m and straight sections	m	525.00		
B23.200	PSA 8.5	SUMS STATED PROVISIONALLY BY ENGINEER b) For work to be executed by the Employer or a nominated subcontractor: Other special tests requested by the Engineer	Prov Sum	1.00	160,000.00	160,000.00
B23.201		Overheads, charges and profit on PSA8.5(b) above	%	160,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 24: ACCESS ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B24	SANS 1200 C	SITE CLEARANCE CLEAR SITE				
B24.001	PSC8.2.1	Clear and grub	ha	2.07		
B24.002	8.2.10	Remove topsoil to nominal depth of 150mm, stockpile and maintain	m³	3,540.00		
	SANS 1200 D	EARTHWORKS				
B24.003	PSD 8.3.10	Topsoiling (obtained from existing stockpiles)	m³	1,000.00		
	SANS 1200 DM 8.3.3	EARTHWORKS (ROADS, SUBGRADE) Treatment of road-bed:				
	PSDM 8.3.3(a)	Road-bed preparation and compaction of material				
B24.004		Compact to 90 % mod. AASHTO maximum density	m³	-		Rate Only
B24.005		Compact to 93 % mod. AASHTO maximum density	m³	3,540.00		
	PSDM 8.3.4	Cut to fill				
B24.006		Compact to 90 % mod. AASHTO maximum density	m³	100.00		
B24.007		Compact to 93 % mod. AASHTO maximum density (layer thickness of 200 mm and less)	m³	2,300.00		
	PSDM 8.3.4	Borrow to fill				
B24.008		Compact to 90 % mod. AASHTO maximum density	m³	100.00		
B24.009		Compact to 93 % mod. AASHTO maximum density (layer thickness of 200 mm and less)	m³	650.00		
	PSDM 8.3.5	Selected layer using material from designated borrow pits or excavation:				
B24.010		Compacted to 93 % of modified AASHTO maximum density (layer thickness 150 mm - G6 material)	m³	3,395.00		
	PSDM 8.3.6	Extra over items 8.3.4, 8.3.5 and 8.3.16 for excavating and breaking down material in:				
B24.011		Intermediate excavation	m³	300.00		
B24.012		Hard excavation	m³	450.00		
Total Carried Forward						

SCHEDULE 24: ACCESS ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B24.013	PSDM 8.3.7	Cut to spoil from Soft excavation	m ³	5,000.00		
B24.014		Intermediate excavation	m ³	990.00		
B24.015		Hard excavation	m ³	900.00		
B24.016	8.3.11	Extra-over items 8.3.2, 8.3.4, or 8.3.5 for temporary stockpiling of material (only on written instructions from the Engineer)	m ³	300.00		
B24.017	PSDM 8.3.17	Extra over items 8.3.4, 8.3.5 and 8.3.16 for obtaining material from commercial sources	m ³	4,145.00		
B24.018	PSDM 8.3.18	Final finishing and cleaning up of the site of the works	Sum	1.00		
	COLTO SECTION 3300 33.13	MASS EARTHWORKS Finishing-off cut and fill slopes, medians and interchange areas:				
B24.019		Cut slopes	m ²	1,000.00		
B24.020		Fill slopes	m ²	1,000.00		
	SANS 1200 ME PSME 8.3.3	SUBBASE Construct the subbase course with material excavated in all materials from commercial sources: 200 mm Thick G6 material compacted to 95% of modified AASHTO density				
B24.021			m ³	3,098.00		
	8.3.5	Process material by the following processes: d) Stabilization				
B24.022			m ³	-		Rate Only
	8.3.8	Stabilizing agent CEM II (as approved by the Engineer)				
B24.023			t	-		Rate Only
	SANS 1200 MF 8.3.3	BASE Construct base with material from commercial sources a) Gravel material				
B24.024			m ³	-		Rate Only
	PSMF 8.3.5	Process material by the following processes: d) Stabilization				
B24.025			m ³	-		Rate Only
Total Carried Forward						

SCHEDULE 24: ACCESS ROADS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B24.026	8.3.8	Stabilizing agent CEM II as approved by Engineer	t	-		Rate Only
	SANS 1200 MH	ASPHALT BASE AND SURFACING				
		PRIME COAT				
B24.027	8.5.1	Prime coat using: Invert bitumen emulsion at a rate of 0.8/litre/m2	m ²	-		Rate Only
B24.028	8.5.5	Variations in quantities of prime: Invert bitumen emulsion	litre	-		Rate Only
		TACK COAT				
B24.029	8.5.3	Spray surface using emulsion: 30% stable-grade emulsion	m ²	-		Rate Only
B24.030	8.5.5	Variations in quantity of emulsion: 30% stable-grade emulsion	litre	-		Rate Only
		ASPHALT SURFACING				
B24.031	8.5.4	Continuously graded surfacing using: A-R1 modified binder, 30 mm thick	m ²	-		Rate Only
B24.032	8.5.5	Variations in quantities of bituminous binder: A-R1 modified binder	litre	-		Rate Only
	PSA 8.5	SUMS STATED PROVISIONALLY BY ENGINEER				
B24.033		b) For work to be executed by the Employer or a nominated subcontractor: Other special tests requested by the Engineer	Prov Sum	1.00	180,000.00	180,000.00
B24.034		Overheads, charges and profit on PS8.5(b) above	%	180,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 25: FENCING						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B25	SANS 1200 C	SITE CLEARANCE				
		CLEAR SITE				
	8.2.4	Reclear surfaces (only on instructions from the Engineer):				
B25.001		Strips, 2m wide for new fencing	m	-		Rate Only
	8.2.5	Take down existing fences:				
B25.002		1,2m high barbed wire stock fence and deliver to Employers' yard in Polokwane	km	-		Rate Only
B25.003		1,2m high x 4,2m wide farm gate complete with gate posts and deliver to Employers' yard in Polokwane	No	-		Rate Only
	PSC 8.2.13	Take down and re-erect existing fences:				
B25.004		1,2m high barbed wire stock fence and erect in new temporary position on the Site as instructed by the Engineer	m	-		Rate Only
B25.005		1,2m high x 4,2m wide farm gate complete with gate posts and erect in new temporary position on the Site as instructed by the Engineer	No	-		Rate Only
B25.006	PSDM 8.3.18	Final finishing and cleaning up of the site of the works	Sum	-		Rate Only
	SANS 1200 G	CONCRETE (STRUCTURAL)				
	8.1.3	CONCRETE				
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Mass concrete: 15 MPa/20mm				
B25.007		Concrete kerb 200mm wide x 300mm deep in ground along bottom of fencing including all necessary excavations, formwork, joints etc cast between concrete post bases with top of kerb flush with ground surface including steel float finish to exposed top surface	m	-		Rate Only
	PE	FENCING				
	PE.01	Supply and erection of new fencing material:				
B25.008	PE.01.01	Medium security invisible type cut resistant strengthened welded mesh panel fencing system comprising 2,4m high x approximately 3m wide panels in minimum 3mm dia vertical and horizontal wires with approximately 76,2 x 25mm aperture size and four anti-climb V- or similar shaped panel horizontal bends, standard security type posts minimum 3m long at 3m centres complete with 400 x 400 x 600mm deep class 15 MPa reinforced concrete post bases in ground with all components fully galvanized	m	-		Rate Only
B25.009	PE.01.02	Extra over for cutting standard width panel to exact width to suit boundary dimensions	No	-		Rate Only
B25.010	PE.01.03	Extra over 2,4m high medium security fence panels with approximately 76,2 x 25mm aperture size for high security panels with approximately 76,2 x 12,7mm aperture size	m	-		Rate Only
B25.011	PE.01.04	Extra over medium security fence panels 2,4m high including posts, etc for alu-galvanized coating for extra corrosion protection (measured per meter length of 2,4m high fencing and gates)	m	-		Rate Only
B25.012	PE.01.05	Extra over high security fence panels 2,4m high including posts, etc for alu-galvanized coating for extra corrosion protection (measured per meter length of 2,4m high fencing and gates)	m	-		Rate Only
Total Carried Forward						

SCHEDULE 25: FENCING						
ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
#REF!	PE.01.06	Additional medium security invisible type cut resistant strengthened welded mesh panel fencing system with approximately 76,2 x 25mm aperture size in irregular shapes/sizes in stream or donga crossings including all cutting, waste, longer posts etc to match fencing and securely fixed in position with all components fully galvanized	m ²	-		Rate Only
B25.013	PE.01.07	Extra over additional medium security fencing with approximately 76,2 x 25mm aperture size in stream and donga crossings for high security fencing with approximately 76,2 x 12,7mm aperture size	m ²	-		Rate Only
B25.014	PE.01.08	Spike rails with ribbed/flared spikes securely fixed along top of fencing and gates, fully galvanized	m	-		Rate Only
	PE.02	New gates:				
B25.015	PE.02.01	Sliding gate 6m wide x 2,4m high to match medium security fencing system with approximately 76,2 x 25mm aperture size welded mesh panels complete with steel framing, bracing, mesh panel covering, posts, rails, guide posts, rollers, guides and guide wheels, locking system, concrete foundation or footing for rails etc, fully galvanized	No	-		Rate Only
B25.016	PE.02.02	Extra over 6m wide x 2,4m high medium security fence sliding gate with approximately 76,2 x 25mm aperture size welded mesh panels for high security sliding gate with approximately 76,2 x 12,7mm aperture size panels, fully galvanized	No	-		Rate Only
B25.017	PE.02.03	Remote controlled electrical motor for 6m wide sliding gate complete with back-up battery pack, electrical connection, gear rail, installation, base/foundation etc (to be approved by Electrical Engineer)	No	-		Rate Only
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B26	SANS 1200 C	SECTION: SITE CLEARANCE				
		CLEAR SITE				
B26.001	8.2.1	Clear and grub Site (Pipe Structures etc)	m ²	200.00		
B26.002	8.2.1	Clear and grub pipeline route (10 m wide)	m	440.00		
B26.003	8.2.2	Remove and grub large trees and tree stumps of girth Over and up to				
		Over 1 m and up to 2 m	No.	15.00		
B26.004		Over 2 m and up to 3 m	No.	5.0		
B26.005	8.2.4	Re-clear surfaces (provisional) (where ordered by Engineer)	ha	0.50		
B26.006	PS 8.2.5	Take down existing fences	m	10.00		
B26.007	8.2.6	Clear hedge and, where not scheduled separately, fence	m	10.00		
B26.008	8.2.7	Dismantle and remove pipelines (not encased in concrete), electricity transmission lines, cables, etc.	m	0.00		
B26.009	8.2.7	Dismantle and remove pipelines encased in concrete	m	0.00		
	PS 8.2.8	Demolish and remove structures/buildings and dismantle steelwork, etc.				
B26.010		Concrete structures with footprint of 200m ² and less, independent of height	No.	1.00		
B26.011		Brick Structures with footprint of 100m ² and less, independent of height	Sum	1.00		
B26.012	8.2.9	Cart materials and debris to unspecified sites and dump (provisional)	t.km	1.00		
B26.013	8.2.10	Remove topsoil to nominal depth 150mm, stockpile, and maintain	m ³	100.00		
	PS 8.2.11	Temporary fencing or hoarding:				
B26.014		(a) For keeping cattle out of from deep excavations	m	500.00		
B26.015		(b) For keeping pedestrians out of deep excavations	m	500.00		
#REF!	SANS 1200 D	SECTION : EARTHWORKS				
#REF!						
#REF!	8.3.2	EXCAVATION				
#REF!	8.3.2(a)	Excavate in all materials and use for embankment or backfill or dispose, as ordered:				
#REF!		Drop Structures (PK278-CP-2B-MP-010,011,012,013,014)	m ³	615.00		
Total Carried Forward						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B26.017		Drainage Sump (PK278-CP-2B-MP-003)	m ³	370.00		
B26.018		Outlet Structure (PK278-CP-2B-MP-004)	m ³	50.00		
	8.3.2(b)	Extra-over items B3.1 to B3.4 for excavation in:				
B26.019		Intermediate material	m ³	100.00		
B26.020		Hard rock material	m ³	50.00		
B26.021		Boulder material, Class A	m ³			
B26.022		Boulder material, Class B	m ³			
	PS 8.3.3	RESTRICTED EXCAVATION				
B26.023		5) Hard rock excavation without using explosives	m ³	5.00		
	8.3.4	IMPORT MATERIAL				
B26.024	PS 8.3.4 (a)	Extra over 8.3.2 and 8.3.3 for Materials from borrow pits and Commercial Sources	m ³	1,000.00		
B26.025	PS 8.3.4 (d)	Extra over 8.3.2 and 8.3.3 for the Importation of material from other excavations on site	m ³ .km	500.0		
B26.026	8.3.9	Extra-over for backfill or fill material against structures	m ³	2,000.00		
		FINISHINGS				
B26.027	8.3.10	Topsoiling	m ²	440.00		
B26.028	8.3.11	Grassing	m ²	440.00		
	SANS 1200 DB	SECTION : PIPE TRENCHES (see drawing PK278-CP-2B-MP-003)				
		EXCAVATION				
	PS 8.3.2 (a)	Excavate in all materials for trenches backfill, compact, and dispose of surplus/unsuitable material, for pipes: 3) Over 900 up to 1200 mm diam. (nominal) for total trench depth:				
B26.029		Exceeding 0,0 m but not exceeding 1,0 m	m ³	-		
B26.030		Exceeding 1,0 m but not exceeding 2,0 m	m ³	870.00		
B26.031		Exceeding 2,0 m but not exceeding 3,0 m	m ³	2,440.00		
	PS 8.3.2 (b)	Extra-over items B4.10 to B4.17 incl. for (prov):				
B26.032		1) Intermediate excavation	m ³	330.00		
B26.033		2) Hard rock excavation	m ³	170.00		
B26.034		3) Hand excavation and backfill where ordered by the Engineer	m ³	100.00		
B26.035		4) Cement-Stabilised (5%) backfill where directed by Engineer	m ³	50.00		
B26.036		5) Soil-crete backfill where directed by Engineer	m ³	50.00		
B26.037	8.3.2 (c)	Excavate and dispose of unsuitable material from trench bottom (Provisional)	m ³	166.00		
Total Carried Forward						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B26.038	PS 8.3.4 (a)	Shore trench for depths as and when instructed by the Engineer (Provisional)				
		Exceeding 1,5 m but not exceeding 2,5 m	m	20.00		
B26.039		Exceeding 2,5 m but not exceeding 3,5 m	m	20.00		
	SANS 1200 LB	SECTION : BEDDING (see drawing PK278-CP-2B-MP-003)				
	8.2.1	Provision of Bedding from Trench Excavations				
	PS 8.2.1.1	Without the need for screening or other treatments:				
B26.040		a) Selected granular material	m ³	15.00		
B26.041		b) Selected fill material	m ³	100.00		
	PS 8.2.1.2	Including for screening and/or other treatment:				
B26.042		a) Selected granular material	m ³	15.00		
B26.043		b) Selected fill material	m ³	100.00		
	PS 8.2.2.3	Commercial sources (Provisional)				
B26.044		a) Selected granular material	m ³	140.00		
B26.045		b) Selected fill material	m ³	1,070.00		
B26.046	8.2.3	Concrete bedding (Provisional)	m ³	50.00		
	SANS 1200 LD	SECTION : PIPEWORK				
	PS 8.2.1	Supply, lay, joint, bed and test HDPE lined concrete bulk pipeline (Class 100D) with spigot and socket joints (SANS 677)				
B26.047		1200 mm nominal diam. with HDPE Lining	m	438.00		
	PS 8.2.1	Extra over item 8.2.1 for specials				
B26.048		Rocker pipes (1.22 m in length) for the following diameters: 1200 mm nominal diam. With HDPE lining - Spigot Side only	No.	3.00		
B26.049		1200 mm nominal diam. With HDPE lining - Spigot and Socket	m	-		Rate Only
Total Carried Forward						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		DROP STRUCTURE (PK278-CP-2B-MP-010,011,012,013,014)				
	SANS 1200 GA	SECTION : CONCRETE STRUCTURE				
	8.2	FORMWORK				
	8.2.1	Rough: Vertical				
B26.050		Walls (Outside)	m ²	882.00		
B26.051		Apron slab (Sides)	m ²	3.10		
	8.2.2	Smooth: Vertical				
B26.052		Walls (Inside)	m ²	76.40		
B26.053		Staircase	m ²	31.50		
	8.2.4	Box out holes/form voids:				
	8.2.4 c)	Large, circular, with depth over and up to				
		0 m to 0,25 m for concrete pipes of nominal diameter:				
B26.054		1200 mm	No.	4.00		
		Large, other shapes, over 0,1 m ² up to 1 m ² in area, depth over and up to				
B26.055		0 m to 0,25 m (Manhole Frame)	No.	0		
	8.3	REINFORCEMENT				
B26.056	8.3.1	Mild steel bars	t	13.00		
B26.057	8.3.2	High-tensile steel bars	t	27.00		
	8.4	CONCRETE				
		High durability concrete (Class 30/19) for spillway, floor slab, sill and benching with 10% polypropylene fibres (50 mm thick).				
B26.058	8.4.1		m ³	10.00		
B26.059	8.4.3	Strength concrete, Class 30/19 for walls, floors & roof slabs	m ³	100.00		
B26.060	8.4.3	Strength concrete, Class 15/19 for channel sides and spillway	m ³	60.00		
	8.4.4	Unformed surface finishes				
		Wood-floated				
B26.061		Apron Slab	m ²	70.00		
		Steel-floated				
B26.062		Floor slab	m ²	325.00		
B26.063		Staircase	m ²	41.00		
B26.064		Benching	m ²	10.00		
Total Carried Forward						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
B26.065	8.5	JOINTS Water Stops at all joints	m	140.00		
B26.066	8.6	PRE-CAST ELEMENTS Pre-cast concrete roof panels as per detail drawing (Class 30/19) End panels with manhole frame and access holes (frame measured elsewhere)	No.	4.00		
B26.067		Middle Panel with access holes	No.	6.00		
B26.068		Middle Panel with puddle flange ventilation piece and access holes	No.	2.00		
B26.069	8.7	GROUTING b) HD Bolts etc. 1) Step Irons	No.	64.00		
B26.070		2) Top mounted Hand and knee rail bases (Ball-Type)	No.	6.00		
B26.071	8.8	HD BOLTS and Miscellaneous metal work 1) Step Irons	No.	64.00		
B26.072		2) Top mounted Hand and knee rails (Ball-Type)	m	30.00		
B26.073		3) Air-ventilation T-piece with rodent protection	No.	6.00		
B26.074		4) Manhole frame and cover	No.	4.00		
B26.075	SANS 1200 LD PS 8.2.13	Water tightness Testing of Drop Structures	No.	6.00		
B26.076		MISCELLANEOUS Fibreglass Grating (38 mm)	m ²	24.00		
B26.077		Sealant between panels as per manufacturers specification	m	66.00		
B26.078		Sealant between pre-cast pipes and box-out as per manufacturers specification	m	64.00		
		OUTLET STRUCTURE (See detail drawings PK278-CP-2B-MP-004)				
	SANS 1200 GA	SECTION : CONCRETE STRUCTURE				
B26.079	8.2	FORMWORK 8.2.1 Rough: Vertical Walls (Outside)	m ²	30.00		
B26.080	8.2.2	Smooth: Vertical Walls (Inside)	m ²	30.00		
B26.081		Steps	m ²	2.00		
Total Carried Forward						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.4	Box out holes/form voids:				
	8.2.4 c)	Large, circular, with depth over and up to				
		0 m to 0,25 m for concrete pipes of nominal diameter:				
B26.082		750 mm	No.	-		Rate Only
B26.083		1200 mm	No.	2.00		
		Large, other shapes, over 0,1 m ² up to 1 m ² in area, depth over and up to				
B26.084		0 m to 0,25 m (Manhole Frame)	No.	0.00		
	8.3	REINFORCEMENT				
B26.085	8.3.1	Mild steel bars	t	0.20		
B26.086	8.3.2	High-tensile steel bars	t	0.50		
	8.4	CONCRETE				
B26.087	8.4.3	Strength concrete, Class 30/19 for walls, floors & roof slabs	m ³	5.00		
		Steel-floated				
B26.088		Floor slab	m ²	21.00		
B26.089		Steps	m ²	2.00		
	8.5	JOINTS				
B26.090		Water Stops at all joints	m	50.00		
		MISCELLANEOUS				
B26.091		Sealant between pre-cast pipes and box-out as per manufacturers specification	m	5.00		
	SANS 1200 DK	SECTION : FORMING RIPRAP EMBANKMENT				
B26.092	DK 8.2.1	Preparation of area to be covered by riprap	m ²	5.00		
B26.093	DK 8.2.4	Supply and place geotextile - Bidim A5 or similar approved	m ²	5.00		
B26.094	DE 8.3.5	Supply and place riprap D50=300mm	m ³	1.00		
		DRAINAGE SUMP (See detail drawing PK278-CP-2B-MP-003)				
	SANS 1200 GA	SECTION : CONCRETE STRUCTURE				
	8.2	FORMWORK				
	8.2.1	Rough: Vertical				
		Walls (Outside)	m ²	55.00		
		Apron slab (Sides)	m ²	0.00		
Total Carried Forward						

SCHEDULE 26: MATURATION POND, EFFLUENT PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.2.2	Smooth: Vertical Walls (Inside)	m ²	55.00		
		Steps	m ²	2.00		
	8.2.4	Box out holes/form voids:				
	8.2.4 c)	Large, circular, with depth over and up to 0 m to 0,25 m for concrete pipes of nominal diameter:				
B26.099		1200 mm	No.	2.00		
	8.3	REINFORCEMENT				
B26.100	8.3.1	Mild steel bars	t	0.50		
B26.101	8.3.2	High-tensile steel bars	t	1.00		
	8.4	CONCRETE				
B26.102	8.4.3	Strength concrete, Class 30/19 for walls, floors & roof slabs	m ³	55.00		
	8.4.4	Unformed surface finishes				
		Steel-floated				
B26.103		Floor slab	m ²	29.00		
	8.5	JOINTS				
B26.104		Water Stops at all joints	m	33.00		
	8.7	GROUTING				
		b) HD Bolts etc.				
B26.105		Step Irons	No.	14.00		
	8.8	HD BOLTS and Miscellaneous metal work				
B26.106		step Irons	No.	14.00		
		MISCELLANEOUS				
B26.107		Sealant between pre-cast pipes and box-out as per manufacturers specification	m	5.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B27		SECTION 1700				
	1700	CLEARING AND GRUBBING				
	B17.01	Clearing and grubbing:				
B27.001		(a) Maturation pond footprint area and drains footprint	ha	0.55		
		SECTION 2100				
	2100	DRAINS				
	21.01	Excavation for open drains:				
		(a) Excavating soft material situated within the following depth ranges below the surface level:				
B27.002		(i) 0m up to 1,5m	m ³	1,210.00		
		SECTION 2300				
	2300	CONCRETE KERBING, CONCRETE CHANNELLING, CHUTES AND DOWNPIPES AND CONCRETE LINING FOR OPEN DRAINS				
	23.01	Concrete kerbing:				
B27.003		(a) Prefabricated battered kerb, SABS 927 fig 7 with joints every 2m.	m	2,059.00		
	23.02	Concrete kerbing-channeling combination:				
B27.004		(a) Prefabricated battered kerb, SABS 927 fig 7, with 400mm wide cast in situ class 25/19 concrete channel, as shown on drawings.	m	2,059.00		
	B23.07	Trimming of excavations for open drains around maturation ponds				
B27.005		(a) in soft material	m ²	1,000.00		
Total Carried Forward						

SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		SECTION 3200				
	3200	SELECTION, STOCKPILING AND BREAKING DOWN THE MATERIAL FROM BORROW PITS, CUTTINGS AND EXISTING PAVEMENT LAYERS, AND PLACING AND COMPACTING THE GRAVEL LAYERS				
B27.006	B32.06	Cut, borrow and stockpile material surrounding the ZZ2 pipeline as well as access ramps over pipeline	m ³	15,600.00		
	B32/33.03	Extra-over item B32.06 for excavating and breaking down material in:				
B27.007		(a) Hard excavation	m ³	4,700.00		
		SECTION 3300				
	3300	MASS EARTHWORKS				
		NOTE: NO ADDITIONAL PAYMENT FOR WORK DONE IN RESTRICTED AREAS				
	B33.01	Cut borrow and stockpile to fill including all haul and including all benching:				
		(a) Material in compacted layer thicknesses of 150 mm and less:				
B27.008		(i) Backfill over culverts compacted to 90% of modified AASHTO density	m ³	11.00		
	B33.10	Roadbed preparation and the compaction of material:				
B27.009		(b) Compaction of drains to 93% modified AASHTO density at 100mm depth.	m ³	1,000.00		
B27.010		(e) Compaction of maturation ponds base preparation layer to 93% modified AASHTO density at 150mm depth.	m ³	12,000.00		
	B33.12	In situ treatment of roadbed:				
B27.011		(a) In situ treatment of maturation pond basins base preparation layer, compacted to 93% modified AASHTO density at 100mm depth.	m ³	11,800.00		
Total Carried Forward						

SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		SECTION 3400				
	3400	PAVEMENT LAYERS OF GRAVEL MATERIAL				
	B34/35.01	Pavement layers constructed from gravel crushed or obtained from cut or borrow, including free-haul up to 1.0km:				
		(d) Rip and recompact gravel subbase (Chemically stabilized material with CEMII) compacted to:				
B27.012		(i) 95% of modified AASHTO density for a compacted layer thickness of 200 mm	m ³	3,140.00		
	B34.01	Pavement layers constructed from material imported from commercial sources, including all haul:				
B27.013		(b) Sand selected layer compacted to 100% modified AASHTO density (fraction sand < 0.075mm less than 20%) to layer thickness 20mm.	m ³	314.00		
		SECTION 5100				
	5100	PITCHING, STONEWORK AND PROTECTION AGAINST EROSION				
	B51.01	Stone pitching:				
B27.014		(b) Grouted stone pitching D50 = 75mm (provisional) for open channel	m ²	1,000.00		
B27.015		(d) Grouted stone pitching D50 = 200mm (provisional) for outside slope of maturation ponds.	m ²	6,600.00		
B27.016		(e) Grouted stone pitching D50 = 200mm (provisional) for maturation pond weir toes.	m ²	250.00		
		SECTION 6200				
	6200	FALSEWORK, FORMWORK AND CONCRETE FINISH				
	62.02	Vertical formwork to provide F2 surface finish to				
B27.017		(a) Maturation ponds weirs	m ²	350.00		
B27.018		(b) Drain culvert headwalls and base slab	m ²	70.00		
Total Carried Forward						

SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		SECTION 6300				
	6300	STEEL REINFORCEMENT FOR STRUCTURES				
	63.01	Steel reinforcement for				
		(a) Maturation pond weir structures				
B27.019		(ii) High yield (Y) stress steel bars	ton	30.00		
		(b) Culvert wing walls and slab				
B27.020		(ii) 450MPa steel bars	ton	1.50		
		SECTION 6400				
	6400	CONCRETE FOR STRUCTURES				
	64.01	Cast in situ concrete:				
B27.021		(a) Weir walls (45/20)	m ³	7.00		
B27.022		(b) Weir floors (45/20)	m ³	14.00		
B27.023		(c) 15MPa Concrete blinding at weirs (15/20)	m ³	2.10		
B27.024		(d) 5MPa culvert lean mix backfill	m ³	0.50		
B27.025		(e) Culvert 50mm blinding layer	m ³	17.00		
B27.026		(f) 35MPa concrete culvert slab and wing walls	m ³	13.00		
		SECTION 7300				
	7300	CONCRETE BLOCK PAVING FOR ROADS				
	73.01	Concrete block paving:				
B27.027		(a) 60 mm thick interlocking paving bricks, autumn, multi colour, used on side walks.	m ²	15,700.00		
	73.03	Provision of approved herbicide and ant poison				
B27.028		(a) Provision of material	PC Sum	1.00		
B27.029		(b) Contractor's charges and profit added to the prime cost sum	%	35,000.00		
Total Carried Forward						

SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		SECTION 8100				
	8100	TESTING MATERIALS AND WORKMANSHIP				
	81.02	Other special tests requested by the Engineer:				
B27.030		(a) Cost of testing	Prov. Sum	1.00		
B27.031		(b) Charge on Prime Cost Sum	%	150,000.00		
		SECTION 8500				
	8500	PROVISIONAL ITEMS				
	B85.01	Protection of existing services:				
B27.032		(a) Provision for protection of existing ZZ2 pipeline	Prov Sum	1.00	150,000.00	150,000.00
B27.033		(b) Handling costs and profit in respect of subitem B85.01 (a) above	%	150,000.00		
	SANS 1200D	MATURATION POND EMBANKMENTS				
	1200 D	EARTHWORKS				
	8.3.4	Importing of Materials				
B27.034		(a) Extra-over for importation of materials from commercial sources (G5 material classification)	m³	85,500.00		
		SANS 1200DE				
	1200DE	SMALL EARTH DAMS				
	B8.3.5	Forming Embankment				
B27.035		(i) Imported material (G5 material classification)	m³	85,500.00		
		GEOSYNTHETIC LINER				
B27.036	B8.3.11	Constructing Bidim A7 Protection Geotextile	m²	108,000.00		
B27.037	B8.3.12	Construction of 1.5mm HDPE Geomembrane	m²	108,000.00		
B27.038	B8.3.13	Construction of 75mm high Category B heavy duty Geocells	m²	29,500.00		
Total Carried Forward						

SCHEDULE 27: MATURATION PONDS, EARTHWORKS & LINER

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		ZZ2 PIPELINE REROUTING				
		SANS 1200L				
	1200L	MEDIUM-PRESSURE PIPELINES				
	8.2.1	Supply, lay and bed pipes complete with Couplings				
B27.039	B8.2.3	Extra-over 8.2.1 for the cutting of the existing pipe and the supplying and fixing of 315mm uPVC Klamflex or similar approved coupling	No.	2.00		
B27.040	B8.2.8	Recover old pipeline of 315mm Ø uPVC to 1m depth	m	624.00		
B27.041	B8.2.15	Wrapping tie-in joints with Denso P1 System or similar approved. (consisting of Denso Paste, Denso Profiling Mastic and Denso Petrolatum Tape)	m	5.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 28: SCUM PUMP STATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B28	SANS 1200G	CONCRETE (STRUCTURAL)				
	8.2	FORMWORK				
	8.2.1	Rough:				
		Vertical formwork to:				
B28.001		Sides of walls	m ²	50.00		
	8.2.2	Smooth:				
		Vertical formwork to:				
B28.002		Sides of walls	m ²	50.00		
		Horizontal				
B28.003		Soffit of Floors propped not exceeding 5.0m	m ²	7.00		
	8.2.5	Narrow widths up to 300 mm wide or high:				
B28.004		end of walls, sides of openings etc	m	66.00		
	8.2.6	Box out holes/form voids				
		Small, circular up to 0,35 m diameter, depths over 0m and up to 0,5m:				
B28.005		150mm diameter through 200 mm thick floor	No.	3.00		
B28.006		200mm diameter through 200 mm thick floor	No.	3.00		
B28.007		250mm diameter through 300 mm thick wall	No.	3.00		
		Small, other than circular, up to 0,1m², depths over 0m and up to 0,5m:				
B28.008		200mmx125mm Electrical floor recess	m	11.00		
	8.3	REINFORCEMENT				
	8.3.1	Mild steel bars				
B28.009		a) 8 mm	t	0.12		
		High-tensile steel bars				
B28.010		c) 12 mm	t	1.04		
	8.4	CONCRETE				
	8.4.2	Blinding layer in 15 MPa/20mm concrete				
B28.011		75mm minimum thickness	m ²	33.00		
	8.4.3	Strength concrete: 35 MPa /20mm in water retaining structures				
B28.012		Floors, footings, walls, slabs, etc.	m ³	-		Rate Only
	8.4.3	Strength concrete: 45 MPa/20mm in water retaining structures				
B28.013		Floor & Walls etc.	m ³	28.00		
Total Carried Forward						

SCHEDULE 28: SCUM PUMP STATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.4.4	UNFORMED SURFACE FINISHES				
		Steel-floated finish				
B28.014		Top of walls	m ²	19.00		
B28.015		Top of floors	m ²	39.00		
B28.016	PSG 8.10	Testing for watertightness:	Sum	1.00		
	PSG 8.11	Cast in of pipes with or without puddle flanges through concrete:				
		Up to 300 mm nominal bore:				
B28.017		Through 300mm Wall	No.	5.00		
	SANS 1200 H	STRUCTURAL STEELWORK				
	8.3.6	Holding down (HD) bolts:				
		c) Handrails, HDG, 1 m high standard ball type, top or side mounted:				
		Rails only (hand and knee rails):				
B28.018		Horizontal	m	7.00		
B28.019		Stanchions only	No.	6.00		
		Bends, end closures and accessories:				
B28.020		90 deg bends or corners	No.	6.00		
B28.021		HD bolts, nuts and washers for each stanchion	Sets	6.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 29: FIREWATER AND SERVICE WATER PUMP STATION - CIVIL WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
B29	C3.3.5	FIREWATER AND SERVICE WATER PUMP STATION - CIVIL WORKS				
	PS 8.5	SUM STATED PROVISIONALLY BY ENGINEER				
B29.001		Firewater and service water pump station - civil works	Prov Sum	1.00	2,200,000.00	2,200,000.00
B29.002		Overheads, charges and profit on item B34.001 above	%	2,200,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 1: CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C1	Chapter 3: Particular Specification Mechanical	CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS				
	Chapter 3	FIXED-CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
C1.001	1.21.1	Contractual Requirements (SANS1200A 8.3.1)	Sum	1		
C1.002	1.21.2	Other Fixed-Charge Obligations (SANS1200A 8.3.3)	Sum	1		
	Chapter 3	TIME-RELATED CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
C1.003	1.21.3	Contractual Requirements (SANS1200A 8.4.1)	Sum	1		
C1.004	1.21.4	Supervision for Duration of Construction (SANS1200A 8.4.3)	Sum	1		
C1.005	1.21.5	Company and Head Office Overhead Costs for the Duration of the Contract (SANS1200A 8.4.4)	Sum	1		
C1.006	1.21.6	Other Time-related Obligations (SANS1200A 8.4.5)	Sum	1		
	1.21.7	Storage of Plant where storage space is provided by:				
C1.007	1.21.7.1	The Contractor	m ³ - month	100		
C1.008	1.21.7.2	The Employer	m ³ - month	100		
	Chapter 3	PROVISIONAL SUMS				
C1.009	1.21.8	Maintenance spares	Prov Sum	1	650,000.00	650,000.00
C1.010	1.21.9	Charges and profit on maintenance spares	%	650,000.00		
C1.011	1.21.10	Additional samples of Materials kept by the Employer	Prov Sum	1	250,000.00	250,000.00
C1.012	1.21.11	Charges and profit on Additional samples of Materials kept by the Employer	%	250,000.00		
C1.013	1.21.12	WWTW Operation and Maintenance	Prov Sum	1	4,500,000.00	4,500,000.00
C1.014	1.21.13	Charges and profit on WWTW Operation and Maintenance	%	4,500,000.00		
C1.015	B16.9	Potable Water Supply System	Prov Sum	1	5,250,000.00	5,250,000.00
C1.016	B16.10	Charges and profit on Potable Water Supply System	%	5,250,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 2: CONTRACTOR'S ESTABLISHMENT ON SITE

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C2	Chapter 3: Particular Specification Mechanical	CONTRACTOR'S ESTABLISHMENT ON SITE				
		FIXED-CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
C2.001	2.4.1	Establishment of facilities on the Site (SANS1200A 8.3.2)	Lump Sum	1		
C2.002	2.4.2	Removal of Site Establishment (SANS1200A 8.3.4)	Lump Sum	1		
		TIME-RELATED CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
C2.003	2.4.3	Operation and Maintenance of Facilities on Site for Duration of Construction (SANS1200A 8.4.2)	Lump Sum	1		
		DAYWORKS				
	2.4.4	Daywork - Labour				
C2.004		Operator, Light equipment	Hr	10		
C2.005		Unskilled Workman	Hr	100		
C2.006		Semiskilled Workman	Hr	20		
C2.007		Mason	Hr	10		
C2.008		Carpenter and Joiner	Hr	10		
C2.009		Welder	Hr	10		
	2.4.5	Daywork - Equipment				
C2.010		Hand roller, vibrator	Hr	10		
C2.011		Plate compactor, vibratory	Hr	10		
C2.012		Rammer, mechanical, over	Hr	10		
C2.013		Air Compressor with hose	Hr	10		
C2.014		Generator	Hr	10		
C2.015		Submersible pump with Electricity & 100m outlet hose	Hr	10		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 3: TESTING AND COMMISSIONING

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C3	Chapter 3: Particular Specification Mechanical	TESTING AND COMMISSIONING				
C3.001		Measurement and payment for testing and commissioning shall be deemed included in the rates tendered for each individual item and in the rates tendered in Part C Schedule 1.	Months	6		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 4: STRUCTURAL METAL WORK

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C4	Chapter 3: Particular Specification Mechanical	STRUCTURAL METAL WORK				
	7.11.1	Supply and delivery of metal items by mass				
		Cladding support				
C4.001		150 x 50 x 20 x 2.5 lip channel purlin	t	0.1		
C4.002		50 x 50 x 6 angle iron support frames	t	0.1		
		Crane Beam				
C4.003		IPE 254 x 146 x 37.2 kg/m I-beam, work load 2t complete with trolley and chain blocks	t	0.35		
		Fasteners				
C4.004		Bolts, nuts and washers	t	0.03		
C4.005		60 x 60 x 6 angle iron stop end 214 mm long complete with 2M12 grade 4.4 bolts	t	0.03		
C4.006		8 mm stiffeners	t	0.03		
C4.007		10 mm end plate	t	0.03		
C4.008		8 mm stiffeners	t	0.03		
C4.009		10 mm end plate	t	0.03		
	7.11.2	Supply and delivery of metal items by length				
C4.010		Galvanised hand rails	m	230		
C4.011		Grade 304 stainless steel hand rails	m	150		
	7.11.3	Supply and delivery of metal items by area				
C4.012		Mentis grating	m ²	1000		
	7.11.5	Installation, testing and commissioning of metal items by mass				
		Cladding support				
C4.013		150 x 50 x 20 x 2.5 lip channel purlin	t	0.1		
C4.014		50 x 50 x 6 angle iron support frames	t	0.1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C4.015		Crane Beam IPE 254 x 146 x 37.2 kg/m I-beam, work load 2t complete with trolley and chain blocks	t	0.35		
		Fasteners				
C4.016		Bolts, nuts and washers	t	0.03		
C4.017		60 x 60 x 6 angle iron stop end 214 mm long complete with 2M12 grade 4.4 bolts	t	0.03		
C4.018		8 mm stiffeners	t	0.03		
C4.019		10 mm stiffeners	t	0.03		
C4.020		8 mm stiffeners	t	0.03		
C4.021		10 mm end plate	t	0.03		
	7.11.6	Installation, testing and commissioning of metal items by length				
C4.022		Galvanised hand rails	m	230		
C4.023		Grade 304 stainless steel hand rails	m	150		
	7.11.7	Installation, testing and commissioning of metal items by area				
C4.024		Mentis grating	m ²	1000		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 5: PIPEWORK

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C5	Chapter 3: Particular Specification Mechanical	PIPEWORK				
	8.25.1	Supply and delivery of pipework, fittings and specials. Also refer to clause 2.8.1 of the detail specification.				
C5.001		Wash water pump station pipework	Lump Sum	1		
C5.002		Primary sludge pump station pipework	Lump Sum	1		
C5.003		RAS pump station pipework	Lump Sum	1		
C5.004		WAS pump station pipework	Lump Sum	1		
C5.005		Thick sludge pump station pipework	Lump Sum	1		
C5.006		Digested sludge day tank pipework	Lump Sum	1		
C5.007		Polyelectrolyte dosing system pipework	Lump Sum	1		
C5.008		Service water pump station pipework	Lump Sum	1		
C5.009		Return water pipework from 15mm screen wash compactors	Lump Sum	1		
C5.010		Return water pipework from 6mm screen wash compactors	Lump Sum	1		
C5.011		Return water pipework from grit classifiers	Lump Sum	1		
C5.012		Return water pipework from 3mm screen wash compactors	Lump Sum	1		
C5.013		Service water pipework to vortex degritters for grit fluidising	Lump Sum	1		
C5.014		Air supply pipework to vortex degritters for grit air lift system	Refer Sch 16			
C5.015		Air supply pipework to vortex degritters for grit sparging system	Refer Sch 16			
C5.016		Service water for the two 3mm screens.	Lump Sum	1		
C5.017		Wash water pipework for the 15mm screen hydro launder	Lump Sum	1		
C5.018		Wash water pipework for the 6mm screen hydro launder	Lump Sum	1		
C5.019		Wash water pipework for the 3mm screen hydro launder	Lump Sum	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C5.020		Service water for the grit classifiers	Lump Sum	1		
C5.021		Balancing tank pinch valve chamber pipework	Lump Sum	1		
C5.022		Service water for the 15mm screenings wash compactors	Lump Sum	1		
C5.023		Service water for the 6mm screenings wash compactors	Lump Sum	1		
C5.024		Service water for the grit classifiers	Lump Sum	1		
C5.025		Service water for the 3mm screenings wash compactor	Lump Sum	1		
	8.25.2	Supply and delivery of pipework (on instruction from the Engineer)				
C5.026		Ø90mm	m	12		
C5.027		Ø100mm	m	35		
C5.028		Ø125mm	m	25		
C5.029		Ø150mm	m	27		
C5.030		Ø200mm	m	20		
C5.031		Ø250mm	m	20		
C5.032		Ø300mm	m	15		
C5.033		Ø700mm	m	10		
	8.25.3	Supply and delivery of pipework, fittings and specials (on instruction from the Engineer)				
C5.034		Supply and delivery of pipework, fittings and specials (as and when instructed by the Engineer)	Prov Sum	1	1,200,000.00	1,200,000.00
C5.035		Charges and profit on supply and delivery of pipework, fittings and specials	%	1,200,000.00		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	8.25.4	Installation, field testing and commissioning of pipework, fittings and specials. Also refer to clause 2.8.1 of the detail specification.				
C5.036		Wash water pump station pipework	Lump Sum	1		
C5.037		Primary sludge pump station pipework	Lump Sum	1		
C5.038		RAS pump station pipework	Lump Sum	1		
C5.039		WAS pump station pipework	Lump Sum	1		
C5.040		Thick sludge pump station pipework	Lump Sum	1		
C5.041		Digested sludge day tank pipework	Lump Sum	1		
C5.042		Polyelectrolyte dosing system pipework	Lump Sum	1		
C5.043		Service water pump station pipework	Lump Sum	1		
C5.044		Return water pipework from 15mm screen wash compactors	Lump Sum	1		
C5.045		Return water pipework from 6mm screen wash compactors	Lump Sum	1		
C5.046		Return water pipework from grit classifiers	Lump Sum	1		
C5.047		Return water pipework from 3mm screen wash compactors	Lump Sum	1		
C5.048		Service water pipework to vortex degritters for grit fluidising	Lump Sum	1		
C5.049		Air supply pipework to vortex degritters for grit air lift system	Refer Sch 16			
C5.050		Air supply pipework to vortex degritters for grit sparging system	Refer Sch 16			
C5.051		Service water for the two 3mm screens.	Lump Sum	1		
C5.052		Wash water pipework for the 15mm screen hydro launder	Lump Sum	1		
C5.053		Wash water pipework for the 6mm screen hydro launder	Lump Sum	1		
C5.054		Wash water pipework for the 3mm screen hydro launder	Lump Sum	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C5.055		Service water for the grit classifiers	Lump Sum	1		
C5.056		Balancing tank pinch valve chamber pipework	Lump Sum	1		
C5.057		Service water for the 15mm screenings wash compactors	Lump Sum	1		
C5.058		Service water for the 6mm screenings wash compactors	Lump Sum	1		
C5.059		Service water for the grit classifiers	Lump Sum	1		
C5.060		Service water for the 3mm screenings wash compactor	Lump Sum	1		
	8.25.5	Installation, field testing and commissioning of pipework, fittings and specials (on instruction from the Engineer)				
C5.061		Ø90mm	m	12		
C5.062		Ø100mm	m	35		
C5.063		Ø125mm	m	25		
C5.064		Ø150mm	m	27		
C5.065		Ø200mm	m	20		
C5.066		Ø250mm	m	20		
C5.067		Ø300mm	m	15		
C5.068		Ø700mm	m	10		
	8.25.6	Installation, field testing and commissioning of pipework, fittings and specials (on instruction from the Engineer)				
C5.069		Installation, field testing and commissioning of pipework, fittings and specials (as and when instructed by the Engineer)	Prov Sum	1	1,200,000.00	1,200,000.00
C5.070		Charges and profit on installation, field testing and commissioning of pipework, fittings and specials (as and when instructed by the Engineer)	%	1,200,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 6: FLOW CONTROL VALVES AND SLUICE GATES

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C6	Chapter 3: Particular Specification Mechanical	FLOW CONTROL VALVES AND SLUICE GATES				
	9.11.1	Supply and delivery of manually or electrically actuated flow control valves and sluice gates				
		Manually Actuated Sluice Gates (refer to P&ID)				
C6.001		1I-SG-01-H	No	1		
C6.002		1I-SG-02-H	No	1		
C6.003		1I-SG-03-H	No	1		
C6.004		1I-SG-04-H	No	1		
C6.005		1I-SG-05-H	No	1		
C6.006		1I-SG-06-H	No	1		
C6.007		1I-SG-07-H	No	1		
C6.008		1I-SG-08-H	No	1		
C6.009		1I-SG-09-H	No	1		
C6.010		1I-SG-10-H	No	1		
C6.011		1I-SG-11-H	No	1		
C6.012		1I-SG-12-H	No	1		
C6.013		1I-SG-13-H	No	1		
C6.014		1I-SG-14-H	No	1		
C6.015		1I-SG-15-H	No	1		
C6.016		1I-SG-16-H	No	1		
C6.017		1I-SG-17-H	No	1		
C6.018		1I-SG-18-H	No	1		
C6.019		1I-SG-19-H	No	1		
C6.020		1I-SG-20-H	No	1		
C6.021		1I-SG-21-H	No	1		
C6.022		1I-SG-22-H	No	1		
C6.023		1I-SG-30-H	No	1		
C6.024		1I-SG-31-H	No	1		
C6.025		1P-SG-01-H through 1P-SG-26-H	No	29		
C6.026		1P-SG-30-H through 1P-SG-32-H	No	3		
C6.027		1P-SG-35-H	No	1		
C6.028		1P-SG-36-H	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C6.029		01-MP-01-SG-01	No	1		
C6.030		01-MP-01-SG-02	No	1		
C6.031		01-MP-01-SG-03	No	1		
		Channel Bottom Sludge Valves 450mm				
C6.032		1P-V-01-PL	No	1		
C6.033		1P-V-02-PL	No	1		
C6.034		1P-V-03-PL	No	1		
C6.035		1P-V-04-PL	No	1		
C6.036		1P-V-09-PL	No	1		
C6.037		1P-V-10-PL	No	1		
C6.038		1P-V-15-PL	No	1		
C6.039		1P-V-16-PL	No	1		
C6.040		1P-V-17-PL	No	1		
C6.041		1P-V-18-PL	No	1		
C6.042		1P-V-23-PL	No	1		
C6.043		1P-V-24-PL	No	1		
		Channel Bottom Sludge Valves 650mm				
C6.044		1P-V-05-PL	No	1		
C6.045		1P-V-06-PL	No	1		
C6.046		1P-V-07-PL	No	1		
C6.047		1P-V-08-PL	No	1		
C6.048		1P-V-11-PL	No	1		
C6.049		1P-V-12-PL	No	1		
C6.050		1P-V-13-PL	No	1		
C6.051		1P-V-14-PL	No	1		
C6.052		1P-V-19-PL	No	1		
C6.053		1P-V-20-PL	No	1		
C6.054		1P-V-21-PL	No	1		
C6.055		1P-V-22-PL	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	9.11.2	Installation, testing and commissioning of manually or electrically actuated flow control valves or sluice gates Manually Actuated Sluice Gates (refer to P&ID)				
C6.056		1I-SG-01-H	No	1		
C6.057		1I-SG-02-H	No	1		
C6.058		1I-SG-03-H	No	1		
C6.059		1I-SG-04-H	No	1		
C6.060		1I-SG-05-H	No	1		
C6.061		1I-SG-06-H	No	1		
C6.062		1I-SG-07-H	No	1		
C6.063		1I-SG-08-H	No	1		
C6.064		1I-SG-09-H	No	1		
C6.065		1I-SG-10-H	No	1		
C6.066		1I-SG-11-H	No	1		
C6.067		1I-SG-12-H	No	1		
C6.068		1I-SG-13-H	No	1		
C6.069		1I-SG-14-H	No	1		
C6.070		1I-SG-15-H	No	1		
C6.071		1I-SG-16-H	No	1		
C6.072		1I-SG-17-H	No	1		
C6.073		1I-SG-18-H	No	1		
C6.074		1I-SG-19-H	No	1		
C6.075		1I-SG-20-H	No	1		
C6.076		1I-SG-21-H	No	1		
C6.077		1I-SG-22-H	No	1		
C6.078		1I-SG-30-H	No	1		
C6.079		1I-SG-31-H	No	1		
C6.080		1P-SG-01-H through 1P-SG-26-H	No	29		
C6.081		1P-SG-30-H through 1P-SG-32-H	No	3		
C6.082		1P-SG-35-H	No	1		
C6.083		1P-SG-36-H	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C6.084		01-MP-01-SG-01	No	1		
C6.085		01-MP-01-SG-02	No	1		
C6.086		01-MP-01-SG-03	No	1		
		Channel Bottom Sludge Valves 450mm				
C6.087		1P-V-01-PL	No	1		
C6.088		1P-V-02-PL	No	1		
C6.089		1P-V-03-PL	No	1		
C6.090		1P-V-04-PL	No	1		
C6.091		1P-V-09-PL	No	1		
C6.092		1P-V-10-PL	No	1		
C6.093		1P-V-15-PL	No	1		
C6.094		1P-V-16-PL	No	1		
C6.095		1P-V-17-PL	No	1		
C6.096		1P-V-18-PL	No	1		
C6.097		1P-V-23-PL	No	1		
C6.098		1P-V-24-PL	No	1		
		Channel Bottom Sludge Valves 650mm				
C6.099		1P-V-05-PL	No	1		
C6.100		1P-V-06-PL	No	1		
C6.101		1P-V-07-PL	No	1		
C6.102		1P-V-08-PL	No	1		
C6.103		1P-V-11-PL	No	1		
C6.104		1P-V-12-PL	No	1		
C6.105		1P-V-13-PL	No	1		
C6.106		1P-V-14-PL	No	1		
C6.107		1P-V-19-PL	No	1		
C6.108		1P-V-20-PL	No	1		
C6.109		1P-V-21-PL	No	1		
C6.110		1P-V-22-PL	No	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 7: DRY WELL PUMPS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C7	Chapter 3: Particular Specification Mechanical	DRY WELL PUMPS				
	13.11.1	Supply and delivery of dry well pumping equipment				
		Dry well self-priming pumps				
C7.001		Inlet works wash water pumps 1I-P-01-CF, 1I-P-02-CF	No	2		
C7.002		Primary sludge pumps 1I-P-03-CF, 1I-P-04-CF 1I-P-05-CF, 1I-P-06-CF	No	4		
		Scum pumps 1I-P-07-CF, 1I-P-08-CF		2		
C7.003		WAS pumps 1P-P-01-CF, 1P-P-02-CF	No	2		
C7.004		RAS pumps 1P-P-03-CF, 1P-P-04-CF, 1P-P-05-CF 1P-P-06-CF, 1P-P-07-CF, 1P-P-08-CF	No	6		
C7.005		Service water pumps 00-01-01-CF, 00-01-02-CF, 00-01-03-CF 00-01-04-CF, 00-01-05-CF	No	5		
		Axial flow pumps complete with channel flap valves:				
C7.006		A-recycle axial flow pumps 1P-P-01-AX, 1P-P-02-AX, 1P-P-03-AX 1P-P-04-AX, 1P-P-05-AX, 1P-P-06-AX	No	6		
C7.007		R-recycle axial flow pumps 1P-P-07-AX, 1P-P-08-AX, 1P-P-09-AX	No	3		
		Progressing Cavity Pumps				
C7.008		Thick sludge pumps 2R-P-01-CF, 2R-P-02-CF	No	2		
C7.009		Digested sludge day tank pumps 2R-P-03-CF, 2R-P-04-CF	No	2		
		Ferric chloride dosing pumps 2R-P-01-DP, 2R-P-02-DP		2		
C7.010		Polyelectrolyte dosing pumps: 2R-P-01-PC, 2R-P-02-PC 2R-P-03-PC, 2R-P-04-PC	No	4		
Total Carried Forward						

Page 354
Water and Sanitation Directorate

TENDER
Polokwane Municipality

SCHEDULE NO 8: HOSTING EQUIPMENT

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C8	Chapter 3: Particular Specification Mechanical	HOISTING EQUIPMENT				
	14.10.1	Supply and delivery of hoisting frame				
		Balancing Tank				
C8.001		1P-LE-01-CB	No	1		
C8.002		1P-LE-02-CB	No	1		
		A-recycle Pumps				
C8.003		1P-LE-03-CB	No	1		
C8.004		1P-LE-04-CB	No	1		
		R-recycle Pumps				
C8.005		1P-LE-05-CB	No	1		
C8.006		1P-LE-06-CB	No	1		
C8.007		1P-LE-07-CB	No	1		
	14.10.2	Supply and delivery of chain hoist with crawl				
		Balancing Tank				
C8.008		Chain hoist with crawl for 1P-LE-01-CB	No	1		
C8.009		Chain hoist with crawl for 1P-LE-02-CB	No	1		
		A-recycle Pumps				
C8.010		Chain hoist with crawl for 1P-LE-03-CB	No	1		
C8.011		Chain hoist with crawl for 1P-LE-04-CB	No	1		
		R-recycle Pumps:				
C8.012		Chain hoist with crawl for 1P-LE-05-CB	No	1		
C8.013		Chain hoist with crawl for 1P-LE-06-CB	No	1		
C8.014		Chain hoist with crawl for 1P-LE-07-CB	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	14.10.3	Installation, testing and commissioning of hoisting frame				
		A-recycle Pumps:				
		Balancing Tank				
C8.015		1P-LE-01-CB	No	1		
C8.016		1P-LE-02-CB	No	1		
		A-recycle Pumps				
C8.017		1P-LE-03-CB	No	1		
C8.018		1P-LE-04-CB	No	1		
		R-recycle Pumps				
C8.019		1P-LE-05-CB	No	1		
C8.020		1P-LE-06-CB	No	1		
C8.021		1P-LE-07-CB	No	1		
	14.10.4	Installation, testing and commissioning of chain hoists with crawl				
		Balancing Tank				
C8.022		Chain hoist with crawl for 1P-LE-01-CB	No	1		
C8.023		Chain hoist with crawl for 1P-LE-02-CB	No	1		
		A-recycle Pumps				
C8.024		Chain hoist with crawl for 1P-LE-03-CB	No	1		
C8.025		Chain hoist with crawl for 1P-LE-04-CB	No	1		
		R-recycle Pumps:				
C8.026		Chain hoist with crawl for 1P-LE-05-CB	No	1		
C8.027		Chain hoist with crawl for 1P-LE-06-CB	No	1		
C8.028		Chain hoist with crawl for 1P-LE-07-CB	No	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 9: SUBMERSIBLE PUMPING EQUIPMENT

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C9	Chapter 3: Particular Specification Mechanical	SUBMERSIBLE PUMPING EQUIPMENT				
	15.9.1	Supply and delivery of submersible pumping equipment				
C9.001		PST subsoil drainage pump	No	2		
C9.002		SST subsoil drainage pump	No	2		
C9.003		Balancing tank subsoil drainage pump	No	2		
	15.9.2	Installation of submersible pumping equipment				
C9.004		PST subsoil drainage pump	No	2		
C9.005		SST subsoil drainage pump	No	2		
C9.006		Balancing tank subsoil drainage pump	No	2		
	15.9.3	Testing and commissioning of submersible pumping equipment				
C9.007		PST subsoil drainage pump	No	2		
C9.008		SST subsoil drainage pump	No	2		
C9.009		Balancing tank subsoil drainage pump	No	2		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 10: MECHANICAL FRONT RAKED SCREENS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C10	Chapter 3: Particular Specification Mechanical	MECHANICAL FRONT RAKED SCREENS				
	16.18.1	Supply and delivery of mechanical front raked screens				
C10.001		15mm coarse screen: 1I-SC-01-M, 1I-SC-02-M	No	2		
C10.002		6mm medium screen: 1I-SC-03-M, 1I-SC-04-M	No	2		
C10.003		3mm fine screen: 1I-SC-05-M, 1I-SC-06-M	No	2		
	16.18.2	Installation, testing and commissioning of mechanical front raked screens				
C10.004		15mm coarse screen: 1I-SC-01-M, 1I-SC-02-M	No	2		
C10.005		6mm medium screen: 1I-SC-03-M, 1I-SC-04-M	No	2		
C10.006		3mm fine screen: 1I-SC-05-M, 1I-SC-06-M	No	2		
		ALTERNATIVE OFFER				
	16.18.1	Supply and delivery of mechanical front raked screens				
C10.007		15mm coarse screen: 1I-SC-01-M, 1I-SC-02-M	No	2		Rate only
C10.008		6mm medium screen: 1I-SC-03-M, 1I-SC-04-M	No	2		Rate only
C10.009		3mm fine screen: 1I-SC-05-M, 1I-SC-06-M	No	2		Rate only
	16.18.2	Installation, testing and commissioning of mechanical front raked screens				
C10.010		15mm coarse screen: 01-IW-01-SC-03 and 01-IW-01-SC-04	No	2		Rate only
C10.011		6mm medium screen: 01-IW-01-SC-05 and 01-IW-01-SC-06	No	2		Rate only
C10.012		3mm fine screen: 01-IW-01-SC-10 and 01-IW-01-SC-11	No	2		Rate only
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 11: MANUALLY CLEANED SCREENS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C11	Chapter 3: Particular Specification Mechanical	MANUALLY CLEANED SCREENS				
	17.8.1	Supply and delivery of manually cleaned screen				
C11.001		Hand-raked screens in bypass channel for 15mm mechanical screens 1I-SC-01-H, 1I-SC-02-H	No	2		
C11.002		Hand-raked screen in bypass channel for 6mm mechanical screens 1I-SC-03-H	No	1		
C11.003		Hand-raked screens in bypass channel for 3mm mechanical screens 1I-SC-04-H, 1I-SC-05-H	No	2		
		Hand-raked screens in service water abstraction channels 01-MP-01-SG-01, 01-MP-01-SG-02, 01-MP-01-SG-03	No	3		
	17.8.2	Installation, testing and commissioning of manually cleaned screen				
C11.005		Hand-raked screens in bypass channel for 15mm mechanical screens 1I-SC-01-H, 1I-SC-02-H	No	1		
C11.006		Hand-raked screen in bypass channel for 6mm mechanical screens 1I-SC-03-H	No	1		
C11.007		Hand-raked screens in bypass channel for 3mm mechanical screens 1I-SC-04-H, 1I-SC-05-H	No	1		
C11.008		Hand-raked screens in service water abstraction channels 01-MP-01-SG-01, 01-MP-01-SG-02, 01-MP-01-SG-03	No	3		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 12: SURFACE-MOUNTED MECHANICAL MIXERS AND AERATORS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C12	Chapter 3: Particular Specification Mechanical	SURFACE-MOUNTED MECHANICAL MIXERS AND AERATORS				
	18.11.1	Supply and delivery of mixer or aerator installations				
C12.001		Scum pump station mixers 1I-MX-01-A & 1I-MX-02-A	No	2		
C12.002		Balancing tank mixers 1P-MX-01-A, 1P-MX-02-A, 1P-MX-03-A 1P-MX-04-A, 1P-MX-05-A, 1P-MX-06-A 1P-MX-07-A, 1P-MX-08-A, 1P-MX-09-A	No	9		
C12.003		Bioreactor anaerobic/anoxic zone mixers 1P-MX-10-A, 1P-MX-11-A, 1P-MX-12-A 1P-MX-13-A, 1P-MX-14-A, 1P-MX-15-A 1P-MX-16-A, 1P-MX-17-A, 1P-MX-18-A 1P-MX-19-A, 1P-MX-20-A, 1P-MX-21-A 1P-MX-22-A, 1P-MX-23-A	No	14		
C12.004		Thick sludge sump mixers 2R-MX-01-A, 2R-MX-02-A	No	2		
C12.005		Digested sludge day tank mixers 2R-MX-03-A, 2R-MX-04-A 2R-MX-05-A, 2R-MX-06-A	No	4		
	18.11.2	Installation, testing and commissioning of mixer or aerator installations				
C12.006		Scum pump station mixers 1I-MX-01-A & 1I-MX-02-A	No	2		
C12.007		Balancing tank mixers 1P-MX-01-A, 1P-MX-02-A, 1P-MX-03-A 1P-MX-04-A, 1P-MX-05-A, 1P-MX-06-A 1P-MX-07-A, 1P-MX-08-A, 1P-MX-09-A	No	9		
C12.008		Bioreactor anaerobic/anoxic zone mixers 1P-MX-10-A, 1P-MX-11-A, 1P-MX-12-A 1P-MX-13-A, 1P-MX-14-A, 1P-MX-15-A 1P-MX-16-A, 1P-MX-17-A, 1P-MX-18-A 1P-MX-19-A, 1P-MX-20-A, 1P-MX-21-A 1P-MX-22-A, 1P-MX-23-A	No	14		
C12.009		Thick sludge sump mixers 2R-MX-01-A, 2R-MX-02-A	No	2		
C12.010		Digested sludge day tank mixers 2R-MX-03-A, 2R-MX-04-A 2R-MX-05-A, 2R-MX-06-A	No	4		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 13: BAFFLES, WEIRS AND OTHER SPECIALLY FABRICATED DEVICES

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C13	Chapter 3: Particular Specification Mechanical	BAFFLES, WEIRS AND OTHER SPECIALLY FABRICATED DEVICES				
	19.9.2	Supply and delivery of fixed weir				
C13.001		Fixed weir plates at primary flow divider 1I-W-01-WP, 1I-W-02-WP	No	2		
C13.002		Fixed weir plates at secondary flow divider 1P-W-01-WP & 1P-W-02-WP	No	2		
	19.9.6	Installation, testing and commissioning of fixed weir				
C13.003		Fixed weir plates at primary flow divider 1I-W-01-WP, 1I-W-02-WP	No	2		
C13.004		Fixed weir plates at secondary flow divider 1P-W-01-WP & 1P-W-02-WP	No	2		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 14: MECHANICALLY SCRAPED SETTLING TANKS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C14	Chapter 3: Particular Specification Mechanical	MECHANICALLY SCRAPED SETTLING TANKS				
	20.19.1	Supply and delivery of settling tank equipment for:				
C14.001		Primary settling tank: 25m diameter 1I-RB-01-M, 1I-RB-02-M	No	2		
C14.002		Secondary settling tank: 30m diameter 1P-RB-01-M, 1P-RB-02-M	No	2		
	20.19.2	Installation, testing and commissioning of settling tank equipment for:				
C14.003		Primary settling tank: 25m diameter 1I-RB-01-M, 1I-RB-02-M	No	2		
C14.004		Secondary settling tank: 30m diameter 1P-RB-01-M, 1P-RB-02-M	No	2		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 15: CHLORINATION

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C15	Chapter 3: Particular Specification Mechanical	CHLORINATION				
C15.001	21.18.3	Supply and delivery of gas chlorination system Gas chlorination system as schematically indicated on PK278-SMEC-01-PRC-DRG-1000-7001, -7002, -7003 & -7004	Lump Sum	1		
C15.002	21.18.4	Installation, testing and commissioning of gas chlorination system Gas chlorination system as schematically indicated on PK278-SMEC-01-PRC-DRG-1000-7001, -7002, -7003 & -7004	Lump Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 16: MECHANICAL DEGRITTER SYSTEMS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C16	Chapter 3: Particular Specification Mechanical	MECHANICAL DEGRITTER SYSTEMS				
C16.001	24.11.1	Supply and delivery of air lift grit pumping system Inlet works vortex degritter grit removal system	No	2		
C16.002	24.11.2	Installation, testing and commissioning of air lift grit pumping system Inlet works vortex degritter grit removal system	No	2		
C16.003	24.11.3	Supply and delivery of grit classifier Inlet works grit classifiers 1I-A-05-M, 1I-A-06-M	No	2		
C16.004	24.11.4	Installation, testing and commissioning of grit classifier Inlet works grit classifiers 1I-A-05-M, 1I-A-06-M	No	2		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 17: SCREENINGS HANDLING EQUIPMENT

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C17	Chapter 3: Particular Specifica-tion - Mechanical	SCREENINGS HANDLING EQUIPMENT				
	25.11.1	Supply and delivery of screenings hydro conveyor				
C17.001		Hydroconveyor for the inlet works 15mm screens	Lump Sum	1		
C17.002		Hydroconveyor for the inlet works 6mm screens	Lump Sum	1		
C17.003		Hydroconveyor for the inlet works 3mm screens	Lump Sum	1		
C17.004		Hydroconveyor for the inlet works grit classifiers	Lump Sum	1		
	25.11.2	Installation, testing and commissioning of screenings hydro conveyor				
C17.005		Hydroconveyor for the inlet works 15mm screens	Lump Sum	1		
C17.006		Hydroconveyor for the inlet works 6mm screens	Lump Sum	1		
C17.007		Hydroconveyor for the inlet works 3mm screens	Lump Sum	1		
C17.008		Hydroconveyor for the inlet works grit classifiers	Lump Sum	1		
	25.11.3	Supply and delivery of wash water system				
C17.009		Wash water system for the inlet works - for the 15mm, 6mm, 3mm screens and the degritting system.	Lump Sum	1		
	25.11.4	Installation, testing and commissioning of wash water system				
C17.010		Wash water system for the inlet works - for the 15mm, 6mm, 3mm screens and the degritting system.	Lump Sum	1		
	25.11.5	Supply and delivery of screenings waste washer compactor				
C17.011		Wash compactor for the inlet works 15mm screens 11-A-01-M, 11-A-02-M	No	2		
C17.012		Wash compactor for the inlet works 6mm screens 11-A-03-M, 11-A-04-M	No	2		
C17.013		Wash compactor for the inlet works 3mm screens 11-A-07-M, 11-A-08-M	No	2		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C17.014	25.11.6	Installation, testing and commissioning of screenings waste washer compactor Wash compactor for the inlet works 15mm screens 1I-A-01-M, 1I-A-02-M	No	2		
C17.015		Wash compactor for the inlet works 6mm screens 1I-A-03-M, 1I-A-04-M	No	2		
C17.016		Wash compactor for the inlet works 3mm screens 1I-A-07-M, 1I-A-08-M	No	2		
	Detail Spec	Supply and delivery of trolley system complete with capstan winch and rails to position a 6m³ waste bin to receive screening or grit from the wash compactor or grit classifier.				
C17.017		For the 15mm screen wash compactors 1I-TK-01-SK	Lump Sum	1		
C17.018		For the 6mm screen wash compactors 1I-TK-02-SK	Lump Sum	1		
C17.019		For the 3mm screen wash compactors 1I-TK-04-SK	Lump Sum	1		
C17.020		For the grit classifier 1I-TK-03-SK	Lump Sum	1		
	Detail Spec	Installation, testing and commissioning of trolley system complete with capstan winch and rails to position a 6m³ waste bin to receive screenings or grit from the wash compactor or grit classifier.				
C17.021		For the 15mm screen wash compactors 1I-TK-01-SK	Lump Sum	1		
C17.022		For the 6mm screen wash compactors 1I-TK-02-SK	Lump Sum	1		
C17.023		For the 3mm screen wash compactors 1I-TK-04-SK	Lump Sum	1		
C17.024		For the grit classifier 1I-TK-03-SK	Lump Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 18: DIFFUSED AERATION EQUIPMENT

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C18	Chapter 3: Particular Specifica-tion - Mechanical	DIFFUSED AERATION EQUIPMENT				
C18.001	26.14.1	Design, Drawings and General: Aeration system for basins 08 to 12.	Lump Sum	1		
C18.002	26.14.2	Supply and delivery of aeration blowers including suction filters, suction and delivery pressure gauges, safety valve, non-return valve and isolation valve. Reactor basin 8: 1P-BL-01-PD, 1P-BL-02-PD, 1P-BL-03-PD	No	3		
C18.003		Reactor basin 9: 1P-BL-04-PD, 1P-BL-05-PD, 1P-BL-06-PD	No	3		
C18.004		Reactor basin 10: 1P-BL-07-PD, 1P-BL-08-PD, 1P-BL-09-PD	No	3		
C18.005		Reactor basin 11: 1P-BL-10-PD & 1P-BL-11-PD	No	2		
C18.006		Reactor basin 12: 1P-BL-12-PD & 1P-BL-13-PD	No	2		
C18.007		Standby Blowers for Basins 10, 11 and 12 1P-BL-14-PD & 1P-BL-15-PD	No	2		
	26.14.3	Supply air manifold and main feeder pipework				
C18.008		Reactor basin 8:	Lump Sum	1		
C18.009		Reactor basin 9:	Lump Sum	1		
C18.010		Reactor basin 10:	Lump Sum	1		
C18.011		Reactor basin 11:	Lump Sum	1		
C18.012		Reactor basin 12:	Lump Sum	1		
	26.14.4	Supply stainless steel feeder pipework				
C18.013		Reactor basin 8:	Lump Sum	1		
C18.014		Reactor basin 9:	Lump Sum	1		
C18.015		Reactor basin 10:	Lump Sum	1		
C18.016		Reactor basin 11:	Lump Sum	1		
C18.017		Reactor basin 12:	Lump Sum	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	26.14.5	Supply header pipework				
C18.018		Reactor basin 8:	No	1		
C18.019		Reactor basin 9:	No	1		
C18.020		Reactor basin 10:	No	1		
C18.021		Reactor basin 11:	No	1		
C18.022		Reactor basin 12:	No	1		
	26.14.6	Supply aeration grids				
C18.023		Reactor basin 8: 1P-F-01-FBA	Lump Sum	1		
C18.024		Reactor basin 9: 1P-F-02-FBA	Lump Sum	1		
C18.025		Reactor basin 10: 1P-F-03-FBA	Lump Sum	1		
C18.026		Reactor basin 11: 1P-F-04-FBA	Lump Sum	1		
C18.027		Reactor basin 12: 1P-F-05-FBA	Lump Sum	1		
	26.14.7	Supply insert-type air flow meters with integrated display				
C18.028		Reactor basin 8:	No	1		
C18.029		Reactor basin 9:	No	1		
C18.030		Reactor basin 10:	No	1		
C18.031		Reactor basin 11:	No	1		
C18.032		Reactor basin 12:	No	1		
	26.14.8	Supply pressure gauges				
C18.033		Reactor basin 8:	No	1		
C18.034		Reactor basin 9:	No	1		
C18.035		Reactor basin 10:	No	1		
C18.036		Reactor basin 11:	No	1		
C18.037		Reactor basin 12:	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	26.14.9	Supply acid injection system				
C18.038		Reactor basin 8:	No	1		
C18.039		Reactor basin 9:	No	1		
C18.040		Reactor basin 10:	No	1		
C18.041		Reactor basin 11:	No	1		
C18.042		Reactor basin 12:	No	1		
	26.14.10	Supply condensate purging system				
C18.043		Reactor basin 8:	No	1		
C18.044		Reactor basin 9:	No	1		
C18.045		Reactor basin 10:	No	1		
C18.046		Reactor basin 11:	No	1		
C18.047		Reactor basin 12:	No	1		
	26.14.11	Supply dissolved oxygen sensors				
C18.048		Reactor basin 9:	No	1		
C18.049		Reactor basin 11:	No	1		
C18.050		Reactor basin 12:	No	1		
	26.14.12	Supply electrical and signal cabling between instruments, controllers and blower room control system to complete installation				
C18.051		Reactor basin 8:	Lump Sum	1		
C18.052		Reactor basin 9:	Lump Sum	1		
C18.053		Reactor basin 10:	Lump Sum	1		
C18.054		Reactor basin 11:	Lump Sum	1		
C18.055		Reactor basin 12:	Lump Sum	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	26.14.13	Installation of aeration blowers including suction filters, suction and delivery pressure gauges, safety valve, non-return valve and isolation valve.				
C18.056		Reactor basin 8: 1P-BL-01-PD, 1P-BL-02-PD, 1P-BL-03-PD	No	3		
C18.057		Reactor basin 9: 1P-BL-04-PD, 1P-BL-05-PD, 1P-BL-06-PD	No	3		
C18.058		Reactor basin 10: 1P-BL-07-PD, 1P-BL-08-PD, 1P-BL-09-PD	No	3		
C18.059		Reactor basin 11: 1P-BL-10-PD & 1P-BL-11-PD	No	2		
C18.060		Reactor basin 12: 1P-BL-12-PD & 1P-BL-13-PD	No	2		
C18.061		Standby Blowers for Basins 10, 11 and 12 1P-BL-14-PD & 1P-BL-15-PD	No	2		
	26.14.14	Install air manifold and main feeder pipework				
C18.062		Reactor basin 8:	Lump Sum	1		
C18.063		Reactor basin 9:	Lump Sum	1		
C18.064		Reactor basin 10:	Lump Sum	1		
C18.065		Reactor basin 11:	Lump Sum	1		
C18.066		Reactor basin 12:	Lump Sum	1		
	26.14.15	Install stainless steel feeder pipework				
C18.067		Reactor basin 8:	Lump Sum	1		
C18.068		Reactor basin 9:	Lump Sum	1		
C18.069		Reactor basin 10:	Lump Sum	1		
C18.070		Reactor basin 11:	Lump Sum	1		
C18.071		Reactor basin 12:	Lump Sum	1		
	26.14.16	Install header pipework				
C18.072		Reactor basin 8:	No	1		
C18.073		Reactor basin 9:	No	1		
C18.074		Reactor basin 10:	No	1		
C18.075		Reactor basin 11:	No	1		
C18.076		Reactor basin 12:	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	26.14.17	Install aeration grids				
C18.077		Reactor basin 8: 1P-F-01-FBA	Lump Sum	1		
C18.078		Reactor basin 9: 1P-F-02-FBA	Lump Sum	1		
C18.079		Reactor basin 10: 1P-F-03-FBA	Lump Sum	1		
C18.080		Reactor basin 11: 1P-F-04-FBA	Lump Sum	1		
C18.081		Reactor basin 12: 1P-F-05-FBA	Lump Sum	1		
	26.14.18	Install insert-type air flow meters with integrated display				
C18.082		Reactor basin 8:	No	1		
C18.083		Reactor basin 9:	No	1		
C18.084		Reactor basin 10:	No	1		
C18.085		Reactor basin 11:	No	1		
C18.086		Reactor basin 12:	No	1		
	26.14.19	Install pressure gauges				
C18.087		Reactor basin 8:	No	1		
C18.088		Reactor basin 9:	No	1		
C18.089		Reactor basin 10:	No	1		
C18.090		Reactor basin 11:	No	1		
C18.091		Reactor basin 12:	No	1		
	26.14.20	Install acid injection system				
C18.092		Reactor basin 8:	No	1		
C18.093		Reactor basin 9:	No	1		
C18.094		Reactor basin 10:	No	1		
C18.095		Reactor basin 11:	No	1		
C18.096		Reactor basin 12:	No	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	26.14.21	Install condensate purging system				
C18.097		Reactor basin 8:	No	1		
C18.098		Reactor basin 9:	No	1		
C18.099		Reactor basin 10:	No	1		
C18.100		Reactor basin 11:	No	1		
C18.101		Reactor basin 12:	No	1		
	26.14.22	Install dissolved oxygen sensors				
C18.102		Reactor basin 9:	No	1		
C18.103		Reactor basin 11:	No	1		
C18.104		Reactor basin 12:	No	1		
	26.14.23	Install electrical and signal cabling between instruments, controllers and blower room control system to complete installation				
C18.105		Reactor basin 8:	Lump Sum	1		
C18.106		Reactor basin 9:	Lump Sum	1		
C18.107		Reactor basin 10:	Lump Sum	1		
C18.108		Reactor basin 11:	Lump Sum	1		
C18.109		Reactor basin 12:	Lump Sum	1		
	26.14.24	Testing and Commissioning				
	26.14.24.1	Diffuser assemblies / pipe connections load tests				
C18.110		Reactor basin 8:	Lump Sum	1		
C18.111		Reactor basin 9:	Lump Sum	1		
C18.112		Reactor basin 10:	Lump Sum	1		
C18.113		Reactor basin 11:	Lump Sum	1		
C18.114		Reactor basin 12:	Lump Sum	1		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
	26.14.24.2	Leak testing / air distribution testing				
C18.115		Reactor basin 8:	Lump Sum	1		
C18.116		Reactor basin 9:	Lump Sum	1		
C18.117		Reactor basin 10:	Lump Sum	1		
C18.118		Reactor basin 11:	Lump Sum	1		
C18.119		Reactor basin 12:	Lump Sum	1		
	26.14.24.3	In-situ oxygenation efficiency determination				
C18.120		Reactor basin 8:	Lump Sum	1		
C18.121		Reactor basin 9:	Lump Sum	1		
C18.122		Reactor basin 10:	Lump Sum	1		
C18.123		Reactor basin 11:	Lump Sum	1		
C18.124		Reactor basin 12:	Lump Sum	1		
C18.125	26.14.25	Confirmation of suitability of the aeration system	Lump Sum	1		
C18.126	26.14.26	Provision of spare parts as specified in the Standard Specification.	Lump Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 19: LINEAR SCREENS AND BELT FILTER PRESSES

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C19	Chapter 3: Particular Specification Mechanical	LINEAR SCREENS AND BELT FILTER PRESSES				
	28.9.1	Design Drawings and General For the complete dewatering system - including WAS thickening and WAS and DL dewatering.	Lump sum	1		
C19.002	28.9.2	Supply and delivery of linear screens				
C19.003		2R-F-01-LS, 2R-F-02-LS 2R-F-03-LS, 2R-F-04-LS	No	4		
	28.9.3	Supply and delivery of belt filter press				
C19.004		2R-F-01-BP, 2R-F-02-BP 2R-F-03-BP, 2R-F-04-BP	No	5		
	28.9.4	Installation, testing and commissioning of linear screen				
C19.005		2R-F-01-LS, 2R-F-02-LS 2R-F-03-LS, 2R-F-04-LS	Lump Sum	4		
	28.9.5	Installation, testing and commissioning of belt filter press				
C19.006		2R-F-01-BP, 2R-F-02-BP 2R-F-03-BP, 2R-F-04-BP	Lump sum	4		
	28.9.6	Supply and delivery of centre-less screw conveyor				
C19.007		2R-C-01-SC, 2R-C-02-SC 2R-3-03-SC, 2R-C-04-SC	No	4		
	28.9.7	Installation, testing and commissioning of centre-less screw conveyor				
C19.008		2R-C-01-SC, 2R-C-02-SC 2R-3-03-SC, 2R-C-04-SC	Lump sum	4		
	B16.5	Design, supply and delivery of instrument air supply system				
C19.009		Air supply system as schematically indicated on PK278-SMEC-01-PRC-DRG-1000-7005	Lump sum	1		
	B16.6	Installation, testing and commissioning of instrument air supply system				
C19.010		Air supply system as schematically indicated on PK278-SMEC-01-PRC-DRG-1000-7005	Lump sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 20: ANAEROBIC DIGESTERS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C20	Chapter 3: Particular Specification Mechanical	ANAEROBIC DIGESTERS				
	B16.1	Design, supply and delivery of anaerobic digestion and pump mixing equipment				
C20.001		Anaerobic digester A	Lump Sum	1		
C20.002		Anaerobic digester B	Lump Sum	1		
	B16.2	Installation, testing and commissioning of anaerobic digestion and pump mixing equipment				
C20.003		Anaerobic digester A	Lump Sum	1		
C20.004		Anaerobic digester B	Lump Sum	1		
C20.005	B16.3	Design, supply and delivery of anaerobic digester gas flare system	Lump Sum	1		
C20.006	B16.4	Installation, Testing and commissioning of anaerobic digester gas flare system	Lump Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 21: CHEMICAL DOSING PLANT

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C21	Chapter 3: Particular Specification Mechanical	CHEMICAL DOSING PLANT				
C21.001	27.10.1	Supply and delivery of chemical dosing plant mixers (tenderer to enter no of mixers required as per his design)	No			
C21.002	27.10.2	Installation, testing and commissioning of chemical dosing plant mixers (tenderer to enter no of mixers required as per his design)	No			
	27.10.3	Supply and delivery of chemical dosing system				
C21.003		Polyelectrolyte dosing system	No	2		
C21.004		Ferric chloride dosing system	No	1		
	27.10.4	Installation, testing and commissioning of chemical dosing system				
C21.005		Polyelectrolyte dosing system	No	2		
C21.006		Ferric chloride dosing system	No	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 22: DEWATERED SLUDGE HANDLING

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C22	Chapter 3: Particular Specification Mechanical	DEWATERED SLUDGE HANDLING The items included in this Schedule are specified in Part B of Chapter 3 - Clause 15. Payment refers numbers refer to the relevant subparagraph of Clause 15.				
C22.001	15.2	Articulated Wheel Loader Articulated wheel loader as specified complete with spare parts as specified in Part B Clause 15.10.3	No	2		
C22.002	15.3	Dewatered Sludge Spreader Dewatered sludge spreader as specified complete with spare parts as specified in Part B Clause 15.10.4	No	2		
C22.003	15.4	Tractor Tractor as specified complete with spare parts as specified in Part B Clause 15.10.5	No	3		
C22.004	15.5	Dried Sludge Turner Dried sludge turner as specified complete with spare parts as specified in Part B Clause 15.10.6	No	1		
C22.005	15.6	Hydraulic Tip Trailer Hydraulic tip trailer as specified complete with spare parts as specified in Part B Clause 15.10.7	No	1		
C22.006	15.7	Legal Requirements All legal requirements as specified in Part B Clause 15.10.8 shall be deemed included in the tendered rates for the items above.	No	1		
C22.007	15.8	Operator Training All operator training requirements and cost as specified in Part B Clause 15.10.9 shall be deemed included in the tendered rates for the items above.	No	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 23: FIRE WATER PUMP STATION

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C23	Chapter 3: Particular Specification Mechanical	FIRE WATER PUMP STATION				
	PS 8.5	SUM STATED PROVISIONALLY BY THE ENGINEER				
C23.001		Fire water pump station	Prov Sum	1	6,500,000.00	6,500,000.00
C23.002		Overheads, charges and profit on fire water pump station	%	6,500,000		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 24: PARSHALL FLUMES

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C24	Chapter 3: Particular Specification Mechanical	PARSHALL FLUMES				
	31.10.1	Supply and delivery of Parshall Flume measuring device				
C24.001		305mm Parshall flume in the inlet channel	No	1		
C24.002		305mm Parshall flume in the outlet channel	No	1		
	31.10.2	Installation of Parshall Flume measuring device				
C24.003		305mm Parshall flume in the inlet channel	No	1		
C24.004		305mm Parshall flume in the outlet channel	No	1		
	31.10.3	Testing and commissioning of Parshall Flume measuring device				
C24.005		305mm Parshall flume in the inlet channel	No	1		
C24.006		305mm Parshall flume in the outlet channel	No	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE NO 3: TESTING AND COMMISSIONING

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
C25	Chapter 3: Particular Specification Mechanical	OPERATIONS AND MAINTENANCE				
C25.001		Measurement and payment for operations and maintenance shall be deemed included in the rates tendered for each individual item and in the rates tendered in Part C Schedule 1 but excluding Part A Schedule 1	Month	12.00		
C25.002	SANS 1200A 8.4 (as amended)	TIME-RELATED ITEMS (FOR DURATION OF OPERATIONS AND MAINTENANCE PERIOD)				
	8.4.1	Contractual Requirements	Month	12.00		
	8.4.2	Operation and Maintenance of Facilities on Site				
	8.4.2.1	Facilities for Engineer				
C25.003	8.4.2.1 a)	Furnished offices (See Clauses 3.2 and 5.2 of SANS 1200 AB, as amended in the Particular Specification)	Month	12.00		
C25.004	8.4.2.1 b)	Telephone (See Clauses 4.1 and 5.4 of SANS 1200 AB, as amended in the Particular Specification)	Month	12.00		
C25.005	8.4.2.1 c)	Nameboards (2 No.) (See Clauses 3.1 and 5.1 of SANS 1200 AB, as amended in the Particular Specification)	Month	12.00		
C25.006	PS 8.4.2.1 d)	Survey Assistants	Month	12.00		
C25.007	PS 8.4.2.1 e)	Survey Equipment (See Clause 4.2 of SANS 1200 AB in the Particular Specification)	Month	12.00		
	8.4.2.2	Facilities for Contractor				
C25.008	8.4.2.2 a)	Offices and storage sheds	Month	12.00		
C25.009	8.4.2.2 b)	Workshops	Month	12.00		
C25.010	8.4.2.2 c)	Laboratories	Month	12.00		
C25.011	8.4.2.2 d)	Living accommodation	Month	12.00		
C25.012	8.4.2.2 e)	Ablution and latrine facilities	Month	12.00		
C25.013	8.4.2.2 f)	Tools and equipment	Month	12.00		
C25.014	8.4.2.2 g)	Water supplies, electric power and communications	Month	12.00		
C25.015	8.4.2.2 h)	Dealing with water (see SANS 1200 A Subclause 5.5)	Month	12.00		
C25.016	8.4.2.2 i)	Access (See SANS 1200 A Subclause 5.8)	Month	12.00		
C25.017	8.4.3	Supervision for Duration of Construction	Month	12.00		
C25.018	8.4.4	Company and Head Office Overhead Costs for the Duration of Construction	Month	12.00		
	PS 8.4.5	Other Time-related Obligations				
C25.019	PS 8.4.5 a)	Health and Safety Obligations	Month	12.00		
C25.020	PS 8.4.5 b)	Security Services Costs	Month	12.00		
C25.021	PS 8.4.5 c)	Environmental Obligations	Month	12.00		
C25.022	PS 8.4.5 d)	EPWP Obligations and Labour-intensive Requirements	Month	12.00		
C25.023	PS 8.4.5 e)	Safety PPE for EPWP Workers	Month	12.00		
C25.024	PS 8.4.5 f)	All Other Time-related Obligations	Month	12.00		
Total Carried Forward						

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
C25.025	SANS 1200A PS 8.5	SUMS STATED PROVISIONALLY BY ENGINEER				
		Engineer's Residential Accommodation for the duration of Operations and Maintenance Period	Prov Sum	1.00	840,000.00	840,000.00
C25.026		Overheads, charges and profit on Engineer's Residential Accommodation	%	840,000.00		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 1: PRELIMINARY AND GENERAL

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
D1	Chapter 4: Particular Specification - Electrical	PRELIMINARY AND GENERAL (Note that where payment references from Chapter 3 are used, these shall be applied <i>mutatis mutandi</i> to the electrical works)				
	2.4.2	FIXED-CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
D1.001	2.4.2.1	Contractual Requirements (SANS1200A 8.3.1)	Sum	1		
D1.002	Chapter 3 2.4.1	Establishment of facilities on the Site (SANS1200A 8.3.2)	Sum	1		
D1.003	2.4.2.2	Other Fixed-Charge Obligations (SANS1200A 8.3.3)	Sum	1		
D1.004	Chapter 3 2.4.2	Removal of Site Establishment (SANS1200A 8.3.4)	Sum	1		
		TIME-RELATED CHARGE ITEMS (RELATED TO CONSTRUCTION PERIOD)				
D1.005	2.4.3.1	Contractual Requirements (SANS1200A 8.4.1)	Sum	1		
D1.006	Chapter 3 2.4.3	Operation and Maintenance of Facilities on Site, for Duration of Construction (SANS1200A 8.4.2)	Sum	1		
D1.007	2.4.3.2	Supervision for Duration of Construction (SANS1200A 8.4.3)	Sum	1		
D1.008	2.4.3.3	Company and Head Office Overhead Costs for the Duration of the Contract (SANS1200A 8.4.4)	Sum	1		
D1.009	2.4.3.4	Other Time-related Obligations (SANS1200A 8.4.5)	Sum	1		
	Chapter 3 1.21.7	Storage of Plant where storage space is provided by:				
D1.010	Chapter 3 1.21.7.1	The Contractor	m ³ - month	100		
D1.011	Chapter 3 1.21.7.2	The Employer	m ³ - month	100		
	SANS 1200A PS 8.5	PROVISIONAL SUMS				
D1.012	1.21.7	Maintenance spares	Prov sum	1	5,000,000.00	5,000,000.00
D1.013	1.21.8	Overheads, charges and profit on maintenance spares	%	5000000		
D1.014	SANS1200A Clause 8.4.5	Additional samples of Materials kept by the Employer	Prov sum	1	100,000.00	100,000.00
D1.015	SANS1200A Clause 8.4.5	Overheads, charges and profit on additional samples of Materials kept by the Employer	%	100000		
D1.016	SANS1200A Clause 8.4.5	Application fees to local supply authority - ESKOM (note that coordination and arrangement of power supply with local supply authority is included for under Items D4.003 and D4.009)	Prov sum	1	15,000,000.00	15,000,000.00
D1.017	SANS1200A Clause 8.4.5	Overheads, charges and profit on application fees to local supply authority (ESKOM)	%	15000000		
Total Carried Forward						

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
Total Brought Forward						
		DAYWORKS				
	Chapter 3 2.4.4	Daywork - Labour				
D1.018		Unskilled	hrs	100		
D1.019		Semi-skilled	hrs	20		
D1.020		Skilled	hrs	10		
D1.021		Supervisor	hrs	10		
D1.022		Foremen	hrs	10		
D1.023		Tradesmen	hrs	10		
D1.024		Artisan	hrs	10		
	Chapter 3 2.4.5	Daywork - Equipment				
D1.025		Hand roller, vibrator	hrs	10		
D1.026		Plate compactor, vibratory,	hrs	10		
D1.027		Rammer, mechanical, over	hrs	10		
D1.028		Compressor: Up to 10 m ³ /minute	hrs	10		
D1.029		Generator	hrs	10		
	Part B: Standard Specifications. SECTION 1 STD SPEC : CONTRACT ADMINISTRAT ION AND GENERAL REQUIREMEN TS	CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS				
D1.030	1.21.1	Provide and maintain a quality system	Sum	1		
D1.031	1.21.4	Test and commission the installation	Sum	1		
D1.032	1.21.5	Provide "as-built" drawings	Sum	1		
D1.033	1.21.6	Provide manuals for the installation	Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

SCHEDULE 1: PRELIMINARY AND GENERAL

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
D3	Chapter 4: Particular Specification - Electrical, Control and Instrumentation n Part A: Description of Works	ELECTRICAL CONTROL & INSTRUMENTATION WORKS				
	1.4.	ELECTRICAL CONTROL & INSTRUMENTATION WORKS				
D3.001	1.4.1	Design Fee	Sum	1		
	1.4.2	Construction/Implementation Cost				
D3.002		a. MV equipment and Transformers/Minisubs	Sum	1		
D3.003		b. MCC's and Local Control Stations	Sum	1		
D3.004		c. Emergency Back-up Power system	Sum	1		
D3.005		d. Control system including PLC equipment and SCADA complete with all Software and Hardware	Sum	1		
D3.006		e. UPS Systems	Sum	1		
D3.007		f. MV Cable installation	Sum	1		
D3.008		g. LV Cable installation	Sum	1		
D3.009		h. Control and Instrumentation Installation	Sum	1		
D3.010		i. Access Control System	Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY						

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

PART C3: SCOPE OF WORK

C3.1 STANDARD SPECIFICATIONS

C3.2 PROJECT SPECIFICATIONS

C3.3 PARTICULAR SPECIFICATIONS

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

PART C3: SCOPE OF WORK

As much as is economically feasible all work shall be implemented by employing Labour Intensive Construction methods. Over and above the normal Building and Allied works to be implemented by employing skilled and unskilled labour the works specified in the “Guidelines for the Implementation of Labour-Intensive Infrastructure Projects under the Expanded Public Works Programme (EPWP)” shall be undertaken using Labour Intensive Construction methods

C3.1 DESCRIPTION OF THE WORKS

3.1.1 Employer’s Objectives

The main objective is to construct The Employer’s objective is to construct the first phase of 20 Ml/day Conventional Activated Sludge (CAS) Bioreactor system as part of the newly proposed Polokwane Regional Wastewater Treatment Works (PRWWTW). The WWTW is being developed to facilitate the increase in treatment capacity for Polokwane Municipality and consequently allow further developments to occur within the area.

The new Polokwane Regional WWTW will initially supplement the existing Polokwane WWTW and Seshego WWTW with the intent to gradually decommission these works over time. The wastewater collected from the various areas will then be transported via a sewer pipe system to the new Polokwane Regional WWTW which will have projected final capacity of 100 Ml/day with the reactor itself operating with the presence of a flow balancing tank.

The employer’s objectives are to deliver public infrastructure using labour intensive methods and in so doing provide work place training opportunities to learners who have a Leaderships Agreements with the Construction Education and Training Authority.

3.1.2 Overview of the Works

An overview of the works pertaining to the Contract is provided in the description below:

1. Construction of a CAS WWTW with the earthworks completed by others.
2. Provide Shop Drawings or Installation specifications, supply and installation of a Mechanical and Electrical technologies required for the works as specified.
3. O & M maintenance works

The land on which the WWTW is to be constructed is undeveloped municipal land with no services. The geology of the area consists of weathered and transported granitic soils with shallow bedrock.

The Contract includes obligations for providing installation specifications or shop drawings with respect to mechanical, electrical, control & instrumentation and building works components. The Contract also includes responsibilities for testing, commissioning and resolution of defects.

The work will be carried using Labour- Intensive approach as much as possible. Labour-intensive works comprise the activities described in SANS 1921-5, Earthworks activities which are to be performed by hand,

and its associated specification data. Such works shall be Constructed using local workers who are temporarily employed in terms of this Scope of Work.

3.1.3 Extent of the Works

The construction of the Polokwane Regional WWTW includes the following:

The treatment works capacity was concluded to operate at a total of 20 Mℓ/day, which employs the CAS bioreactor configuration for biological nutrient removal.

The plant will discharge effluent into the Sand River which requires a high effluent quality. When operated according to the prescribed procedure the quality of effluent should comply with the Special Standards of the National Water Act of 1998, including minor effluent enhancements. The quality of the effluent should as minimum comply with the following standards:

- COD - < 75 mg/ℓ
- pH - 5.5 – 9.5
- Free saline Ammonia as Nitrogen - < 1 mg/ℓ
- Nitrate/Nitrite as Nitrogen - < 10 mg/ℓ
- Orthophosphate as Phosphorus - < 1 mg/ℓ
- Suspended solids - < 25 mg/ℓ

Flow from the primary settling tanks will enter the reactor works through a collection chamber. The construction of the inlet works, primary settling tanks, collection chamber, sludge treatment train, and surrounding civil works, along with the provision of installation specifications or shop drawings, supply and installation of the mechanical and electrical aspects as required, also form part of this contract.

The new activated sludge reactor will be complete including all mechanical installations, electrical installations, pipework, civil works and structural works.

The following ancillary civil works are included:

- Supply of a 20 Mℓ/day biological reactor;
- Establishment of the Contractor's Camp Site;
- Site clearance;
- Supply of inlet works,
- Supply of Primary settling tanks,
- Supply of balancing tank,
- Supply of CAS BNR system with associated pump stations;
- Supply of secondary clarifier,
- Supply of chemical dosing facilities,
- Supply of dewatering and sludge drying facilities,
- Supply of disinfection facilities
- Supply of anaerobic digestion facilities,
- Hand railing;
- Location, exposing and protection of existing services;
- Excavation, trench preparation and compaction;
- Supply, bedding and laying of pipes between various elements;

- Backfilling and testing of installation;
- Reinstatement of surfaces to original condition;

Mechanical work comprises the provision of installation specifications or shop drawings, manufacture, supply, delivery, installation, testing, commissioning, training and upholding during the Defects Notification Period of the following:

- a. Inlet Works: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of:
 - (i) Mechanical front raked and hand-raked bar screens at the inlet works which includes screenings wash presses, associated screenings launder conveyors, and a skip dolly to house skips containing the removed screenings.
 - (ii) Sluice channel mounted gates with and without actuators
 - (iii) Provision of mechanical equipment for two new vortex degritters including all associated pumping and piping equipment, valves, grit classifiers and a skip dolly to house skips containing the removed grit
- b. Primary Settling Tanks (PST's): The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of the mechanical equipment associated with rotating bridges for two (2) new PST
- c. Flow Balancing Tank: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of mixers.
- d. Biological Reactor: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of mixers and fine bubble aerostation.
- e. Secondary Settling Tanks (SST's): The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of the mechanical equipment associated with rotating bridges for four (4) new SST.
- f. Thin Sludge Sump: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of the mechanical equipment associated with the mixers.
- g. Linear screens: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of the mechanical equipment associated with the Linear screens.
- h. Chlorine Disinfection Facility: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of all equipment associated with a gaseous chlorine facility for disinfection of wastewater.
- i. Wash-water pumps: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of pumping equipment and associated filters to pump treated effluent for plant use.
- j. RAS pump station: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of new pumps and pipework for pumping of return activated sludge (RAS) to the Biological Reactor.
- k. WAS pump station: The provision of installation specifications or shop drawings, supply, delivery, installation, testing and commissioning of new pumps and pipework for pumping of waste activated sludge (WAS) to the thin sludge sump.
- l. General:
 - (i) Provision of numerous sluices and weirs for the works.
 - (ii) Provision of pipework, valves and instrumentation at numerous locations on the plant.
 - (iii) Provision of lifting equipment.

- (iv) Provision of pipework and instrumentation for flow meter chambers.
- (v) Provision of spares as specified in the Contract.

The electrical portion of this contract shall include the following:

- a. Liaison with the supply authority (Polokwane Local Municipality) to coordinate the connection to MV supply
- b. Surge arrestor to the overhead lines termination pole
- c. Underground cable from Mini-Sub to new Mini-Sub
- d. One mini-sub, including a three-way RMU
- e. LV Motor controls centres
- f. LV cables and cable support systems
- g. Electrical actuators for valves and penstocks
- h. Bonding and earthing
- i. Lightning protection
- j. Testing and commissioning of the electrical installation
- k. Certificates of compliance

"This Scope of Works defines the comprehensive Operations and Maintenance (O&M) requirements for the new 20.00ML/day Wastewater Treatment Plant (WWTP). The Contractor is mandated to provide seamless transition management from the Ready for Commissioning (RFC) milestone to the Ready for Operation (RFO) milestone, and to assume O&M responsibilities for twelve (12) months beyond the RFC stage. The primary objective is to ensure that the facility is operated by a fully trained, competent team capable of maintaining 100% compliance with the Water Use License (WUL) while protecting the Employer's capital investment through rigorous preventative maintenance and asset management protocols. The following duties are considered but not exhaustive:

a. Management & Administration

To comply with Green Drop KPA 1 (Technical Management), the Contractor must provide a staff complement registered with the Department of Water and Sanitation (DWS). For a 20 ML/day plant (typically Class B or C works), the following is required:

- (i) Staffing & Training (Sub-Clause 5.5): Deploy a qualified team (Plant Manager, Process Engineers, Millwrights, Lab Techs). Complete all classroom and "hands-on" training before the RFC date.
- (ii) Works Manager (Class V): Must be a registered Professional Engineer or Senior Technologist with extensive wastewater experience to oversee the entire 24-month period.
- (iii) Supervisory Process Controller (Class IV): One lead supervisor responsible for the technical process performance and IRIS data submissions.
- (iv) Shift Process Controllers (Class III/IV): At least one qualified controller per 8-hour shift to ensure 24/7 onsite presence.
- (v) Maintenance Team: One dedicated Mechanical Fitter and one Electrician/Millwright for preventative maintenance.
- (vi) Asset Management: Establish an electronic Asset Register for all 20ML/day infrastructure (pumps, blowers, screens, SCADA).
- (vii) O&M Manuals (Sub-Clause 5.7): Provide final, site-specific manuals in English that cover every component from the inlet works to the chlorination/UV contact tank.
- (viii) Reporting: Monthly reports detailing inflow volumes (ML/d), energy consumption, chemical usage, and any "Near Miss" safety incidents.

b. Process Operation (The 20ML/day Flow)

- (i) Inlet Works: Daily cleaning of mechanical screens and grit removal systems to prevent downstream clogging.
- (ii) Biological Treatment: Management of Activated Sludge or BNR (Biological Nutrient Removal) processes. Includes monitoring Dissolved Oxygen (DO) levels and Mixed Liquor Suspended Solids (MLSS).
- (iii) Clarification: Monitoring of sludge blankets and automated return/waste sludge (RAS/WAS) pumping rates.
- (iv) Disinfection: Ensuring residual chlorine levels or UV intensity meet the Department of Water Affairs (or local regulator) standards for a daily throughput of 20 ML.

c. Maintenance Protocols

- (i) Preventative (PM): Scheduled lubrication, belt tensioning, and vibration analysis on all rotating equipment (aerators, pumps).
- (ii) Corrective: 24/7 emergency response for equipment failure. Note: Failure to repair critical items within the 30-day window between RFC and RFO may trigger RFO Delay Damages.
- (iii) Calibration: Quarterly calibration of flow meters, pH probes, and DO sensors to ensure SCADA accuracy.

d. Laboratory & Compliance

The Contractor is bound by Sub-Clause 9.1 of the FIDIC Yellow Book to meet "Tests on Completion" and "Tests after Completion."

- (i) Sampling: Daily sampling of Raw Sewage (Influent) and Treated Effluent.
- (ii) Testing: Lab analysis for COD (Chemical Oxygen Demand), BOD, Ammonia, Nitrates, and E.coli.
- (iii) Compliance: Ensure that all 20 ML/day of treated water meets the Water Use License (WUL) conditions.
- (iv) Effluent Quality: Must consistently meet the National Water Act General Limit:
 - Faecal Coliforms: 0 CFU/100ml
 - COD: < 75 mg/l
 - pH: 5.5 – 9.5
 - Free saline Ammonia as Nitrogen: < 1 mg/l
 - Nitrate/Nitrite as Nitrogen: < 10 mg/l
 - Orthophosphate as Phosphorus: < 1 mg/l
 - Suspended solids: < 25 mg/l

e. Health, Safety & Environment (HSE)

- (i) PPE & Signage: Supply of all safety gear and hazardous chemical signage (especially for chlorine/polymer areas).
- (ii) Sludge Disposal: Management of sludge drying beds or mechanical dewatering; transport of "cake" to a licensed landfill or composting site.
- (iii) Housekeeping: Grounds keeping, grass cutting, and odour control within the plant perimeter.
- (iv) Wastewater Risk Abatement Plan (W²RAP): Annual review of process risks (e.g., power failure, toxic inflow) as required by DWS for Green Drop certification.
- (v) Safety Compliance: Quarterly Safety Audits and annual medical screenings for all staff handling raw sewage.

f. Consumables & Spares

- (i) Inventory: Maintain a "strategic spares" and chemicals for a minimum of 3 months buffer stock to minimise downtime.
- (ii) Chemicals: Procurement and dosing of polymers, coagulants, or disinfectants required for the 20.00 ML/day process.

The Contractor's obligations shall also include strict compliance with any environmental requirements and/or reports deemed to form part of this Contract as well as any Occupational Health and Safety requirements. This description of the works is not necessarily complete and shall not limit the work to be carried out by the Contractor under the Contract.

3.1.4 Location of the Works

The location of the Works is North-East of Polokwane (See Location Plan in Volume 5 Book of Drawings.) and the limits of the project are as shown on the General Layout plan bound into the Volume 5 Book of drawings. The site shall not only include the works area for the construction of the new services, but shall be extended in the broader sense to take account of all areas occupied by the Contractor, be it deliberate or unintentional, in the execution of the contract.

Choosing a location for the site camp will be the responsibility of the successful tenderer assisted by the municipality in finding space in the ward.

3.1.5 Description of Site and Conditions

The following site conditions shall be deemed to have been taken into consideration by the Contractor in the pricing of his Tender:

a. Altitude above sea level: 1214 m mean

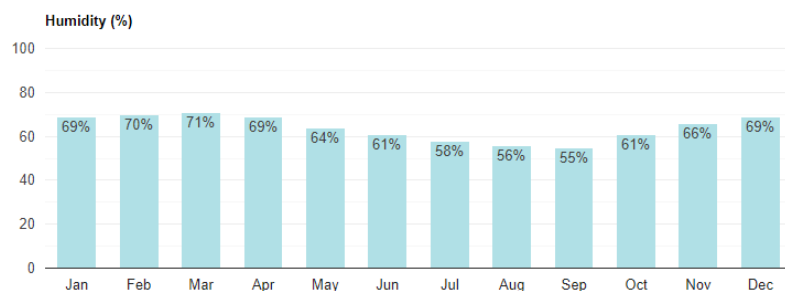
b. Average maximum/minimum temperatures for Polokwane:

Month	High Temperatures (°C)	Low Temperatures (°C)
January	29°	17°
February	29°	17°
March	28°	16°
April	26°	12°
May	24°	8°
June	21	5°
July	21°	5°
August	24°	7°
September	27°	11°
October	28°	13°
November	28°	15°
December	29°	17°

Source: National Centres for Environmental Information

c. Average Relative Humidity per month:

Average humidity Polokwane, South Africa



Source: https://www.weather-atlas.com/en/south-africa/polokwane-climate#humidity_relative

d. Average Rainfall: Refer to Particular Conditions of Contract Sub-Clause 8.4 for a description of average rainfall conditions at the Site

3.1.6 Work to Be Carried Out By Others (Under Separate Contracts)

The following works will be carried out under separate contracts by other contractors:

- a) Construction of outfall sewers to the new Polokwane Regional WWTW.
- b) Include Earthworks

The Contractor shall be required to undertake all reasonable endeavours to liaise with these other contractors in order that potential delays and additional costs are avoided insofar as is reasonably possible. 'Reasonable endeavours' shall include weekly co-ordination meetings with the other contractors, and implementing the actions agreed therein.

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C3.2 STANDARD SPECIFICATIONS

The standard specifications on which this contract is based are:

Specification	Description
SANS 1200 A	General (1986)
SANS 1200 AB	Engineer's office (1986)
SANS 1200 C	Site clearance (1980)
SANS 1200 D	Earthworks (1988)
SANS 1200 DB	Earthworks (pipe trenches) (1988)
SANS 1220 DK	Gabions and pitching (1996)
SANS 1200 DM	Earthworks (roads, subgrade) (1981)
SANS 1200 G	Concrete (Structural) (1982)
SANS 1200 H	Structural steelwork (1990)
SANS 1200 HB	Cladding and sheeting (1985)
SANS 1200 HC	Corrosion protection of structural steelwork (1988)
SANS 1200 L	Medium Pressure Pipelines (1983)
SANS 1200 LB	LB Bedding (Pipes) (1983)
SANS 1200 LC	Cable ducts (1981)
SANS 1200 LD	Sewers (1982)
SANS 1200 LE	Storm Water Drainage (1982)
SANS 1200 M	Roads (general) (1996)
SANS 1200 ME	Subbase (1981)
SANS 1200 MF	Base (1981)
SANS 1200 MFL	Base (light pavement structures) (1996)
SANS 1200 MJ	Segmented paving (1984)
SANS 1200 MK	Kerbing and channelling (1983)
SANS 1200 MM	Ancillary roadworks (1984)

The SANS Specification is available from:

Office Address
1 Dr Lategan Road
Groenkloof
Pretoria

Postal Address
Private Bag X191
Pretoria
0001

Telephone:

Telefax:

National: 012 428 7911

National: 012 344 1568

International: +27 12 428 7911

International: +27 12 344 1568

PARTICULAR SPECIFICATIONS AND VARIATIONS AND ADDITIONS TO THE STANDARD SPECIFICATIONS

C3.3 PARTICULAR SPECIFICATIONS

In addition to the Standardized and Project Specifications the following Particular Specifications shall apply to this contract and are bound in hereafter.

The Particular Specifications applicable to this Contract are the following:

- Particular Specification Chapter 1: Amendments to SANS1200
- Particular Specification Chapter 2: Civil
- Particular Specification Chapter 3: Building Works
- Particular Specification Chapter 4: Testing and Commissioning Specification
- Particular Specification Chapter 5: Socio-Economic Development Specification
- Particular Specification Chapter 6: Mechanical Specifications
- Particular Specification Chapter 7: Electrical and Control & Instrumentation Specifications

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C3.3.1 VARIATIONS TO STANDARD SPECIFICATIONS

Specification		Description
C3.3.1.1	SANS 1200 A	General (1986)
C3.3.1.2	SANS 1200 AB	Engineer's office (1986)
C3.3.1.3	SANS 1200 C	Site clearance (1980)
C3.3.1.4	SANS 1200 D	Earthworks (1988)
C3.3.1.5	SANS 1200 DB	Earthworks (pipe trenches) (1988)
C3.3.1.6	SANS 1220 DK	Gabions and pitching (1996)
C3.3.1.7	SANS 1200 DM	Earthworks (roads, subgrade) (1981)
C3.3.1.8	SANS 1200 G	Concrete (Structural) (1982)
C3.3.1.9	SANS 1200 H	Structural steelwork (1990)
C3.3.1.10	Not used	
C3.3.1.11	SANS 1200 L	Medium Pressure Pipeline (1983)
C3.3.1.12	SANS 1200 LB	LB Bedding (Pipes) (1983)
C3.3.1.13	SANS 1200 LC	Cable ducts (1981)
C3.3.1.14	SANS 1200 LD	Sewers (1982)
C3.3.1.15	SANS 1200 LE	Storm Water Drainage (1982)
C3.3.1.16	SANS 1200 M	Roads General
C3.3.1.17	SANS 1200 ME	Subbase (1981)
C3.3.1.18	SANS 1200 MF	Base (1981)
C3.3.1.19	SANS 1200 MJ	Segmented paving (1984)
C3.3.1.20	SANS 1200 MK	Kerbing and Channelling
C3.3.1.21	SANS 1200 MM	Ancillary Roadworks

SANS 1200A: PRELIMINARY AND GENERAL - PROJECT SPECIFICATIONS

Clause	SANS1200 A Project Specification
2.3 (c)	Measurement and Payment REPLACE THE FOLLOWING Fixed charge: A charge that is not subject to adjustment on account of variation in the value of the Contract amount or the Contract Time of Completion. Time-related charge: A charge, the amount of which varies in accordance with the Time for Completion of the work, adjusted in accordance with the provisions of the Contract. Value-related charge: A charge, the amount of which varies pro rata with the final value of the measured work executed and valued in accordance with the provisions of the Contract.
5.1	3.1 Preservation and replacement of survey beacons and pegs subject to the Land Survey Act DELETE THE WORDS “in the vicinity of boundaries” IN THE SECOND SENTENCE OF SUBCLAUSE 5.1.2 AND REPLACE THE WORDS “under the direction of” IN THE SAME SENTENCE WITH “in consultation and liaison with.” ADD THE FOLLOWING AFTER THE SECOND SENTENCE OF SUBCLAUSE 5.1.2: The Contractor and the Engineer shall record on the said list, their concurrence or disagreement (as the case may be) regarding the completeness and accuracy of the details recorded therein. REPLACE THE THIRD SENTENCE OF SUBCLAUSE 5.1.2 WITH THE FOLLOWING: At the completion of the Contract, the Contractor shall expose all pegs that were listed at the commencement of the construction as being in order and the Contractor shall arrange with a registered Land Surveyor for the checking of the positions of all such pegs and the replacement of those that the Land Surveyor’s check reveals have become disturbed or damaged. The Contractor shall, as a precedent to the issue of the Certificate of Completion, provide to the Engineer, a certificate from the registered Land Surveyor, certifying that all the pegs listed at the commencement of construction in accordance with the provisions of this clause, have been checked and that those found to have been disturbed, damaged or destroyed have been replaced in their correct positions, all in accordance with the provisions of the said Act. The costs of all checking, replacement and certification as aforesaid shall be entirely for the Contractor’s account. This, with the provisions always that the Contractor shall not be held liable for the cost of replacement of pegs which: c) Cannot reasonably be re-established in their original positions by reason of the finished dimensions of the permanent works, and d) The contractor can prove beyond reasonable doubt to the satisfaction of the Engineer, were disturbed, damaged or destroyed by others beyond his control.
5.2	3.2 WATCHING, BARRICADING, LIGHTING AND TRAFFIC CROSSINGS ADD THE FOLLOWING This involves accommodating traffic along the farm roads and other access roads as well as along the main Dendron road where pipe-jacking or other methods of crossing the road are in progress and be paid for under 8.8.2.

Clause	SANS1200 A Project Specification
5.3	3.3 Protection of existing structures <i>REPLACE</i> "Machinery and Occupational Safety Act, 1983 (Act No 6 of 1983)" <i>WITH</i> "Occupational Health and Safety Act, 1993 (Act No 85 of 1993), as amended," <i>AND INSERT THE FOLLOWING AFTER</i> "(Act No. 27 of 1956)": "as amended."
5.4	3.4 Protection of overhead and underground services REPLACE THE HEADING AND THE CONTENTS OF SUBCLAUSE 5.4 WITH THE FOLLOWING: 5.4.1 Location of existing services Before commencing with any work in an area, the Contractor shall ascertain the presence and actual position of all services which can reasonably be expected by an experienced and competent Contractor to be present on, under, over or within the Site. Without in any way limiting his liability in terms of the Conditions of Contract in relation to damage to property and interference with services, the Contractor shall, in collaboration with the Engineer, obtain the most up-to-date plans as are available, showing the positions of services existing in the area where he intends to work. Neither the Employer nor the Engineer offers any warranty as to the accuracy or completeness of such plans and because services can often not be reliably located from plans, the Contractor shall ascertain the actual location of services depicted on such plans by means of careful inspection of the Site. The Contractor shall, by the use of appropriate methodologies and as part of his obligations under Sub-Clause 4.7 [Setting Out], carefully expose all existing services at such positions as are agreed to by the Engineer. This is for the purposes of verifying the exact location and position of the services as required to fulfill the Contractor's design and execution responsibilities under Sub-Clause 4.1 [Contractor's General Obligations]. Where the exposure of existing services involves excavation to expose underground services: The Contractor shall be deemed to have satisfied himself as to the nature of the ground and sub-surface conditions in accordance with Sub-Clause 4.10 [Site Data]. The further requirements of Sub-Clause 4.18 [Protection of the Environment] and Sub-Clause 4.22 [Site Data and Items of Reference] (as applicable to the Particular Conditions) shall apply. The aforesaid procedure shall also be followed in respect of services not shown on the plans but which may reasonably be anticipated by an experienced Contractor to be present or potentially present on the site. All services, the positions of which have been determined as aforesaid at the critical points, shall henceforth be designated as 'known services' and their positions shall be indicated by the Contractor on a separate set of drawings, a copy of which shall be furnished to the Engineer without delay. As soon as any service which has not been identified and located as described above is encountered on, under, over or within the site, it shall henceforth be deemed to be a known service and the aforesaid provisions pertaining to locating, verifying and recording its position on the balance of the site shall apply. The Contractor shall notify the Engineer immediately when any such service is encountered or discovered on the Site. Whilst he is in possession of the Site, the Contractor shall be liable for all loss of or damage as may occur to (a) Known services, anywhere along the entire lengths of their routes, as may reasonably be deduced from the actual locations at which their positions were verified as aforesaid, due cognizance being taken of such deviations in line and level which may reasonably be anticipated, and

Clause	SANS1200 A Project Specification
	(b) Any other service which ought reasonably to have been a known service in accordance with the provisions of this clause. The Contractor shall also be liable for consequential damage in regard to (a) and (b), whether caused directly by the Contractor's operations or by the lack of proper protection. No separate payment will be made to the Contractor in respect of any costs incurred in preparing and submitting to the Engineer the Drawings as aforesaid. These costs shall be deemed included in the Contractor's other tendered rates and prices included in the Contract. Payment to the Contractor in respect of exposing services at the positions agreed by the Engineer and as described above will be made under the payment items (if any) as may be provided for in the respective sections of the specifications pertaining to the type of work involved. 5.4.2 Protection during construction The Contractor shall take all reasonable precautions and arrange its operations in such a manner as to prevent damage occurring to all known services during the period which the Contractor has occupation and/or possession of the Site. Services left exposed shall be suitably protected from damage and in such a manner as will eliminate any danger arising there from to the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations. Unless otherwise instructed by the Engineer, no services shall be left exposed after its exact position has been determined and all excavations carried out for the purpose of exposing underground services shall be promptly backfilled and compacted. In roadways, the requirements of Sub clause 5.9 of SANS 1200 DB should be observed. In other areas compaction is to be to 90% modified AASHTO density. 5.4.3 Alterations and repairs to existing services Unless the contrary is clearly specified in the Contract or ordered by the Engineer, the Contractor shall not carry out alterations to existing services. When any such alterations become necessary, the Contractor shall promptly inform the Engineer, who will either make arrangements for such work to be executed by the owner of the service, or instruct the Contractor to make such arrangements himself. Should damage occur to any existing services, the Contractor shall immediately inform the Engineer, or when this is not possible, the relevant authority, and obtain instructions as to who should carry out repairs. In urgent cases, the Contractor shall take appropriate steps to minimise damage to and interruption of the service. No repairs of telecommunication cables or electric power lines and cables shall be attempted by the Contractor. The following list of contact telephone numbers is provided for:

Clause	SANS1200 A Project Specification																												
	<table><tr><th>Service</th><th>Authority</th><th>Contact Details</th><th>Contact Number</th></tr><tr><td>Communication</td><td>Telkom</td><td>TBC</td><td>TBC</td></tr><tr><td>Electricity</td><td>Eskom</td><td>TBC</td><td>TBC</td></tr><tr><td>Municipal Electricity</td><td>Polokwane</td><td>Mr Eric Matsetela</td><td>015 290 2457</td></tr><tr><td>Bulk Water</td><td>Polokwane Municipality</td><td>Ms. Khethiwe Motau</td><td>015 290 2286</td></tr><tr><td>Provincial Road</td><td>RAL</td><td>Ms. Nare Mehlape</td><td>015 284 4608</td></tr><tr><td>Municipal Road</td><td>Polokwane Municipality</td><td>Mr. Pilot Ramotwala</td><td>015 290 2204</td></tr></table>	Service	Authority	Contact Details	Contact Number	Communication	Telkom	TBC	TBC	Electricity	Eskom	TBC	TBC	Municipal Electricity	Polokwane	Mr Eric Matsetela	015 290 2457	Bulk Water	Polokwane Municipality	Ms. Khethiwe Motau	015 290 2286	Provincial Road	RAL	Ms. Nare Mehlape	015 284 4608	Municipal Road	Polokwane Municipality	Mr. Pilot Ramotwala	015 290 2204
Service	Authority	Contact Details	Contact Number																										
Communication	Telkom	TBC	TBC																										
Electricity	Eskom	TBC	TBC																										
Municipal Electricity	Polokwane	Mr Eric Matsetela	015 290 2457																										
Bulk Water	Polokwane Municipality	Ms. Khethiwe Motau	015 290 2286																										
Provincial Road	RAL	Ms. Nare Mehlape	015 284 4608																										
Municipal Road	Polokwane Municipality	Mr. Pilot Ramotwala	015 290 2204																										
6	3.5 Tolerances ADD THE FOLLOWING 6.4 Use of tolerances No guarantee is given that the full specified tolerances will be available independently of each other, and the Contractor is cautioned that the liberal or full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of the work. Except where the contrary is specified, or when clearly not applicable, all quantities for measurement and payment shall be determined from the ‘authorised’ dimensions. These are specified dimensions or those shown on the drawings or, if changed, as finally prescribed by the Engineer, without any allowance for the specified tolerances. Except if otherwise specified all measurements for determining quantities for payment will be based on the ‘authorised’ dimensions. If work is constructed in accordance with the ‘authorised’ dimensions plus or minus the tolerances allowed, the calculation of quantities will be based on the																												

Clause	SANS1200 A Project Specification
	'authorised' dimensions, regardless of the actual dimensions to which the work has been constructed. When the work is not constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the Engineer may nevertheless, at his sole discretion, accept the work for payment. In such cases no payment shall be made for quantities of work or material in excess of those calculated for the 'authorised' dimensions, and where the actual dimensions are less than the 'authorised' dimensions minus the tolerance allowed, quantities for payment shall be calculated based on the actual dimensions as constructed."
7.2	3.6 Approved Laboratories REPLACE WITH THE FOLLOWING: "Unless otherwise specified in the relevant specification or elsewhere in the Project Specification, the following shall be deemed to be approved laboratories in which design work, or testing required in terms of a specification for the purposes of acceptance by the Engineer of the quality of materials used and/or workmanship achieved, may be carried out: (a) Any testing laboratory certified by the South African National Accreditation Systems (SANAS) in respect of the nature and type of testing to be undertaken for the purposes of the Contract; (b) Any testing laboratory owned, managed or operated by the Employer or the Engineer; (c) Any testing laboratory established and operated on the Site by or on behalf of the Employer or the Engineer; (d) Any other laboratory that the Engineer approves in his absolute discretion."
8.1.2.1 b)	MEASUREMENT AND PAYMENT, Preliminary and General Item or Section, Contents REPLACE THE LAST SENTENCE WITH THE FOLLOWING: Separate items will be scheduled to cover the fixed, value-related and time-related components of the Contractor's preliminary and general costs.
8.2	Payment PS8.2.1 Fixed-charge and value-related items REPLACE THE CONTENTS OF SUBCLAUSE 14.1 [The Contract Price] AND 14.3 [Application for Interim Payment] WITH THE FOLLOWING: The Contract Price shall be the lump sum and shall not be subject to adjustment for changes in the quantity of work performed, except as provided under Clause 13 [Variations and Adjustments]. Notwithstanding Sub-Clause 8.4 [Extension of Time for Completion], the lump sum for fixed-charge items shall remain firm unless a Variation is instructed under Clause 13.3 [Variation Procedure]. Before any payment is certified for these items, the Contractor shall submit evidence to the Engineer that the mobilization of Plant and establishment of Site facilities have been completed to a standard acceptable to the Engineer. If the Contractor fails to provide documented proof of ownership or the value of the establishment on Site, the Engineer may withhold a portion of the payment until the Works are completed or the required evidence is provided.

Clause	SANS1200 A Project Specification
	PS8.2.1.1 Fixed-charge items Payment for fixed-charge items listed in the Schedule of Prices (or Schedule of Payments) shall be made as follows: (a) FIFTY PER CENT (50%) of the lump sum upon the Engineer's approval that the facilities have been fully provided and are operational. (b) THIRTY-FIVE PER CENT (35%) of the lump sum will be made when the amount certified for payment, including retention monies but excluding the second installment referred to herein, exceed 50% of the tender sum. (c) FIFTEEN PER CENT (15%) upon the issue of the Taking-Over Certificate and after the Contractor has cleared the Site in accordance with Sub-Clause 11.11 [Clearance of Site]. (d) No adjustment shall be made to these sums for any variation in the value of the Works or the Time for Completion, except through a formal Variation instruction under Sub-Clause 13.3.1. PS8.2.1.2 Value-related items Payment for value-related items shall be made in three instalments: (d) The first instalment (40%) when the value of work certified (excluding Materials on Site and Preliminaries) exceeds 5% of the Accepted Contract Amount. (e) The second instalment (40%) when the cumulative amount certified (including Retention but excluding this instalment) exceeds 50% of the Accepted Contract Amount. (f) The final payment (20%) upon the issue of the Performance Certificate and fulfillment of all obligations under the Contract. Adjustments to value-related items due to scope changes shall be determined under Sub-Clause 13.3 (Variation Procedure) and applied to the final instalment. PS8.2.2 Time-related items REPLACE THE CONTENTS OF SUBCLAUSE 14.3 [Application for Interim Payment] WITH THE FOLLOWING: Subject to Sub-Clause 14.3, payment for time-related items shall be made monthly in equal proportions by dividing the lump sum by the Time for Completion (in months). The Engineer may withhold payment if the progress of the Works is significantly behind the Sub-Clause 8.3 Programme. If an Extension of Time (EOT) is granted under Sub-Clause 8.4, any adjustment to time-related items shall be treated as a Claim under Clause 20.2 or a Variation under Clause 13.3. Such adjustments shall be proportional to the original lump sum and the period of extension and shall constitute full compensation for all time-related costs arising from the delay.

Clause	SANS1200 A Project Specification
8.3	Scheduled fixed-charge and value-related charge ADD THE FOLLOWING TO CLAUSE 8.3.3 Other fixed-charge obligations PS8.3.3(a): Notice and warning to property owners Unit: Sum The sum shall cover the full compensation and cost of supply and delivery of the notices and warnings to property owners at least 10 days before work is to take place on their properties. PS8.3.3(b): OHS Act Obligations Unit: Sum The sum shall cover the full compensation and fixed costs for the compliance with the Occupational Health and Safety Act, Construction Regulations 2003 and all the requirements stipulated in the Employer's Health and Safety Specifications." PS8.3.3(c): EMP Obligations Unit: Prov Sum The sum shall cover the full compensation and all fixed costs for compliance with the requirements of The Employer's Environmental Management Plan. This will include amongst others: The appointment of an Environmental Control Officer (ECO) that meets the Employer's requirements. Making application(s) for Licenses to damage/destroy protected trees (in terms of section 15(1) of the National Forests Act no 84 of 1998): The cost associated with corrective action and rehabilitation for cases where Heritage Resources and or graves are unearthed, which measures & corrective action shall be determined in coordination with the E.C.O. PS8.3.3(d): Pipe Inspector Unit: Prov Sum Appointment and part time employment of an Employer-approved inspector to assess the quality and tolerances of pipes being manufactured for the project at the manufacturer's facility and providing assistance to the Contractor on site with the laying of the pipes as well as the related reporting to and liaison with the Engineer. This payment clause to be read with clause 4.12.6 of the Project Specifications (SANS 1921). The Contractor will be reimbursed for his administration via a percentage (to be determined by him) of the Provisional Sum. PPS8.3.3(e): Blasting Unit: Sum This item will cover all fixed costs the Contractor may require establishing all resources and infrastructure he may require to enable him to do all blasting required on site. (See Particular Specification C3.4.14)
8.4.2.1 d)	ADD The Contractor shall make available for the duration of the contract period, when required by the Engineer, one skilled and one unskilled survey labourers.
8.4.2.1 e)	ADD The Contractor shall make available for the duration of the contract period, Survey Equipment as set out in SANS1200AB
8.4.2.1 f)	ADD The Contractor shall make available for the duration of the contract period, Transport as set out in SANS1200AB

Clause	SANS1200 A Project Specification
8.4.5	Other Time-Related Items ADD THE FOLLOWING TO CLAUSE 8.4.5. PS8.4.5 (a): OHS Act Obligation Unit: Month The monthly amount shall cover the full compensation and all time related costs for the duration of the contract, for the compliance with the Occupational Health and Safety Act, Construction Regulations 2003 and all the requirements stipulated in the Employer's Health and Safety Specifications. The cost shall include the salary for a full time OHS Officer for the project. PS8.4.5 (b): Security Services Costs Unit: Month The sum shall cover the full compensation and all costs for a sufficient 24 hour guarded services for the duration of the contract. PS8.4.5 (c): Community Liaison Officer Unit: Month The stated sum shall cover full compensation and all costs payable on a monthly basis, to provide a full time qualified and suitable experienced Community Liaison Office for the duration of the contract. The stated sum shall also cover for the CLO cell phone airtime." PS8.4.5 (d): EMP Obligations Unit: Provisional Sum The amount shall cover the full time employment of an Employer-approved Environmental Control Officer (ECO) for the project. PPS8.4.5 (e): Blasting Unit: Month This item will cover the costs of the Contractor for the maintenance of resources and infrastructure relating to his blasting activities.
	PS8.4.5 (f): On-the-job-training of Engineering student Unit: Provisional Sum The amount shall cover the full-time employment of an On-the-job-training Engineering student for the duration of the contract.
8.5	PS8.5 Sums Stated Provisionally by Engineer AMEND SUBCLAUSE 8.5.b) 1 AND ADD THE FOLLOWING ITEMS: i) Alteration to existing services by authorities Unit: Prov. Sum ii) Refurbishment or replacement of existing pumps at Waste Activated Sludge pump station and Prime Sludge pump stations 1 and 2 Unit: Prov. Sum iii) Provision of photographic records Unit: Prov. Sum iv) Temporary protection of services Unit: Prov. Sum The Contractor is responsible for both the cost of normal testing as described in the Project Specifications and for the cost of any additional test that indicates that the Specifications have not been complied with." These sums will be paid to the Contractor in equal monthly amounts."

Clause	SANS1200 A Project Specification
8.7	Day Works ADD THE FOLLOWING NEW CLAUSES: 8.7.1 Scope This section covers the method of measurement and payment for work carried out on a day work basis. 8.7.1.1 General requirements Work will be classified as day work only if the Engineer considers no other rate in the Bill of Quantities appropriate for payment purposes. An instruction regarding all work to be carried out under day work in terms of Clause 6.5 of the FIDIC Yellow Book 2017 Edition will be issued at the discretion of the Engineer. Some or all of the items priced under day work in the Bill of Quantities may possibly not be required for this Contract. Before ordering any material, the Contractor shall submit quotations to the Engineer for his approval, and shall submit such receipts or vouchers to the Engineer as may be necessary for proving the amount claimed. 8.7.1.2 Measurement and payment - day works The day work rates submitted for vehicles and construction equipment, in section C2.1.13 shall be a hire charge for the use of the vehicle and driver or constructional plant/equipment and operator (excluding VAT) and shall apply only to vehicles and construction equipment approved in writing by the Engineer. The rate shall include for maintenance, fuels and oils and other operating costs, establishment, insurance and other contingency costs relating to the running of the vehicle, plant or equipment. Where there is ambiguity between the power developed at the flywheel and mass of a machine, the power shall govern the measurement category. The Contractor and the Engineer will agree on the method of recording the working hours prior to the commencement of the work. Any long period of idling at any one time which in the opinion of the Engineer or his representative is beyond that required for normal operating conditions will not be paid for as working time. Non-working hours for any reason shall not be measured for payment. The percentage for overheads and profit, as referenced under Sub-Clause 13.4 [Provisional Sums] and applied to Variations under Sub-Clause 13.3 [Variation Procedure], shall include full compensation for all administrative costs, Site and home-office supervision, overheads, insurance, and all liabilities and obligations related to the operation and maintenance of the Contractor's Equipment and Plant. The tendered percentage shall also include the "Profit" element as defined in Sub-Clause 1.1.20 [Cost Plus Profit] and shall be subject to the Schedule of Cost Components or the adjustment for changes in cost as provided for under Sub-Clause 13.7 [Adjustments for Changes in Cost], if applicable in the Contract Data.

Clause	SANS1200 A Project Specification
8.8.4	Temporary works - Existing services AMEND THE SUB CLAUSE AS FOLLOWS: PS8.8.4(a) Establishment of specialist equipment Unit: No The amount tendered shall cover the cost for each establishment of the specialist equipment for detection of underground services and related specialist operators as ordered by the Engineer. PS8.8.4(b) Use of specialist equipment Unit: Day The amount tendered shall cover the cost of the use of the specialised equipment by experienced operators for detection of underground services including the presentation of results and reporting on the location of services by specialists as ordered by the Engineer. PS8.8.4(c): Excavate by hand in soft material to expose existing services Unit: m³ The rate shall include full compensation for all hand excavation as per the dimension approved by the Engineer for the locating, exposing and moving of existing services. Excavation outside of approved dimensions will not be paid. The rate must also include for backfill and compaction to 90% of mod AASHTO density and, if applicable, the removal of excess material not used for backfill, the securing of excavations, for handling surface and subsurface water, for protection of existing services and for any other activity necessary to complete the work. No extra-over for haulage will be applicable on the transport of excess material. No distinction will be made between classes of material or types of services. The intention is to backfill and cover the service before nightfall to avoid having to protect the service overnight. Where protection is required this will be paid for under day works. Note: The Contractor must provide sufficient supervision over labourers when services are exposed.

Clause	SANS1200 A Project Specification
8.8.7	Temporary works – Dust Control ADD THE FOLLOWING NEW CLAUSES: PS8.8.7 Dust Control Unit: Month Dust control should be implemented to comply with the: Dust Control: National Environmental Management – Air Quality Act, 2004 (Act 39 of 2004 – National Dust Control Regulations (2005). The purpose of the Regulations is to prescribe general measures for the control of dust in all areas. The Contractor shall take appropriate measures to minimise dust generation on site during construction activities, in particular where activities are undertaken in close proximity to agricultural crops and residential areas. The Contractor shall ensure that loose building materials and excavated material stockpiles are adequately protected against wind by using suitable covering, such as canvas. In the short term stockpiles, active construction areas and unpaved roads may also be dampened to minimise dust generation. Specific dust abatement measures include the following: • Remove only limited vegetation • Impose speed restrictions to a maximum of 40 km/hr. • Wet suppression to the roads using a light spray as often as required to be effective. Quantities of water used must not result in runoff, erosion and/or muddied areas. If in the opinion of the Engineer the control measures are ineffective, he may instruct the Contractor to increase the application and/or number of applications. This will not entitle the Contractor to any additional payment for this work/dust control.
8.9 New Clause	PS8.9: Standing time Unit: hour Rate to include all costs the Contractor incurs on an hourly basis (labour, plants, equipment, security, offices, supervisory staff and other time related costs). Standing time will be paid to the Contractor in a case where there are delays from the Employer in providing information or instruction and where the Contractor have no work to be undertaken during that period. The Contractor will only be able to claim standing time if he has given the Engineer at least 2 days prior notice of the expected standing time.

SANS 1200AB: ENGINEER'S OFFICE - PROJECT SPECIFICATIONS

Clause	SANS 1200AB: Engineer’s Office Project Specification																		
3.2	a) Office Buildings The Engineer’s site supervisory staff will consist of the following (See also Clause C3.1.1): 1) One Resident Engineer who will be responsible for contract. 2) One Assistant Resident Engineer 3) One Clerk of Works who will be responsible for contract ADD THE FOLLOWING The contractor shall provide three (3) air conditioned offices and a boardroom as detailed below. Doors shall be lockable and two keys shall be provided. The siting of all offices shall be to the Engineer’s satisfaction and shall be decided upon in consultation with him and confirmed in writing before erection. <table><tr><th>Dimensions</th><th>Boardroom</th><th>Engineer’s Office</th></tr><tr><td>Minimum floor area</td><td>28m²</td><td>3 x 15m²</td></tr><tr><td>Minimum window area per room</td><td>4.0m²</td><td>3.0m²</td></tr><tr><td>Minimum window area opening per room</td><td>2.4m²</td><td>1.5m²</td></tr><tr><td>Minimum clear height</td><td>2.5m</td><td>2.5m</td></tr><tr><td>Shaded parking for vehicles</td><td></td><td>3</td></tr></table> In addition to the requirements of SANS1200AB the following should also be provided: Each office shall be equipped with the following: (i) Refrigerator (only one for the engineer’s offices) (ii) Printer (only one for engineer’s offices if it can be so positioned that all offices can be connected to the printer via WIFI and is easily accessible without going outdoors).	Dimensions	Boardroom	Engineer’s Office	Minimum floor area	28m ²	3 x 15m ²	Minimum window area per room	4.0m ²	3.0m ²	Minimum window area opening per room	2.4m ²	1.5m ²	Minimum clear height	2.5m	2.5m	Shaded parking for vehicles		3
Dimensions	Boardroom	Engineer’s Office																	
Minimum floor area	28m ²	3 x 15m ²																	
Minimum window area per room	4.0m ²	3.0m ²																	
Minimum window area opening per room	2.4m ²	1.5m ²																	
Minimum clear height	2.5m	2.5m																	
Shaded parking for vehicles		3																	

Clause	SANS 1200AB: Engineer's Office Project Specification
	(iii) Sufficient racks and hangers for hanging contract drawings. The hangers shall be of the "Barhold" type, with one hanger to five drawings. (iv) 1 x Double 80-watt fluorescent light fittings complete with ballast and tubes. The Boardroom shall be equipped with the following: (i) Conference table large enough to accommodate twelve people and have an area of at least 15m². (ii) Fifteen office chairs (iii) 2 x Double 80-watt fluorescent light fittings complete with ballast, tubes and a double wall plug. All offices and the boardroom must have uncapped internet access with at least 4Mbps speed. Each office and the boardroom must be provided with an air conditioning unit that must be able to cool and heat. The office units must be 12 000 btu and the boardroom an 18 000 btu unit. Each office and the boardroom must have at least two double 230 volt plug outlets. Each carport shall be constructed so that the vehicle parked under it is always protected against the direct rays of the sun. The carport area shall be at least 20 m² and the floor shall be covered with a layer of crushed stone to alleviate dusty and muddy conditions. The carport(s) shall be positioned so as to provide easy and convenient access to the Engineer's offices. The Contractor shall provide and maintain a computer printer that shall comply with the following minimum specifications: (i) Printers shall, unless otherwise approved by the Engineer, be Samsung SCX-4600 Colour Laser Printer Series or equivalent compatible. (ii) All computer hardware shall be provided complete with the requisite connecting cables and all interfacing devices and software necessary for its efficient operation as an integral system. All computer and other equipment provided shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 48 hours after notification by the Engineer's staff. The Contractor shall further provide at his own cost, all paper, ink cartridges, files and other consumables reasonably required by the Engineer. Accommodation for Engineer's Supervisory Staff ADD THE FOLLOWING: The Contractor must provide three (3) X three-bedroom house/s with two bathrooms and a double lockable garage for the duration of the contract. The Contractor must provide and pay for the cost of all municipal services i.e. water, sanitation, electricity and rubbish removal. Each house must be fitted with a 4 plate stove and oven and uncapped internet with 4Mbps speed.

Clause	SANS 1200AB: Engineer's Office Project Specification
4.1	PLANT: TELEPHONE REPLACE SUBCLAUSE 4.1 OF SANS 1200 AB WITH THE FOLLOWING: The Contractor shall at his own cost, arrange for the provision of three (3) Samsung A3 or similar approved cellular phones and 150 minutes of airtime and 20 GB data bundles per month for the Engineer's representatives. The Contractor at the tendered rates under the relevant scheduled item shall recover the associated charges and telephone calls and data bundles associated with the contract"
4.2	PLANT: ADD 4.2 SURVEY EQUIPMENT The Contractor must provide and maintain basic survey instruments: dumpy level, tripod stand and staff as follows: Survey equipment shall include: • Calibrated Automatic Level with protective case • Tripod • 5m telescopic staff • Measuring tape (100 m steel) • 1m spirit level • Paper, Clipboard and level book. • Benchmark locations and levels All survey equipment provided by the Contractor shall be in good condition, properly calibrated and fit for the purpose."
4.3	PLANT: ADD 4.3 TRANSPORT The Contractor shall provide three rentals 0,75 ton LDV(s) for the full time use on site of the Engineer's supervisory staff. Each LDV must have an engine capacity of at least 1800cc and must be fitted with a tracking device, alarm and an air conditioner. The LDV(s) must be parked in a safe place overnight where it will be under the supervision of a guard. The rental must include the following: * All operational costs such as fuel, services, insurance with no excess payments, licensing etc. * All maintenance costs such as tyres, spare parts etc. The rental agreement must provide for a replacement within 48 hours should the LDV become in-operational due to maintenance or an accident. The Contractor must wash and clean each LDV at least once a week.

SANS 1200C: SITE CLEARANCE - PROJECT SPECIFICATIONS

Clause	SANS 1200C Site Clearance - Project Specification
5.1	Areas to be Cleared and Grubbed ADD THE FOLLOWING All bulk pipeline routes shall be cleared to a total width of 18m with 8m and 10m to either side of the pipeline centre line, unless otherwise instructed by the Engineer. Route pegs or markers shall not be destroyed or damaged during clearing operations.
5.2.3.2	Individual trees REPLACE THE LAST SENTENCE WITH THE FOLLOWING: An amount of R 3000.00 will be deducted from moneys due to the Contractor as a penalty for every tree that is damaged or removed unnecessarily.
8.2.5	Take Down Existing Fences ADD THE FOLLOWING The rate shall include removing all fence material from the site, filling of holes, levelling ground surfaces and cleaning the site as well as providing temporary fence during construction.
8.2.8	Demolish and remove structures/buildings and dismantle steelwork, etc. REPLACE "Unit: sum" WITH "Unit: sum or number of m²". REPLACE THE LAST SENTENCE WITH: The rate shall cover the cost of all such separate items as scheduled in the Schedule of Quantities."
8.2.11	SCHEDULED ITEMS - Temporary fencing or hoarding: ADD THE FOLLOWING ITEMS: PS8.2.11 Temporary fencing or hoarding: (a) Indicate temporary usage, description and type Unit: m (b) Etc. for other usage and types. The unit of measurement shall be the linear metre of fence or hoarding supplied and erected, and in the case of temporary fencing for maintaining and removing on completion of the works or part of the works. The tendered rate shall include full compensation for the cost of supplying and erecting the complete fence as specified or scheduled and in the case of temporary fencing for taking down the fences, removing from the site, filling of holes, levelling ground surfaces and cleaning the site. Seventy per cent (70%) of the tendered rate shall be payable on completion and approval of the temporary fences, and the remaining thirty per cent (30%) on completion of the removal of the fences."

SANS 1200D: EARTHWORKS – PROJECT SPECIFICATIONS

Clause	SANS 1200D: Earthworks - Project Specification
1	SCOPE 1.1 INTERPRETATION ADD THE FOLLOWING TO THE SUB-CLAUSE: This section shall include all work in obtaining materials for work under this contract, negotiation with owners of the ground on which borrow pits are situated, clearing the site, stripping excess or unsuitable overburden, excavating selected material for use on the works, and finishing off the borrow area to the satisfaction of both the owners and the Engineer, all in accordance with these Specifications or as directed.” ADD THE FOLLOWING NEW SUB CLAUSES: 1.2 General The Contractor shall be solely responsible for the locating and supply of all materials required from borrow pits or commercial sources for the due and proper construction of the works embodied in this contract. Before commencing operations at any borrow pit the Contractor shall consult the property owner concerned and the Engineer regarding his proposals for operating the quarry or borrow pit and obtaining access thereto. The Contractor must also liaise with the relevant authorities and apply for the relevant licensing. The Contractor shall take all measures for the protection and control of livestock, etc., which is made necessary by his operations, such as provision of gates in the existing fences and ensuring that all gates are closed during the whole of the time that they are not actually in use by his traffic. Where access to the Contractor's quarries is not obtainable by existing roads he shall after consultation with the property owner concerned construct such access roads and provide such gates as he requires and as the authorities concerned may agree to, but the cost of construction of such access roads and the provision of gates shall be deemed to be covered by the prices tendered for the construction of those parts of the works in which the materials from the quarries concerned are being used. The provision of gates and subsequent removal of the gates when no longer required as well as restoration of the fence to its former standard will be at the Contractor's expense. Whenever required by the owner of the land on which the borrow pit is situated or when it appears necessary in the interest of public health, or the prevention of soil erosion, adequate provision for draining the borrow pit must be made.
2.3	Definitions REPLACE THE DEFINITION FOR “Specified density” WITH THE FOLLOWING The specified dry density expressed as a percentage of modified AASHTO dry density.

Clause	SANS 1200D: Earthworks - Project Specification
	REPLACE THE DEFINITION FOR “Stockpile” WITH THE FOLLOWING: Stockpile (verb): The process of selecting and, when necessary, loading, transporting and off-loading material in a designated area for later use for a specific purpose. ADD THE FOLLOWING DEFINITIONS: Commercial source: A source of material provided by the Contractor, not the Employer, and including any borrow pit, provided by the Contractor. Fill: An embankment or terrace constructed of material obtained from excavations or borrow pits. In roads it includes the earthworks up to the underside of the selected subgrade level. Fill (material): Material used for the construction of an embankment or terrace. Roadbed: The natural in situ material on which the fill, or in the absence of fill, the pavement layers, are constructed.
3.1.	3.1.1 Method of classifying ADD THE FOLLOWING: The classification of material other than ‘soft excavation’ shall be agreed upon before excavation may commence. The Contractor shall immediately inform the Engineer if and when the nature of the material being excavated changes to such an extent that a new classification is warranted for further excavation. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to reclassify, at his discretion, such excavated material. ADD THE FOLLOWING NEW SUB CLAUSES: 3.1.3 Classification for hand excavation Classification of material for various types of hand excavation will be based on the results of a dynamic cone penetrometer test. The category of material shall be determined by testing the material at regular intervals and at various depths along the centre line of the trench. A minimum of 5 tests shall be done at each location and the average number of blows of the tests shall be used to determine the category of material. The interval between test locations shall be determined by the variation of material type but shall not exceed 50m. The depth of testing shall be determined by the variation of material type and can increase or decrease in hardness with increasing depth of excavation. The table below indicates the categories:

Clause	SANS 1200D: Earthworks - Project Specification				
	Category of Material	Consistency		DCP Blows to Penetrate 100mm	
		Granular	Cohesive	Granular	Cohesive
	Soft Soft excavation shall be excavation in material that can be efficiently removed from the trench using a pick and shovel but not requiring prior breaking using mechanical equipment such as pavement breakers.	Up to dense	Firm to very stiff	0 -15	1 - 8
	Rock Rock excavation shall be excavation in material other than described above which by nature of the material requires prior breaking using mechanical equipment, such as pavement breakers with moil points, before being removed from the trench	-	-	16 > 50	9 > 15
3.3.1	SELECTION – General ADD THE FOLLOWING The Contractor is required to deal selectively and stockpile topsoil for re-use and spreading over the surface of the excavated area upon completion of backfilling.				
3.3.3 New Clause	SELECTION ADD THE FOLLOWING SUBCLAUSE: 3.3.3 Selection in borrow pits and excavations Approval of a borrow area for a certain purpose does not necessarily mean that all the material in that area is suitable for the specified purpose but rather that it contains some suitable material. The onus shall rest on the Contractor to ensure that the borrow pit is worked so as not to cross-contaminate suitable				

Clause	SANS 1200D: Earthworks - Project Specification
	materials and that material is carefully selected and only the material that is suitable for its intended purpose is removed as required.
5.1.1.1	Barricading and lighting <i>REPLACE</i> "Machinery and Occupational Safety Act, 1983 (Act 6 of 1983)" <i>WITH</i> "Occupational Health and Safety Act, 1993 (Act 85 of 1993)." <i>REPLACE SUB-PARAGRAPH (a) AND (b) WITH THE FOLLOWING AND ADD SUB-PARAGRAPH c):</i> a) Adequately protected by a barrier or fence comprising fluorescent orange plastic netting of height at least 1 000mm and as close to the excavation as practicable; and b) Provided with notice boards marked "CLOSED – GESLUIT" at each end of closed or partially closed roads; and c) Provided with flashing orange lights, placed at 15m intervals along the barricading at night. <i>ADD THE FOLLOWING TO THIS SUBCLAUSE:</i> Should the Contractor fail to provide adequate lighting, signing and barricading, access to properties, or leave the site in a dangerous condition, the Engineer shall be entitled to suspend all work under the Contractor until in the Engineer's opinion the Contractor's obligation in these respects have been fulfilled and/or arrange for any emergency work to be carried out by some other agency and to deduct the cost of this work from any monies due to the Contractor."
5.1.1.2	Safeguarding of excavations <i>REPLACE</i> "Machinery and Occupational Safety Act" <i>IN SUB-PARAGRAPH (a) WITH</i> "Occupational Health and Safety Act, 1993 (Act 85 of 1993)." <i>ADD THE FOLLOWING TO SUB PARAGRAPH (d):</i> Loose ground, materials, tools and appliances shall be kept clear of the edge of the excavations and a pathway at least 0.30m shall be left clear along the edge of the excavation.
5.1.1.3	Explosives <i>REPLACE THE CONTENTS OF THIS SUBCLAUSE AS FOLLOWS:</i> Where blasting is resorted to, it shall be carried out strictly according to Explosives Act and Regulations 1956 (Act No. 26 of 1956, as amended) and the Particular Specifications in this document. However, in no case will blasting be allowed if a reasonable possibility exists of damage to any foundation, wall, pipe, cable or any structure, complete or partly complete. Where the Engineer considers blasting to be dangerous, the same shall not be permitted and his decision shall be final and binding. Wherever blasting is permitted and resorted to in the vicinity or within the limits of existing townships, roads, etc., it shall only be executed under the cover of

Clause	SANS 1200D: Earthworks - Project Specification
	sufficient earth backfills, heavy wire mesh screens or rubber matting of adequate weight and area to prevent the blasted material from being ejected from the trench. If any damage should occur, the Contractor shall carry out remedial work arising from such damage and will be held to have allowed therefore in his price. The Contractor shall undertake such blasting so that the Peak Particle Velocity (PPV) as measured at the closest point to the existing outfall sewer and or building structure shall not exceed 25mm/s. Each blast shall be monitored and the findings recorded by an appropriately qualified explosives expert using a suitably calibrated apparatus. The Contractor shall also timeously inform the relevant inspectorate and obtain the required blasting permit from the South African Police Services, Division of Explosives before proceeding with any blasting on site. If in the opinion of the Engineer, the Contractor makes careless use of explosives, he may forbid the Contractor the use of explosives. It is a condition that should blasting result in the disturbing of material outside the trench, the Engineer will require the Contractor to remove the disturbed material and backfill it to a compaction standard of the natural in-situ material. All this work for correcting areas of disturbed material will be done at the Contractor's cost. The schedule rate for hard rock excavation shall cover all costs incurred in connection with supply, transportation, storage and handling of explosives, the related blasting costs and any remedial work should this be required."
5.1.1.4	Hard rock excavation without using explosives It is a condition that should blasting result in the disturbing of structures outside the trench; the Engineer will require the Contractor to remove the rock material by means of pneumatic or hydraulic breakers, e.g. jack-hammers or wood- peckers.
5.1.2.2	Existing Services - Detection, location and exposure ADD THE FOLLOWING There are several services that will intersect pipe trenches on this project. In particular, within the existing WWTW as well as closer to Polokwane and within the irrigated areas to the north of the project. The exposure by the Contractor of underground services, as required in terms of sub clause 5.4 of SANS 1200 A (as amended) shall be carried out by careful hand excavation at such positions and to such dimensions as are agreed to by the Engineer. Unless otherwise instructed or agreed by the Engineer, no service shall be left exposed after its exact position has been determined and all excavations carried out for the purposes of exposing underground services shall be promptly backfilled and compacted to the following densities: (a) In roadways: 93% Mod AASHTO density; and

Clause	SANS 1200D: Earthworks - Project Specification
	(b) In all other areas: 90% Mod AASHTO density.
5.1.3	Storm water and groundwater ADD THE FOLLOWING TO THE SUB-CLAUSE: The Contractor shall, where applicable and at the earliest practicable opportunity, install the permanent drainage specified or shown on the drawings if any and shall at his own cost provide the temporary drainage required to protect the Works.
5.1.4.3	Excavated material not to endanger or interfere AMEND THE CLAUSE AS FOLLOWS: A safe, clear path shall be kept open at all times for pedestrians. Equipment, materials and waste shall be stored, stockpiled or removed in such a manner that pedestrians are not endangered and that the nuisance level is kept to a minimum. If construction activities occupy the whole footway and verge area so that pedestrians are forced to walk in the traffic lane, adequate protection from traffic shall be provided. Where instructed by the Engineer or where the Works impose a danger to traffic or pedestrians, the Contractor shall at his own cost remove off Site excavated material to temporary stockpiles (approved by the Engineer) and the return to Site, excavated material for use as backfill or bedding.
New Clause 5.1.4.4	ADD THE FOLLOWING NEW SUBCLAUSE: Open Trenches Unless otherwise permitted and where relevant, not more than the 200m of trench in one place shall be opened ahead of the completed and backfilled pipeline.
5.1.6	Road traffic control DELETE THE SECOND SENTENCE OF SUBCLAUSE 5.1.6
5.2.2.1	Excavation - Excavation for general earthworks and for structures ADD THE FOLLOWING TO PARAGRAPH (b): When the nature of the material precludes the above procedure, additional excavations shall be carried out to provide working space for the erection of formwork. The rate tendered for item 8.3.5 will be deemed to include the cost of a working width of 600 mm, but the Contractor may excavate a greater working width at no additional cost to the Employer. REPLACE THE CONTENT OF PARAGRAPH (e) WITH THE FOLLOWING: Where excavations have been carried below the authorised levels, the Contractor shall backfill such excavations to the correct level with approved

Clause	SANS 1200D: Earthworks - Project Specification
	gravel compacted to 90% of modified AASHTO density or to the density of the surrounding material. Where excavations have been carried out in hard material, the Engineer may direct the over-excavation to be backfilled with flow strength concrete if there is a danger of settlement or differential settlement of the foundations. Where the sides of excavations against which concrete is to be cast have been over-excavated or have collapsed partially, the Contractor shall re-trim the excavations if necessary and, unless other remedial measures are agreed to by the Engineer, shall fill the gap by casting the concrete for the structure, including the additional concrete that may be required as a result of the over- excavation or partial collapse. The cost of the additional concrete or remedial measures shall be for the Contractor's account.
5.2.2.3	Excavation – Disposal ADD THE FOLLOWING All materials disposed of in identified areas will be compacted to 90% of Mod AASHTO density.
5.2.2.4 New Sub Clause	Excavation ADD THE FOLLOWING SUBCLAUSE Selection and stockpiling The Contractor shall organise and carry out his operations in such a manner as will prevent the contamination of suitable embankment and backfill material with unsuitable materials. Any excavated material which becomes, in the Engineer's opinion, unsuitable for use in embankments or backfill as a result of contamination, shall be disposed of in a manner acceptable to the Engineer and shall be replaced by the Contractor with materials acceptable to the Engineer, all at the Contractor's cost.
5.2.5	Transport for earthworks Designated sites for use of excess materials must be identified by the Contractor and approved by the Engineer.
7.2	Taking and testing of samples REPLACE THE CONTENT OF THIS SUBCLAUSE WITH THE FOLLOWING: The Contractor shall arrange with the approved independent laboratory to carry out sufficient tests on a regular basis as agreed between him and the Engineer to determine whether the degree of compaction, and, where applicable, the quality of materials used, comply with the specifications and shall submit the results of these tests to the Engineer in a form approved by him. The compaction requirements for fills shall be deemed complied with when at least 75% of the dry-density tests on any lot show values equal to or above the

Clause	SANS 1200D: Earthworks - Project Specification
	specified density and when no single value is more than five percentage points below the specified value. The Contractor must supply the Engineer with comprehensive test results regarding the proposed borrow material 14 days before any borrowing starts. The results must contain enough information to enable the Engineer to access the quality and quantity of material available from the borrow site. The total cost of these tests must be borne by the Contractor. The exploitation of the pit must be planned in such a way that material of varying quality may be selected and loaded directly or otherwise stockpiled temporarily without contamination. If, after trial, it is found that any sources of supply, which have previously been approved, do not furnish a uniform product, or if the product from any source proved unsatisfactory in any way, the Contractor shall furnish materials from other approved sources. The Engineer may from time to time instruct the Contractor to submit samples from approved sources of supply in order to ensure that the quality of materials remains satisfactory. The cost of taking and testing of samples shall be borne by the Contractor.
8.3.3	Restricted excavation ADD THE FOLLOWING ITEM TO SUBCLAUSE 8.3.3 b) PS5). Hard rock excavation without using explosives Unit: m³ The schedule rate for hard rock excavation without using explosives shall cover all costs incurred in connection with supply of specialist equipment, the transportation to and from the site as well as the removal and disposal of the hard material should this be required."
8.3.4	Importing of materials DELETE THE EXISTING SUB CLAUSE (a) AND REPLACE WITH: PSa) Extra over 8.3.2 and 8.3.3 for Materials from borrow pits and Commercial Sources Unit m³ The rate for importing material from borrow pits selected by the Contractor or other commercial sources shall cover the cost of acquiring suitable material, handling and transportation regardless of distance, and placing. No separate payment will be made for location of borrow pits, the taking of samples, the testing of samples, the construction and maintenance of access roads, the clearing of the borrow pit site, the removal and replacement of overburden, the shaping and drainage of borrow pits, the scarifying of access roads, and paying of any royalties. ADD THE FOLLOWING NEW SUBCLAUSE: PSd) Extra over 8.3.2 and 8.3.3 for the Importation of material from other excavations on site Unit m³ The rate shall cover loading, transporting and placing of material. No extra-over for haulage will be applicable.
8.3.8.1	Existing Services (see 5.1.2.2) - Location. ADD Where measured per cubic metre, the rate shall include backfill to the satisfaction of the Engineer.

SANS 1200L: MEDIUM-PRESSURE PIPELINES - PROJECT SPECIFICATION

Clause	SANS 1200L: Medium-Pressure Pipelines - Project Specification
2.1.2	Supporting Specifications ADD THE FOLLOWING TO SUB-CLAUSE 2.1.2: (h) SANS 1200 HA (i) SANS 1200 HC
2.4	Abbreviations ADD THE FOLLOWING TO SUB-CLAUSE 2.4: AC or FC : Fibre reinforced cement HDPE : High-density polyethylene uPVC : Unplasticised Polyvinyl Chloride
3.1	General ADD THE FOLLOWING TO SUB-CLAUSE 3.1: All pipes and fittings shall be marked with the manufacturer's name, its grade, type or class, the SANS standardisation mark where applicable, and any other markings that may be required in terms of this section. Should different manufacturers supply the same type of pipe for the Contract, the products of only one manufacturer shall be used in any section of pipeline between two elements. Record of where the different products have been installed shall be handed to the Engineer for inclusion in the as-built drawings. Pipes shall be supplied in standard lengths. The cutting of pipes on Site will only be permitted if the Contractor can satisfy the Engineer that he can finish off the ends of cut pipes to the same standard and within the same tolerances as the ends of uncut pipes. Standard shorter lengths of concrete pipes shall be factory-made and the cutting of concrete pipes on Site will only be allowed at the Engineers instruction.
3.2	AC Pipes and Specials REPLACE SUB-CLAUSE 3.2 WITH THE FOLLOWING: FC pipes shall comply with the relevant requirements of SANS 819 and shall have suitable approved flexible joints. FC fittings shall have a crushing strength equal to or better than that of the pipes to which they are coupled and shall otherwise comply with the relevant requirements of SANS 819. Fibre-cement pipes shall be dipped and fittings shall be factory-coated internally and externally.

Clause	SANS 1200L: Medium-Pressure Pipelines - Project Specification
3.3	CI Pipes, Fittings and Specials ADD THE FOLLOWING TO SUB-CLAUSE 3.3: All cast iron pipes and fittings shall comply with the requirements of BS EN 598:2007+A1:2009. Before leaving the foundry, all cast iron pipes and fittings shall be protected against corrosion in accordance with the Corrosion Protection Specification.
3.4.1	General DELETE SUB-CLAUSE 3.4.1 AND SUBSTITUTE WITH: All screwed and socketed pipes shall be solid-drawn, seamless, medium duty and shall comply with the requirements of SANS 62. Welding will not be permitted on galvanized piping. All mild steel pipes and fittings other than screwed and socketed pipes, shall comply with the requirements of SANS 719 grade A. Specials shall be manufactured from straight pipes in accordance with the relevant requirements of BS EN 10311:2005 and BS EN 10224:2002. All welding in pipes and specials shall be electric fusion welding. Before leaving the factory, all mild steel pipes and fittings shall be protected against corrosion in accordance with the Standardized Corrosion Protection Specification. Plain ends of pipes and fittings shall be covered and protected against damage while being transported from the factory to the Site. Wall thickness of pipes and fittings shall be 8mm, unless specified otherwise in the Detailed Specifications
3.4	Steel Pipes, Fittings and Specials ADD THE FOLLOWING TO SUB-CLAUSE 3.4 PSL 3.4.5 Welds Pipes shall be manufactured from steel strips or plates continuously welded along the seams and the height of the inner weld reinforcement shall not exceed 1 mm. In the case of pipes to be used with couplings, the external weld reinforcement shall be ground flush with the outer wall of the pipe over a suitable distance from the end of the pipe. Pipes should preferably have a continuous helical seam but nevertheless longitudinal and circumferential seams would be acceptable for this Contract.
3.4	Steel Pipes, Fittings and Specials ADD THE FOLLOWING TO SUB-CLAUSE 3.4 PSL 3.4.6 Hydraulic Testing at Factory Pipes shall be hydraulically tested in accordance with SABS 719.
3.7.1	uPVC Pipes REPLACE THE SUB-CLAUSE 3.7.1 WITH THE FOLLOWING: Unplasticised Polyvinyl Chloride (uPVC) pipes and fittings shall comply with the requirements of SANS 966 and shall be of the class(es) as specified for each application and shall be fitted with spigot and socket Z-joints with rubber sealing rings. Except for bends, which shall be of uPVC with a factory-applied Z-joint at one end, all fittings for use with uPVC pipes shall be of cast iron with wall thickness in accordance with SANS 546 and socket dimensions in accordance with SANS 966 for larger diameters and of uPVC with equal or higher strength class for smaller diameters.

Clause	SANS 1200L: Medium-Pressure Pipelines - Project Specification
3.7.2	Polyethylene Pipes REPLACE THE SUB-CLAUSE 3.7.2 WITH THE FOLLOWING: Polyethylene pipes shall be of high-density type complying with the requirements of SANS 533 type IV and shall be of type(s) and class(es) as specified for each application. Pipe fittings shall be of the compression type
3.8.3	Flanges and accessories ADD THE FOLLOWING TO SUB-CLAUSE 3.8.3: The dimensions and drilling of standard flanges shall comply with the requirements of SANS 1123 table 10. Flanges shall be machined flat, i.e. without a raised joint face. Puddle flanges shall have the same dimensions as standard flanges but shall be undrilled. Faces of flanges which will be in contact with jointing gaskets shall receive a protective coating similar to the corrosion protection specified for the internal surface of the pipes and fittings of such thickness and consistency as will not impair the air/gas/water tightness of the joint. The jointing gaskets shall comply with the requirements of BS 3063 and shall be cut to the full width of the flange and holed for bolts. Bolts for flanges shall comply with the requirements of BS EN 1092-1:2002 and BS EN 1092-2:1997 for the working pressures specified.
3.9	Corrosion Protection DELETE SUB-CLAUSE 3.9 AND REPLACE WITH: Refer to Corrosion Protection Specification in this Document.
3.10	Valves DELETE SUB-CLAUSE 3.10 AND REPLACE WITH: Refer to Valve Specification in this Document.
5.1.4	Depth and Cover ADD THE FOLLOWING TO SUB-CLAUSE 5.1.4: The minimum cover required is 900 mm.
5.4	Concrete Encasing ADD THE FOLLOWING TO SUB-CLAUSE 5.4: PSL 5.4.1 Soilcrete Encasing A mixture of Portland cement and gravel of base quality that is mixed in a ratio of 1:10 must be provided at positions indicated by the Engineer. Provision must be made to keep the pipe in position during the placement of the soilcrete encasing. The length of soilcrete encasing will be determined by means of a site instruction from the Engineer.
8.2.5	Supply and place pipes, valves and specials REPLACE THE SUB-CLAUSE 8.2.5 WITH THE FOLLOWING: Supply, testing and installation of pipework, fittings and specials as detailed on the drawings. Unit: Metre or Lump Sum The tendered sum per linear metre or lump sum shall include full compensation for the supply of all material, bolts and nuts as described under C3.4.5.---, manufacture of the pipes, fittings and specials and shall further include for delivery, installation, jointing, testing, holding in position during concrete encasing, blanking off ends to prevent ingress of foreign matter, cleaning out pipes, fittings and specials before connecting up and the full corrosion protection of pipes, fittings and specials as specified.

SANS 1200LB: BEDDING (PIPES) - PROJECT SPECIFICATION

Clause	SANS 1200LB Bedding (Pipes) - Project Specification
3.1	Selected granular material REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING: Selected granular material shall be graded soil with a PI less than 6 and shall have 100% passing the 19.5mm sieve-size with a compactibility factor of less than 0.3. Where there is a possibility of the surrounding material washing into the bedding both the bedding cradle and the pipe shall be surrounded with geofabric.
3.3	Bedding ADD THE FOLLOWING: Concrete pipes are deemed to be rigid pipes for the purposes of this sub clause. All HDPE pipes are to be laid on a Class B Bedding as per the drawing on Bedding Profiles in Volume 2: Book of drawings.
3.4.1	Selection -Suitable material available from trench excavation REPLACE THE WORDS “(but is not required)” IN THE FIFTH LINE WITH THE WORDS “(at his own cost)”.
5.2.2	PLACING AND COMPACTING OF RIGID PIPES - Class B and Class C Beddings. ADD The bedding shall be compacted to the specified density then scarified immediately below the pipe to 1/3 of the pipe outside diameter in order to provide continuous, uniform support for the pipe. (See drawing with Bedding Profiles in the Book of Drawings: Volume 2)
5.2.5 New Clause	Placing and compacting of rigid pipes ADD THE FOLLOWING 5.2.5 Soilcrete Bedding Where excavation is in rock and instructed by the Engineer, the pipes shall be supported on a continuous cradle of Soilcrete made by using a material with a PI < 12 and no stones > 38mm. The material shall be mixed in a concrete mixer and have a max slump of 200mm and a minimum 28-day cube compressive strength of 1.5 MPa. During pipe laying and before the placing of the soilcrete bedding, the pipes shall be suitably supported as shown on the Trench Excavation and Bedding Profile Drawing in the Book of Drawings: Volume 2.

Clause	SANS 1200LB Bedding (Pipes) - Project Specification
	Care shall be taken during the placing of the Soilcrete to prevent movement or flotation of the line by limiting height of the Soilcrete to not greater than 20% of the diameter of the pipe. The selected fill blanket shall not be placed in any section until a period of 24 h has elapsed after placement of the bedding cradle in that section. The main fill shall not be placed in any section until the bedding cradle in that section has achieved a compressive strength of at least 1.5 MPa. The maximum thickness of Soilcrete under the centre line of the pipe shall be 175mm and the minimum shall be 50mm under the Spigot. Hence the vertical alignment of the Trench Bottom is critical.
7.1	TESTING - Density REPLACE THE SECOND SENTENCE IN THE FIRST PARAGRAPH WITH The test will be carried out using the nuclear density gauge. ADD THE FOLLOWING SUB-CLAUSE 7.1.1 Submission of bedding compaction test results The Contractor will be required to submit to the Engineer two (2) compaction test results of bedding for every 15 metres. Bedding compaction to be 90% MOD AASTHO density. The compaction tests to be performed using a nuclear density gauge. The reference Mod AASHTO density is to be obtained for each uniform material used in the Works.
7.3 New Clause	ADD TESTING - Strength The Contractor will be required to submit to the Engineer two (2) Concrete or Soilcrete slump and one (1) set of 6 cubes strength tests on bedding for every 15 metres.
8.1.1	PS8.1.1 MEASUREMENT AND PAYMENT: PRINCIPLES: Supply of Bedding Materials Measured Separately. ADD The payment for laying the pipeline will also cover the costs of testing the bedding material quality, density, strength and compactability.
8.1.3	PS8.1.3 Measurement Payment Principles - Volume of bedding materials ADD THE FOLLOWING TO THIS SUB-CLAUSE The volume of bedding material shall be measured net i.e. the volume of the pipe is to be deducted.
8.1.5	Measurement Payment Principles : - Disposal of displaced material DELETE THIS SUB-CLAUSE AND REFER TO CLAUSE SANS 1200DB 5.6.3:

Clause	SANS 1200LB Bedding (Pipes) - Project Specification												
8.1.6	PS8.1.6 M&P Principles : - Free-haul REPLACE THIS CLAUSE WITH No extra-over payments for haulage will be applicable on this project.												
8.2.1	Scheduled items: - Provision of bedding from trench excavations DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING: PS8.2.1.1 Without the need for screening or other treatments: <table><tr><td>a) Selected granular material</td><td>Unit: m³</td></tr><tr><td>b) Selected fill material.</td><td>Unit: m³</td></tr><tr><td>c) Soilcrete</td><td>Unit: m³</td></tr></table> The rates shall cover the cost of acquiring, from any point along the trench excavation as may be selected by the Engineer bedding that complies with the relevant requirements of the specification, of delivering it to points alongside the trench spaced to suit the Contractor's methods of working, supplying cement and mixing as required as well as disposing of displaced material. No extra-over payments for haulage will be applicable on this project. PS8.2.1.2 Including for screening and/or other treatment: <table><tr><td>a) Selected granular material.</td><td>Unit: m³</td></tr><tr><td>b) Selected fill material.</td><td>Unit: m³</td></tr><tr><td>c) Soilcrete</td><td>Unit: m³</td></tr></table> The rates shall cover the cost of screening by means of mesh sieves or otherwise treating excavated material, at any point along the trench excavation as may be selected by the Engineer, in order to produce bedding that complies with the relevant specification, delivering it to points along the trench, spaced to suit the Contractor's methods of working, supplying cement and mixing as required, making good any backfill deficiency there may be from points where screened backfill material has been acquired, and of disposing of displaced material. No extra-over payments for haulage will be applicable on this project. NOTE: In terms of standardized specification covering pipelines SANS 1200LD, the payment rate for the supply and laying of pipelines covers the cost of handling bedding material from alongside the trench and placing it under and around the pipeline.	a) Selected granular material	Unit: m ³	b) Selected fill material.	Unit: m ³	c) Soilcrete	Unit: m ³	a) Selected granular material.	Unit: m ³	b) Selected fill material.	Unit: m ³	c) Soilcrete	Unit: m ³
a) Selected granular material	Unit: m ³												
b) Selected fill material.	Unit: m ³												
c) Soilcrete	Unit: m ³												
a) Selected granular material.	Unit: m ³												
b) Selected fill material.	Unit: m ³												
c) Soilcrete	Unit: m ³												
8.2.2.3	PS8.2.2.3 Supply only of bedding by importation - From commercial sources (Provisional) ADD THE FOLLOWING SUB-SUBITEM TO THIS CLAUSE: <table><tr><td colspan="3">(c) Special bedding material</td></tr><tr><td>1) Description of material</td><td></td><td>Unit: m² or m³</td></tr><tr><td>2) Etc. for other items</td><td></td><td></td></tr></table> The unit of measurement shall be the square metre or cubic metre of material as specified. The rate shall cover the cost as specified for (1) and (2). The rate shall include the cost of acquiring from commercial sources, transporting regardless of distance, off-loading, supplying cement and mixing as required ready for placing in the trench bottom clean where ordered by the Engineer.	(c) Special bedding material			1) Description of material		Unit: m ² or m ³	2) Etc. for other items					
(c) Special bedding material													
1) Description of material		Unit: m ² or m ³											
2) Etc. for other items													

SANS 1200LD: SEWERS – PROJECT SPECIFICATIONS

Clause	SANS 1200LD Sewers - Project Specification
3.1.2	MATERIALS: PIPES, FITTINGS, AND PIPE JOINTS - Reinforced concrete pipes ADD The quality management systems in the manufacturing process and the quality of the pipes shall be checked at irregular intervals at the Manufacturer's premises to ensure compliance with the specification and to ensure that the pipelines can be constructed to the specified tolerances and will remain durable for the 50-year design life. Manufacturing facilities to be ISO 9001:2008 accredited. The Contractor must obtain and provide to the Engineer the Manufacturer's SANS certificate of accreditation for his approval before the final order is placed with the manufacturer. The Contractor must draw the manufacturer's attention to the alignment tolerances specified below so that the pipes can be manufactured to a tolerance that will facilitate compliance. In areas with gradients less than 1:800, the tolerance on pipe ID shall be +/- 5mm for all pipe diameters and not the tolerances specified in SANS 677. The pipes shall be concrete reinforced pipes with spigot and socket joints. The nominal internal diameter and nominal effective lengths will be as indicated on the orders. Pipes will also be assessed once delivered to site in accordance with a sampling plan agreed with the manufacturer. Pipes with elliptically placed reinforcement will not be used. Additional to the marking requirements specified in SANS 677, the contract number will be indelibly marked on each pipe at the factory. Pipes to be manufactured according to SI classification of SANS 677 with structural strengths of 100D. During the manufacturing process each pipe will be provided with a 3mm thick HDPE layer with anchor knobs to ensure integrity between the concrete pipe and HDPE layer. The HDPE layer should preferably be light green in colour. The manufacturer's quote should make specific allowance for 200mm wide capping strips, which will be welded onto every pipe joint formed on site. Where the nominal diameter of the pipe is equal or larger than 900mm, a selected number of pipes are to be manufactured with pre-formed manholes to suite the drawings and these are to be installed as required at manhole positions.
3.1.8 New Clause	MATERIALS Pipes, fittings, and pipe joints - Rubber joint rings ADD THE FOLLOWING NEW SUBCLAUSE:

Clause	SANS 1200LD Sewers - Project Specification
	3.1.8 Rubber Joint Rings Rolling rubber joint rings shall comply with the relevant requirements of Part I of SANS 974-1 and shall not have more than one joint, which joint shall be positioned at the soffit of the pipeline.
3.1.9 New Clause	MATERIALS, PIPES, FITTINGS AND PIPE JOINTS – High Density Polyethylene Pipes (HDPE) ADD All HDPE piping must conform to SANS ISO 4427 and the pipe manufacturer must be SABS accredited. All piping will be HDPE PE 100 piping with a Standard Diameter Ratio (SDR) of 17 and a pressure class of PN10. All pipe fittings will be HDPE and must be able to withstand a PN 10 pressure class after fabrication. All jointing must be done using electrofusion welding complying with SABS 0269, and therefore bar coded electrofusion fittings are to be used where these are available. The following information must be recorded for each weld and submitted to the Engineer within 48 hours after the weld has been completed and before any payment will be made: Supplier's fitting type and size, welding time and resistance, Pipe SDR range where the fitting is safe to be used, the cooling time and the time in which the joint was not allowed to be moved, No additional costs will be paid for these records and the cost thereof will form part of the rate for the supply and laying of the pipeline. The rising mains will be provided with air valves as indicated on the drawings.
3.5.2	Manholes, chambers, etc. - Precast concrete sections ADD THE FOLLOWING TO THE SUB CLAUSE Precast concrete manhole sections, slabs, lids and frames shall conform to SANS 1294. Dolomitic aggregate shall be used in the manufacture of the manhole sections, levelling rings and slabs."
3.5.7	MANHOLES - Step irons REPLACE "Step Irons" with "Steps" REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING: Steps shall be as described in SANS1294
3.5.8.1 and 3.5.8.2 New Clauses	Manhole cover and frames REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING: 3.5.8.1 Precast concrete elements Precast concrete roof slabs and covers shall comply with the applicable requirements of SABS 1294 and the strength requirements specified on the drawings. The elements shall be manufactured in accordance with the details shown on the drawings using concrete consisting of dolomitic aggregate.

Clause	SANS 1200LD Sewers - Project Specification
	Precast concrete roof slabs and covers shall be used throughout the works except in roadways, or where otherwise ordered by the Engineer. 3.5.8.2 Manhole covers and frames Manhole covers and frames shall be appropriate heavy duty composite plastic that comply with SANS 50124 and with a suitable locking device, all to be approved by the Engineer.
5.2.3	CONSTRUCTION - Laying and bedding - Method ADD THE FOLLOWING The pipes shall be pulled into final position in accordance with the manufacturers requirements.
5.2.6 and 5.2.7 New Clauses	CONSTRUCTION -Laying and bedding ADD THE FOLLOWING TO THE SUB CLAUSES 5.2.6 Jointing Jointing inside the pipes shall be carried out strictly using approved materials with a backing strip and durable sealant. 5.2.7 Depth of cover beneath roadways and vehicular trafficked areas during construction The minimum depth of cover during construction shall be 750mm.
5.4	Connections to manholes REPLACE ENTIRE CONTENTS WITH The sewer shall be jointed to the pipes built into the manholes as shown on the drawings.
5.6.2.3	Benching REPLACE "1:3 cement mortar" WITH "concrete topping consisting of 2 parts Calcium Aluminate Cement, 2 parts sand and 3 parts 7 mm concrete stone, by mass. The sand proportion may be varied between 1 1/2 and 2 1/2 to obtain ideal workability"
5.6.6	The laying and jointing of channels in manholes ADD Any bitumen or other coating applied to the exterior of channels shall be removed before they are laid.
5.6.7 New Clause	ADD THE FOLLOWING 5.6.7 Finished cover level

Clause	SANS 1200LD Sewers - Project Specification
	Unless otherwise shown on the drawings or ordered, the level of the top surface of the cover shall be: • For manholes within carriageways; flush with the final surface of the roadway. • For manholes within road reserves; 50mm above finished ground level. • For manholes within midblock; 250mm above finished ground level. • For manholes within open spaces; 500mm above the finished ground level.
5.6.8 New Clause	5.6.8 Rectification of water infiltration Any exfiltration or infiltration visible in the manhole channels, pipe ends or benching shall be rectified by demolishing the base and rebuilding. Rectification of infiltration through the walls and/or joints may be attempted only by externally applied measures, failing which the manhole shall be demolished and re-constructed. Precast concrete manholes shall be constructed in accordance with the details shown on the drawings. Joints between chamber sections shall be sealed by placing an approved flexible sealant in the joints using a method approved by the Engineer.
5.9.1	Connecting sewers - Location and details REPLACE THE WORDS "Drawing LD-7 or Drawing LD-8 as applicable" WITH "The relevant Municipal Standard Detail Drawings."
5.9.2	Marker posts Marker posts to be installed on the centre line of the outfall sewers. As a standard marker posts are installed on all PI point on a pipeline but due to the allowable deflection angles of the joint of the type of pipes used in the design the horizontal alignment is designed to incorporate long radius curves. A manhole is designed at the start of the curve and at the end of the curve. Therefore, installing a marker post at the PI will be far removed from the actual centre line of the pipe line. Marker posts shall therefore be erected at the beginning and end of the curve as well as a minimum of three (3) marker posts to be installed on the centreline of the curve spaced equally between the above mentioned manholes. On straight sections, marker posts are to be installed at a maximum distance of 100 m.
6.3	TOLERANCE - Manhole invert levels REPLACE "±50 mm" IN THE SECOND LINE WITH "±25 mm where concrete pipes are being used". ADD

Clause	SANS 1200LD Sewers - Project Specification
	Any required deviation by the Contractor, in excess of the tolerance, must be authorised by the Engineer
6.4	TOLERANCE - Alignment and grade between manholes REPLACE “5% OF THE NOMINAL DIAMETER OF THE PIPE” IN 6.4(a) 1) WITH “the lesser of 3% of the nominal diameter of the pipe or 70 x % Gradient (mm) where concrete pipes are being used” (For example, if the gradient is 0.1% (1/1000) the tolerance required for gradient is 70 x 0.1 = 7mm) REPLACE b) with: b) There shall be no steps > 5mm at the junctions between successive pipes.
6.6 New Clause	ADD 6.6 As-built information The Contractor shall submit “As-Built” levels, distances between manholes and the grades of pipelines for which he requires payment at the time he submits his monthly payment claim. A sample form is obtainable from the Engineer.
7.2.6	Water tightness of manholes, drop structures and connection chambers. ADD Especially in areas where the water table is low, a test as detailed hereafter, to verify the water tightness of any manhole, drop structure or connection chamber will be requested by the Engineer’s Representative. Exfiltration: The structure shall be filled with water to the top of its wall level and this depth maintained for at least 24 hours. Water must be added to maintain this level. The addition of water is stopped at the start of the subsequent 24- h o u r period. At the end of the subsequent 24-hour period the drop in water level is to be measured. The structure will have satisfied the test requirement provided the drop is less than 75 mm per metre in depth of the structure measured from channel invert to the original height of the water. At the discretion of the Engineer’s Representative a shorter testing time, minimum 3 hours, will be allowed in which case a 'drop in level' pro rata to the time tested ,shall be used.
7.2.7 New Clause	ADD THE FOLLOWING NEW CLAUSE: 7.2.7Alignment Assessments This will be carried out with in-situ inspections where pipes are large enough for man entry else a CCTV camera with a pan, rotate and zoom facility is to be provided to assess the alignment and quality of installation.
7.2.8 New Clause	ADD THE FOLLOWING NEW CLAUSE: 7.2.8 Acceptance criteria

Clause	SANS 1200LD Sewers - Project Specification
	The acceptance of the pipe length or manhole shall depend upon whether it satisfies the criteria set out in SABS 1200 LD clauses 6, 7 and the clauses above. No pipelines are to be covered prior to inspection and approval by the Engineer. Once the pipeline has been laid and bedded in the compacted bedding cradle (to half pipe) between control points, the Engineer must be called out to inspect the installation. The Contractor is to provide the necessary equipment in order for the Engineer to adequately assess that the pipeline has been laid to the specified tolerances. Further, where appropriate, a water test in accordance with the specifications (Pipes up to 750 mm), is to be conducted and witnessed by the Engineer prior to the placing of the Fill Blanket. Visual inspection are to be done on larger pipes.
8.2.1	PS8.2.1 Supply, lay, joint, bed and test pipeline ADD THE FOLLOWING TO THE SUB CLAUSE: The rate tendered shall further cover the cost of providing the water and for flushing out the pipeline as called for in terms of 7.2.1, as well as for the disposal of the water. The measured quantity of completed pipe length will only be included in the payment certificate when the pipeline has satisfied the test after the completion of the backfill to ground level - See 7.2.8. Prior to this, payment can be made as materials on site. The rate shall therefore also include the joining of the HDPE lining with a 200 mm wide HDPE capping strip at each pipe joint according to the suppliers specification.
8.2.2	PS8.2.2 Extra over item 8.2.1 for specials All specials shall include for the provision of couplings as required.
8.2.3	PS8.2.3 Manholes, Drop Structures, Confluence boxes and Connection structures ADD THE FOLLOWING TO THE SUB CLAUSE: Separate items will be scheduled for the different types of structures in depth increments of 0,5m, the depth being measured as indicated on the drawings or in the Bill of Quantities. The rate shall cover the cost of dealing with any excavation including working space (as if in soft excavation including disposal of surplus) that is additional to that measured under the item for excavation or pipe trench excavation as appropriate, constructing the manholes complete as detailed on drawings, the provision of materials including approved rungs and handholds, manhole covers and frames and the laying and jointing of channels as for "straight through manholes", benching, as well as building in the short pipe specials measured under 8.2.2
	Structures will not be measured for payment until they have been accepted in terms of 7.2.6.
8.2.7	PS8.2.7 Encasing of pipes in concrete Notwithstanding the provisions of the payment Clause, provision shall be made for forming joints at positions that suit the pipe lengths used, as well as for complying with the requirements of 5.7.
8.2.13 New Clause	PS8.2.13 Water tightness Testing of Structures Unit: No The rate tendered shall cover the cost of providing all equipment and materials necessary to complete the test in accordance with the requirements of 7.2.6, irrespective of the depth of structure. Payment will only be made for a successful test.

SANS 1200HA: STRUCTURAL STEELWORK (SUNDRY ITEMS) – PROJECT CONDITIONS

Clause	SANS 1200HA Structural Steelwork (Sundry Items) - Project Specification
2.1	Supporting Specifications ADD THE FOLLOWING TO SUB-CLAUSE 2.1: (c) SANS 1200 H
3.3.1	Bolts and Nuts (other than Friction Grip) ADD THE FOLLOWING TO SUB-CLAUSE 3.3.1: All bolts and nuts shall be of grade 4,6 steel. Washers shall be provided at each nut and shall be of the same material (or coating where applicable) to match the bolt and nut. Single coil square section spring washers shall be fitted to all nuts subject to vibration. Bolts other than jacking bolts shall project not less than 3mm and not more than 10mm from the heads of the nuts after tightening. Holding down bolts to be built into concrete work as well as bolts to be installed above ground level directly above and under water shall all be of stainless steel grade 304. Bolts for flexible couplings and flanges for underground installation shall be hot-dip galvanised in accordance with the requirements of SANS 763. Bolts to be installed inside buildings shall be hot-dip galvanised in accordance with the requirements of SANS 763 and afterwards painted with the pipework and fittings as specified in the Corrosion Protection Specification. Suitable plastic sleeves and/or washers shall be used for protection against corrosion by metallic action.
5.2.10	Protective Treatment DELETE SUB-CLAUSE 5.2.10 AND REPLACE WITH: Refer to Corrosion Protection Specification in this Document.
5.2.6	Handrails DELETE SUB-CLAUSE 5.2.6 AND REPLACE WITH: Stanchions for handrailing shall be of approved prefabricated ball type made in one piece without welding at ball joints to accept the hand and knee-rails and shall have 150 x 75 x 10 mm baseplates drilled for M 12 bolts at 100 mm centre. Baseplates shall be floor mounted. Hand and knee-rails shall consist of 25 mm nominal inside diameter tubing cut and bent to shape. Stanchions shall be spaced not more than 1,5 metres apart. Unless otherwise shown, all handrailing shall be 900 mm above walkway level. All tubing, stanchions and baseplates shall be manufactured in grade 304 stainless steel or hot dipped galvanised (heavy coating), as scheduled or shown on the drawings. All stainless-steel components shall have a No. 1 surface finish and surfaces shall be pickled and passivated in accordance with the requirements of the Corrosion Protection Specification.
5.2.7	Ladders DELETE SUB-CLAUSE 5.2.7 AND REPLACE WITH:

Clause	SANS 1200HA Structural Steelwork (Sundry Items) - Project Specification
	Ladders shall be of all welded construction. Materials used shall be as stated on the drawings. Pickling and passivation shall be carried out in accordance with the requirements of the Corrosion Protection Specification. Vertical ladders shall comprise stringers at 600 mm centres made of 32 mm nominal bore pipes with 3,56 mm wall thickness and rungs spaced at 300 mm centres made of 16 mm diameter solid round bars. The stringers shall be drilled on one side only to provide a sliding fit for the ends of the rungs which shall protrude through these holes up to the opposite inside face of the stringer and be welded all around where they enter the holes in the stringers. Lugs for bolting ladders to walls shall consist of 20 mm nominal bore pipes with 2,87 mm wall thickness. Baseplates for stringers and lugs shall be 150 x 60 x 10 mm drilled for 2 No. M12 stainless steel bolts. Where safety cages are specified the hoops shall be made of 50 x 6 mm flat bars and the longitudinal of 40 x 6 mm flat bars, all in accordance with the dimensions as shown on the Drawings.
5.2.8	Prefabricated Open Grid Flooring DELETE SUB-CLAUSE 5.2.8 AND REPLACE WITH: Open grid flooring shall be of square pattern type of approved manufacture with 40 x 4 mm minimum thickness bearer bars spaced at not more than 40 mm centres and shall be manufactured in grade 304 stainless steel or 3CR12 steel (as scheduled or as shown on the Drawings). The tendered rate shall include for all cutting into the required panels, banding and for frames detailed below. Open grid flooring shall be provided with welded frames as scheduled, made of 50 x 50 x 5 mm thick 3CR12 steel angle to provide a seating for the open grid flooring. The net clearance between the side bars of the open steel flooring and the vertical leg of the frame or strip shall be 5 mm per side. The frames shall be complete with 100 x 40 x 3 mm 3CR12 steel anchors fixed at 500 mm centres for building the frame into the concrete work. Pickling and passivation shall be carried out in accordance with the requirements of the Corrosion Protection Specification.
5.2.9 New Clause	Floorplates Floors ADD THE FOLLOWING TO SUB-CLAUSE 5.2 PSHA 5.2.9 Floorplate floors Floorplate shall have a thickness of 4,5 mm and shall be of the non-slip type. The floorplate shall be made up as shown on the Drawing complete with handles, hinges and locating angles welded to the underside. The tendered rate shall include for all cutting into the required panels and for a frame described on the drawing. Floorplate shall be manufactured in grade 304 stainless steel or 3CR12 steel (as scheduled or as shown on the Drawings) and shall be pickled and passivated as specified in the Corrosion Protection Specification.

C3.3.2 PARTICULAR SPECIFICATIONS FOR CIVIL WORKS

1. BUILDING WORK – PARTICULAR SPECIFICATION

1.1. Scope

This section covers the various construction activities associated with the erection of buildings, which form part of certain civil projects. Building work shall be carried out in accordance with the National Building Regulations and the information contained in this section.

Work appurtenant to the erection of buildings such as earthworks, concrete work, structural steelwork, etc. shall be carried out as specified in the appropriate sections of these specifications and will be measured and paid for under those sections.

1.2. Supporting Specifications

The following specifications shall, inter alia, form part of the Contract Document:

- a) SANS 1200 A
- b) SANS 1200 D
- c) SANS 1200 G
- d) SANS 1200 H

The Standardised Specification for Corrosion Protection and Painting for Civil Engineering Works.

1.3. Materials

1.3.1. Brickwork, Plaster Work and Floor Screeds

- a) Bricks

Bricks shall comply with SANS 227 and shall be classified according to their intended use as defined below.

Engineering bricks in both the face and stock categories shall be durable and selected for their uniformity of dimension, with a minimum average strength of 49 Mpa. These bricks shall be of clay, and shall be pressed or wire cut and free from cracks, chips or defects.

Face bricks shall not require any further decorative treatment and shall be selected for their uniformity of dimension, colour and texture, with a minimum average compressive strength of 28 Mpa. These bricks shall be of clay, and shall be pressed or wire cut and free from chips, cracks, stones or other defects. Water absorption shall not exceed 2%. Special care shall be taken in the loading, stacking and handling of face bricks, as no damaged bricks may be used.

Stock bricks shall be suitable for general building work and shall have a minimum compressive strength of 7 Mpa. Special stock bricks shall have a minimum compressive strength of 17 Mpa. The water absorption of stock bricks shall not exceed 10%.

Satisfactory proof of the load-bearing capacity of the bricks offered shall be submitted before deliveries are made to the Site.

Air bricks shall be well-burnt terracotta and shall be free from cracks and blemishes and lined with copper mosquito gauze.

Three samples of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be of a standard equal to or better than that of the approved samples.

- b) Cement

Cement shall comply with the requirements of SANS 471 and shall be stored under cover. The use of Portland blast-furnace cement (PBFC), which complies with the requirements of SANS 626 will only be allowed if so specified in the Project Specifications.

c) Aggregate

Fine aggregate shall be naturally occurring sand or shall consist of crushed rock or gravel, and shall be hard, clean and free from adherent coatings or other deleterious matter. Sand for plaster and mortar shall comply with the requirements of SANS 1090, whereas the aggregates for normal and granolithic floor screeds shall comply with the requirements of the latest editions of BS 1199 and BS 1200 respectively.

d) Water

Water shall be clean and free from clay, silt, oil, acid, alkali, organic or other matter, which would impair the required strength and durability of the mortar, plaster or floor screed.

Wall ties

Wall ties shall be of the galvanised, crimped, single wire type, and shall comply with the requirements of SANS 28.

e) Damp-proof sheeting

Damp-proof sheeting shall comply with SANS 248, type FV for fibre felt, or SANS 952, type B for embossed polyethylene sheeting.

1.3.2. Ironmongery

a) General

All steel and iron work shall be delivered clean and free from rust, pitting or other defects. Shop priming shall be applied before delivery and shall consist of a coat of red oxide paint, or any other approved anti-rust paint on all surfaces.

Unless otherwise specified, all materials shall conform at least to the appropriate SANS or BS standards where such standards apply to ironmongery, steel, cast iron or any other related materials.

Pressed steel door frames

Pressed steel door frames shall comply with SANS 1129 and shall be manufactured from 1,6 mm thick mild-steel sheeting, pressed to the required shapes, properly mitred, welded and reinforced, with all welding neatly cleaned off.

Frames shall be of the widths required to suit the thickness of the walls into which they are built and shall be fitted with suitable tie bars and braces at the bottom. Three lugs to be built into the brickwork shall be provided on each jamb.

Rebates in frames and transoms for doors shall be of the widths required to suit the thicknesses of the doors and shall be fitted with a pair of approved steel butt hinges set flush into recesses in the frames. 4,5 mm thick reinforcing plates shall be welded to the backs of the frames at hinge positions.

Heads of frames over double doors shall be drilled where required to form keeps for bolts and shall be fitted with one rubber buffer for each leaf of the door.

Frames for single doors shall be fitted with approved chromium striking plates and an adjustable striking-plate keeper boxes in at the back of the frame by a welded-on sheet-metal box. The frames shall be fitted with a minimum of two rubber buffers. Frames shall be protected against twisting and damage during transit and erection.

b) Steel window frames

All steel window frames shall comply with SANS 727 and shall be of the types and sizes shown on the Drawings.

Standard industrial types of steel window frames shall be constructed from rolled mild-steel industrial sections, 35 mm wide by 3 mm thick, with opening sections constructed from standard residential sections, 25 mm wide by 3 mm thick, welded at angles and properly jointed at intersections.

Window frames shall be formed perfectly flat, truly square and properly jointed at all angles, and the opening portion shall fit properly on all faces and shall open and close freely.

Glazing bars shall be continuous with jointed intersections, the ends being neatly tenoned into the frame and securely welded in position.

Frames shall be fitted with standard fixing lugs.

Opening sections shall open as indicated on the Drawings, and shall be fitted with steel hinges with brass pins. Pivots shall be fitted with bronze ring centres.

Side hung or top hung opening sections shall be fitted with brass handles and friction stays. Bottom hung sections shall be fitted with friction pivots and spring catches.

Weather bar drips shall be attached to the fixed frames for the complete width of the window at the head of outward opening sections.

Composite windows may either be delivered completely assembled with mullions and transoms or as separate units for assembly on the Site, but "one-piece" construction is preferred.

Burglar-proofing for steel window frames

Burglar-proofing for steel window frames shall be constructed from rolled mild steel rods of at least 12 mm diameter and welded at all intersections to form openings not exceeding 125 mm by 250 mm.

Burglar-proofing sections shall be formed perfectly flat, truly square where applicable and properly welded onto the window frame in such a manner that it does in no way prohibit the opening/closing of windows nor the cleaning of window panes.

Burglar-proofing shall be welded/fixed to the window frame prior to the building in of the frame.

c) Door locks and handles

All door locks shall comply with the requirements of SANS 4 and shall be of approved manufacture and pattern. All locks shall be supplied with two keys. Keys shall be distinctly numbered with consecutive numbers and each key shall be stamped with the same number as that of the lock which it controls. No two locks in any one building may have the same key.

External doors shall be fitted with four-lever heavy-duty mortise locks, which shall be master-keyed.

All locks shall be properly installed and, after completion, striker plates shall be adjusted and the locks serviced. Door handles shall be of cast zinc of approved manufacture and pattern.

d) Miscellaneous fittings

All retaining devices for doors and windows as well as fittings such as coat hooks, retaining hooks, etc. shall be of solid brass. All fittings shall be secured by screws or set screws of the same material and finish as the fitting.

Fittings to be fixed to plastered walls, masonry or floors shall be fixed direct by means of patent plastic or fibre plugs fitted into drilled holes.

Door stops shall be provided at every door and shall be 40 mm diameter rubber stops.

1.3.3. Glazing

a) Glass

The quality of all window glass shall be such that surface deterioration will not develop after glazing. All glass shall be free from bubbles, waviness, scratches, stains or other imperfections.

Unless otherwise specified, sheet glass for glazing shall be flat-drawn clear glass of ordinary glazing quality and of the thicknesses indicated below.

□ For panes not exceeding 0,75 m² in area: 3mm

□ For panes exceeding 0,75 m² but not exceeding 1,5 m² in area: 4mm

b) Putty

All putty shall comply with the requirements of SANS 680. Putty shall not be too hard or soft or caked when used, and shall dry evenly without crazing or cracking. Defective putty shall be cut out and replaced by the Contractor at his own expense, and any broken glass shall also be so replaced and putty so repainted.

1.3.4. Carpentry and Joinery

a) General

All timber used for structural purposes shall be of merchantable grade and shall comply with the requirements of SANS 563 and SANS 1245. Structural timber shall be carefully selected and of the best quality, free from large or dead knots, shakes, wavey edges or other defects. Purlins and bracing shall comply with the requirements of SANS 653. Finger-jointed structural timber shall comply with the requirements of SANS 10096 and laminated timber with the requirements of SANS 1089.

Hardwoods and softwoods for joinery shall comply with SANS 1099 and SANS 1359 respectively and suitable species shall be used for the various purposes. Unless otherwise specified, all materials shall conform to the appropriate SANS or BS specification where such standards exist for nails, screws, bolts, adhesives, etc.

b) Preservative treatment

All structural timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SANS 10005, and no untreated timber shall be used. The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

c) Priming

The jointing surfaces of all joints exposed to the weather and built-in portions of frames shall be thickly primed except where adhesives are specified. Carpentry and joinery items, which are prepared for painting by the manufacturer, shall be knotted and primed before being dispatched to the Site. Prime surfaces shall be touched up where necessary during the progress of the work or where Site adjustments have been made.

1.3.5. Roof Sheeting and Accessories

a) Roof sheeting

(i) Galvanised-steel sheeting

Galvanised-steel sheeting shall have a minimum ungalvanised thickness of 0,5 mm and shall be of the profile as scheduled or shown on the Drawings. The sheeting shall comply with the requirements of an approved manufacturer's specification. The galvanising shall comply with the relevant requirements of SANS 934 for class Z 600 coating and shall have been passivated.

(ii) Fibre-cement sheeting

Fibre-cement sheeting shall have a minimum thickness of 5 mm, shall be of the profile as scheduled or shown on the Drawings, and shall comply with the relevant requirements of SANS 685.

(iii) Concrete roof tiles

Samples of concrete roof tiles shall be submitted to the Engineer for his prior written approval.

b) Fasteners

Fasteners and washers shall comply with the requirements of SANS 1273, shall be durable, and shall be protected against corrosion to a standard at least equal to the standard of corrosion protection of the sheeting material with which they are to be used. Fasteners to be used with fibre-cement sheeting shall be hot-dip galvanised fasteners.

Bolts and rivets used with galvanised sheeting shall be at least 4 mm in diameter, and those used with fibre cement sheeting, at least 6 mm in diameter. Self-tapping screws and blind rivets may be used for side- stitching and as fasteners for ridging, flashings, etc.

c) Rain-water goods and flashings

Rain-water goods such as launders, gutters, down pipes, etc. and flashings shall be of the size and materials as scheduled or shown on the Drawings, and the materials shall, if similar, comply with the same requirements as specified for the sheeting. All rain-water goods shall be supplied complete with adequate quantities of suitably shaped brackets and fasteners.

d) Sealants

Sealants shall comply with the requirements of SANS 110, SANS 1254 or SANS 1305 as applicable or with the sheeting manufacturer's recommendations as approved by the Engineer.

1.3.6. Tiling

Wall tiles shall be 'first-grade' glazed ceramic tiles complying with the requirements of SANS 22 for class E tiles and shall be true and regular in shape and size and of even colour.

Quarry tiles shall be the best quality pressed tiles, sound, well burnt, even in size and colour and free of markings, hollows, cracks and chips.

1.3.7. Waterproofing of Concrete Roof

Waterproofing for concrete roof slabs shall be approved synthetic rubber or plastic sheet roof covering capable of being fusion welded at joints to provide a homogenous layer over the whole roof area. The sheeting must have fibreglass or similar stretch-resistant backing fully bonded to the sheeting and to be capable of withstanding extreme climatic conditions and to be manufactured in the RSA. It shall furthermore be biologically neutral, resistant to ultra-violet rays and heat, compatible with bitumen and be of a thickness of not less than 2 mm.

1.4. Construction

1.4.1. Brickwork

a) General

Rough and fair cutting shall be performed as required, and the brickwork shall be fitted around any steel work. Face brickwork shall be carefully cut and fitted to suit fittings.

Chases shall be left or formed for edges of concrete flows, staircases, etc. Chases shall also be provided wherever they may be required for pipes, conduits, switch boxes, distribution boards, and the like. Joints shall be raked out for flashings.

b) Cement mortar

Cement mortar will, unless otherwise specified, consist of 1 part of Portland cement to 4 parts of sand by volume for normal brickwork and 1 part of Portland cement to 3 parts of sand by volume for reinforced brickwork. The ingredients for cement mortar shall be measured in proper gauge boxes on a boarded platform and thoroughly mixed. Alternatively, mixing may be by means of an approved mechanical batch mixer. Only when the dry ingredients have been thoroughly mixed and a mixture of uniform colour has been obtained may the water be added in sufficient quantity to obtain mortar with the required consistency.

Cement mortar shall be used within two hours of adding water to the mix and shall not be used after two hours or if it has begun to set. Mortar shall be turned over frequently until it is used to prevent is from setting.

c) Brickwork

Dimensions of all the brickwork shall be set out and built as shown on the Drawings. Bricks shall be kept wet before laying and the top of brickwork shall be wetted before any further bricks are laid. Bricks shall be well buttered with mortar before being laid and all joints shall be thoroughly flushed up as the work proceeds. All joints to faced brickwork shall be neatly made and key drawn with a 6mm key.

Brickwork shall be carried up in a uniform manner with no portion being raised more than 1 m above an adjacent portion. All perpendes, quoins, etc. shall be kept strictly true and square and the whole properly bonded together.

Brickwork shall be built in stretcher bond or English bond as shown on the Drawings and bats shall not be used except where required for the bond. All joints shall be 10 mm wide and four courses shall measure 340 mm.

Brickwork for cavity walls and solid walls built in stretcher bond shall be tied with wall ties placed not more than one metre apart in every third course, and shall be staggered vertically or as otherwise specified in the Project Specifications. At openings, the ties shall be positioned not more than 300 mm apart along the periphery of the opening and 150 mm from the opening.

Face brickwork shall be kept perfectly clean and rubbing down of the brickworks shall not be allowed. Scaffold boards shall be turned back during heavy rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

d) Reinforced brickwork

Brickwork over door and window openings shall be reinforced with steel rods, welded or expanded mesh, etc. Reinforcement shall be placed in each course of brickwork for a minimum of 4 courses or as shown on the Drawings. Reinforced brickwork shall continue at least 300 mm on each side of the openings.

Brick lintels shall be built upon rigid temporary supports left in position for not less than 7 days after brick- laying. Prestressed concrete lintels may be used where approved by the Engineer.

e) Key for plaster

Joints of all brickwork receiving plaster shall be raked out, or the brick surfaces shall otherwise be prepared with an acrylic slurry or any other approved bonding agent.

f) Damp-proofing

A damp-proof course shall be laid over the full width of all the walls at a minimum height of 150 mm above the final ground level or wherever else it may be required, and it shall be lapped for at least 150 mm at angles and joints. A damp-proof course shall also be laid and stepped under all external sills.

1.4.2. Plaster work

a) Finish

A plastered finish may consist of a combination of one or more of the following:

A single coat or first coat, comprising one application of a 1:6 cement: sand mixture with a wood or steel- float finish.

If a first coat, the plaster shall be wood-floated and then scratched, raked or otherwise roughened to provide a mechanical key for the second coat, which shall be applied within 24 hours. Should it be impossible to apply the second coat within 24 hours, the first coat shall be kept moist until the second coat is applied.

A second coat comprising one application of a 1:6 cement: sand mixture with a wood-float finish. A finishing coat comprising a 1:1½ gypsum: sand mixture with a steel-float finish.

b) Thickness

The total thickness of the plaster finish shall be 10 mm minimum and 20 mm maximum.

c) Workmanship

All plaster work shall be finished smooth and ready to receive paint. Plaster shall be flush with the faces of all switch and plug boxes, the interiors of which shall be kept free from plaster. Plastered surfaces shall be plumb and jambs and reveals shall be formed square.

The plasterer shall cut out and make good all cracks, blisters and other defects and leave the plaster work, on completion, in a state, which is acceptable to the Engineer.

1.4.3. Floor screeds

a) Normal screeds

Normal screeds shall have a mix proportion by mass consisting of 1 part of Portland cement and 3 parts of fine aggregate. A minimum amount of water is to be used but it shall be sufficient to allow adequate compaction.

Screeds shall be laid on clean hardened bases, prepared as for granolithic screeds, in panels not exceeding 14 m and shall be steel-trowel led to a true and smooth finish. In monolithic construction the panels shall not exceed 30 m. Joints in screeds shall coincide as closely as possible with joints in the bases. The thickness of screeds shall be as shown on the Drawings or as directed by the Engineer.

The entire screed surface shall be free from loose or raised particles of aggregate, trowel marks or from any irregularities, humps or depressions exceeding 5 mm when measured from a 3 m long straight-edge.

Screeds shall be cured for 3 to 7 days as may be directed by the Engineer, and shall be protected from damage.

No moisture-sensitive floor finish shall be laid on screeds unless a reliable moisture test shows that the screed is sufficiently dry to receive the covering.

b) Granolithic screeds

Granolithic floor screeds shall be composed of 2 parts of Portland cement to 3 parts of aggregate with sufficient water added to obtain a consistency as dry as may be practicable. The screed shall be rendered with a wood float and struck off with a steel trowel after set has commenced.

The granolithic mixture shall be floated onto the concrete floor slab within 12 hours of the latter having been laid. Where this cannot be done within 12 hours, the concrete surfaces shall be thoroughly hacked, cleaned, watered and treated with an approved cement slurry or with an approved bonding agent, as may be directed before the granolithic screed is laid.

Where a tinted granolithic screed is specified, it shall be placed in two layers, a lower layer placed to within 6 mm of the finished level and an upper layer into which the pigment has been mixed. No dusting on of colouring material will be allowed.

The surface of all granolithic screeds shall be kept damp for a period of at least 7 days after laying by covering it with polyethylene sheeting or by thickly covering it with wet sand, sawdust or Hessian kept moist by frequently sprinkling it with water.

The granolithic screeds shall be not less than 20 mm thick, finished to falls as shown on the Drawings, and shall be laid in panels not exceeding 6,0 m. Thresholds shall be finished with granolithic screeds 25 mm thick, treads 25 mm thick, and risers 20 mm thick, including rounded nosing and readings.

Edges next to walls shall be finished with projecting skirting, 75 mm high, with rounded top edges, unless otherwise specified or instructed by the Engineer.

1.4.4. Door and Windows

All built-in door and window frames shall be set straight, plumb and level, and shall operate to the satisfaction of the Engineer after fixing has been completed.

Fittings shall be either removed, or wrapped and protected from damage, until all rough trades have been completed.

1.4.5. Glazing

Glass shall be cut in panes to suit all glazed openings with sufficient clearance all round to prevent cracking by expansion, contraction or vibration.

In all cases the glass shall be well bedded and back-puttied and installed as specified in SANS 10137. All putty shall be carefully trimmed, cleaned off and neatly finished off straight with smooth surfaces and sharp mitres. A paint primer shall be applied as soon as the putty has dried out sufficiently to prevent shrinkage cracks from forming. The entire glazing operation shall be cleaned before the premises are handed over for occupation.

1.4.6. Carpentry and Joinery

a) General

Carpentry work shall be carried out in a manner consistent with good workmanship and in compliance with the Drawings.

The carpenter shall perform all cutting away and making good in attendance upon all other trades and he shall provide and maintain temporary coverings required for the protection of any finished work that might be damaged if left unprotected during the progress of the work.

b) Joining

Unless otherwise specified, all joints shall be secured by means of a suitable type and a sufficient number of approved connectors. All joints shall be carefully made in such a way that they will not impair the strength and stiffness of the beams or members

c) Timber roof construction

The plates, joists, rafters, purlins, brandering and other pieces used for the construction of the roof and trusses shall be of the dimensions, spacing and construction, as shown on the Drawings. All the joints in the framework shall be of the most appropriate type, accurately formed and adequately secured with fasteners as specified.

1.4.7. Joinery Work

a) General

Joinery work shall consist of the manufacture, delivery to the Site, and fixing in the buildings, of all joinery shown on the Drawings.

Except where a special finish is specified, the Contractor shall have all stairs, landings, doors, shelves and other joinery work cleaned and scrubbed down and shall leave all his work in a good order to the satisfaction of the Engineer.

b) Fabrication

The joiner shall perform all the necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all the other works necessary for correct joining. He shall also provide all metal plates, screws, nails and other fixings that may be necessary for doing the specified joinery work properly.

c) Joints

Where joints are not specifically indicated, they shall be the recognised forms of joints for each position. The joints shall be so made as to comply with Part 2 of BS 1186.

d) Skirting, cornices, etc.

Skirting, cornices, etc. shall not be installed until after the wall coverings have been applied, the flooring laid and ceilings installed, unless otherwise specified.

e) In situ joinery

In situ joinery work shall not be executed until after all floor, wall and ceiling surfaces have been formed or constructed, unless otherwise instructed.

f) Ceilings

Ceilings shall consist of plasterboard or fibre-cement panels as shown on the Drawings and shall be nailed to the brandering or suspended from the roof structure. The panels shall be separated by exposed tees and insulated with a 50 mm thick fibreglass wool blanket where shown on the Drawings.

1.4.8. Roofing and Accessories

Flashings, ridging, eaves closers, etc. shall be of the size and shape necessary to suit the sheeting used. Flashings shall be of an approved type and shall be properly cut, lapped, shaped, dressed and fixed in an approved manner to render a waterproof finish. Provision shall be made for expansion and contraction in long lengths and at expansion joints of the building.

Gutters shall be fixed on suitable brackets and shall fall to outlets, all as directed by the Engineer. Gutters and brackets shall be standard units.

All downpipes shall be watertight and shall be fixed 25 mm clear of the finished wall face or structure by means of suitable brackets, and at approved spacings. The positions of the downpipes shall be as directed by the Engineer.

1.4.9. Tiling

Tiles shall be fixed to walls with an approved adhesive and finished with white cement joints. Tiles shall be laid with straight joints and arranged symmetrically in the tiling pattern.

Concrete tiles and all other types of hard tiles used as floor cover shall be bedded in cement mortar and shall be laid level. Tiles shall be laid with straight joints and flush with granolithic work, where applicable.

Vinyl floor tiles shall be laid level and with straight joints. The adhesive compound used and the method of laying employed shall be strictly in accordance with the tile manufacturer's instructions.

1.4.10. Waterproofing of Concrete Roofs

The sheeting shall be properly glued down and shall be turned up against parapets and properly flashed, sealed and dressed down into outlets and flashed around all protrusions all as shown on the Drawings.

On completion the entire surface area of the waterproofing shall be given two coats of a reflective paint compatible with the waterproofing material.

The entire waterproofing installation must be carried out by specialists, who have been appointed by the manufacturer and the work must be guaranteed against any defects in material and/or workmanship for a period of ten years. Should any leaks become apparent during this time, the Contractor must undertake to have same repaired without delay.

1.5. **Measurement and**

Payment Brickwork

(describe)

½ Brick Wall Unit: sq.m (m²)

1 Brick Wall Unit: sq.m (m²)

1½ Brick Wall Unit: sq.m (m²)

The tendered rate per square metre shall be based on the dimension as indicated on the drawings.

2. CONCRETE PALISADE FENCING – PARTICULAR SPECIFICATION

2.1. Scope

This specification refers to the requirements for the manufacture and installation of concrete palisade fencing.

2.2. Interpretations

a) **This specification shall be read inter-alia with the remainder of the Contract.**

2.3. Materials

2.3.1. Engineering

The structural design and dimensions of all elements (posts, rails and pales) shall be submitted for approval by the Engineer.

2.3.2. Concrete

All concrete elements shall be manufactured from sound concrete, free of structural defects, complying with any sample if previously submitted. The required concrete compressive strength in all pre-fabricated pre-stressed elements shall be a minimum of 30 Mpa at 28 days, determined in accordance with SABS method 863.

2.3.3. Finishing

All elements shall have off-shutter finish on three sides, with the fourth side having a wood floated finish.

2.3.4. Reinforcement Steel

All steel used for reinforcements in pre-fabricated elements shall be high yield steel with a minimum characteristic strength of 400 Mpa, and shall be free of rust, loose scale, flux, grease or oil substances and shall in general comply with SABS 920 and BS 4482.

2.3.5. Reinforcement Wires

All reinforcing wires shall be of the crimped variety and shall be free of rust, loose scale, flux, grease or oil substances and shall in general comply with BS 5896.

2.3.6. Posts

The post shall be 3.0m long and slotted to take the two horizontal load bearing rails. The front edge shall be curved. Posts shall be spaced at 2.0m centre.

2.3.7. Concrete Ground Beam

A concrete ground beam of dimension 150 x 400mm deep shall be cast between posts. The gap between the ground beam and pales shall be no more than 120mm.

2.3.8. Rails

Two rails of 1.98m long shall each have eleven holes to receive 10mm carriage type bolts. All rails are to be grouted into posts with 2:1 sand/cement.

2.3.9. Pales

Eleven pales shall be placed between posts that are 2.0m apart. The pales shall be 2.4m long with two holes to take 10mm carriage type bolts. The front edges shall be curved. Pales are spaced at +/- 190mm centres, with gaps no more than 120mm.

2.3.10. Nuts and Bolts

All nuts, bolts and washers used for the erection of the fence shall be electro-galvanised (zinc and chrome passivated). All bolts used for the erection of the fence shall have their ends burred over. The holes shall be filled with 2:1 sand-cement mortar.

2.3.11. Razor Wires

The fence is topped with continuous 450mm diameter galvanised razor wire security coil fixed to the inside of shaped mild steel bracket, including all necessary straining wires, etc., all set up strictly in accordance with material supplied and methods employed by the manufacturer.

2.4. Plant

All plant and equipment used for the manufacture and erection of concrete palisade fencing shall be in good working order. All plant and equipment used for installing concrete palisade fencing shall be subject to approval by the Engineer.

2.5. Construction

Precast concrete palisade fencing shall have overall height of 2.55m.

2.5.1. Setting Out

The line and level of all fences shall be set out by a surveyor. Setting out points shall be inspected and approved by the Engineer before erecting of fencing commences.

2.5.2. Posts

Palisade posts are placed at 2.0m centres, embedded to full depth in concrete in a foundation hole of at least 460mm x 460mm and a depth of 600mm. Posts shall be vertical in line and level and properly supported until concrete has sufficiently hardened. Foundation concrete strength shall be a minimum of 15 Mpa at 28 days

2.5.3. Rails

Horizontal rails shall slide into posts and grouted with 2:1 sand/cement mix.

2.5.4. Pales

Pales set at ± 180 mm centre to centre, with maximum gap of 120mm between pales. Maximum distance between.

2.6. Tolerances

All due care shall be taken to install fences to the correct line and level. Installation of posts, ground beams, posts and rails shall have a tolerance of no more than ± 10 mm.

2.7. Testing

All materials shall be factory-tested for strength and durability in accordance with the relevant SANS specifications. The Contractor shall confirm the line and level of fencing and posts.

2.8. Measurement and Payment

The following items are scheduled:

2.8.1 Concrete palisade fencing complete, including posts, foundations, rails, and pales m

Measurement for this item shall include all plant, equipment, labour, materials, and other associated costs for setting out and installing concrete palisade fencing complete. This item shall also include concreting and excavation in all materials for post foundations

2.8.2 Ground beam complete of size 150mm x 400mm m

Measurement for this item shall include all plant, equipment, labour, materials, and other associated costs for setting out and installing ground beams. This item shall also include all concreting and excavation in all materials.

2.8.3 Supply and install 450mm diameter razor wire security coil and steel brackets m

Measurement for this item shall include all plant, equipment, labour, materials, and other associated costs for supplying and installing 450mm diameter galvanised razor wire security coil. This item shall also include 500 x 30 x 6mm mild steel bracket at 45 degrees, attached to pales with 10mm diameter, 140mm long M10 carriage type bolt and nut, through fixing holes, staining wires, and etcetera

C3.3.3 QUALITY ASSURANCE REQUIREMENTS

a) Contractor Qualification

The Engineer may, at his discretion, require a Quality Audit of the painting sub-contractor to ensure that he has the management, facilities, skilled staff, and quality control facilities and staff to carry out quality control during application of coatings to ensure compliance with the specification.

The contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by the Engineer or his representative.

The contractor shall obtain confirmation from the material supplier that materials to be used comply with the specification and are suitable for the intended purpose.

b) Quality Control

The contractor shall have the necessary equipment and staff knowledgeable in test procedures to carry out all the quality control required to ensure compliance with the specification. The contractor will be required to produce a quality plan and a program for carrying out the work, batch numbers of materials used, environmental conditions, all as required by the specification. Quality control shall be inclusive in the contractor's tender price.

c) Quality Surveillance

Independent surveillance – the Engineer may employ an independent technically qualified organisation to carry out quality surveillance of the work on his behalf.

Program – the Contractor shall advise the Engineer timeously, in writing, when and where the following processes will be carried out:

- (i) Completion of fettling or dressing prior to leaving the fabricator's works.
- (ii) Blast cleaning and application of the first or primer coat.
- (iii) After completion of all coats to be applied at the contractor's works.
- (iv) At the commencement of repairs to be carried out on site.

Failure of the Contractor to advise the Engineer of his program may result in rejection of the work.

d) Access for surveillance

For the purpose of carrying out quality surveillance, the Engineer or his representative shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time. The Contractor shall provide, at his own cost, any equipment or labour necessary to gain access to surfaces which are coated, to be coated or are in the process of being coated.

e) Samples

The Engineer or his representative may remove any reasonable samples of materials to be used in the coating application. Rejection of the sample will place a hold on the use of material of the same batch number and may lead to rejection of all that batch of material and the reworking of any components that have already been coated with rejected material.

f) Destructive testing

The Engineer or his representative may carry out reasonable destructive tests to ascertain compliance with the specification. Areas thus damaged shall be repaired by the contractor to the satisfaction of the Engineer at no additional cost.

g) Cost of Quality Surveillance

Cost of Quality Surveillance shall be borne by the Employer, except when surveillance results in rejection of the lot or when notice by the Contractor results in a fruitless trip, in which cases the cost shall be debited against the contractor's account.

h) Quality Control Records

Proper and adequate quality control records shall be maintained by the Contractor for all stages of the work. These records shall be available for inspection by the Engineer or his representative at the time of Quality Surveillance. Incomplete, inaccurate or inadequate records shall be

regarded as non-compliance with the specification, and the cost of surveillance will be back charged to the contractor.

i) Data Sheets, Specifications and Codes of Practice

The contractor shall have available the latest issues of manufacturer's data sheets materials to be used, National specifications and Codes of Practice relevant to the work to be carried out, as well as a copy of this specification, all of which shall be available to the contractor's Quality Control Manager.

C3.3.4 COLOUR CODING

This Specification has been adopted for the Works to ensure the colour coding of electrical equipment, mechanical plant and pipework.

The Water Wastewater Treatment Works shall conform to the ruling Occupational Health and Safety Act.

Throughout the Specification the colours used shall match the corresponding colours given in SANS Specification 1091, National Colour Standards for Paint: 2004 (as amended).

Item	Colour	Code to SANS 1091
Electric motors, pumps, speed reducers, baseplates and compressors	Navy light grey	G 35
Electric panels:		
Externally	International orange	A 15
Internally	White	-
Pipework for:		
Steam	Pastel grey	G 54
Methane	Light stone	C 37
Compressed air	Arctic blue	F 28
Fresh water	Brilliant green with white band at pipe extremities	D 10
Recycled effluent	Light orange	G 80
Air saturated water	Turquoise blue	B 26
Raw sludge	Dark violet	E 18
Digested sludge	Middle brown	F 06
Waste activated sludge	Royal blue	B 07
Supernatant liquor	Avocado	F 01
Poly-electrolyte	Canary yellow	C 12
Hydraulic oil	Salmon pink	C 61

For items not included in the above table the Engineer will select the required colours.

(1) SUMMARY OF SYSTEMS: MILD ENVIRONMENTS

System	Substrate	Surface Preparation	Coating System	Requirements
A.1	Bare steel	Blast clean Sa 2,5 Profile 25-50 micrometres	Prime SANS 719 Type 1 Undercoat SANS 681 Type 2 Alkyd Enamel SANS 630 Type 2 Interior – 1 coat Exterior – 2 coats	Smooth, glossy, uniform coating. No visible defects. DFT min: Interior – 75 micrometres Exterior – 100 “
A.2	Steel cleaned and primed with Zinc Chromate Primer	Abrade whole surface. Scrub with detergent. Wash thoroughly. Allow to dry.	Primer SANS 679 Type 1 Undercoat SANS 681 Type 2 Alkyd Enamel SANS 630 Type 2 Interior – 1 coat Exterior – 2 coats	Smooth, glossy, uniform coating. No visible defects. DFT min: Interior – 75 micrometres Exterior – 100 “
A.3	Factory applied coatings etc. Motors & gearboxes	Abrade surface. Scrub with detergent. Wash thoroughly. Allow to dry.	Alkyd Enamel SANS 630 Type 1 or Type 2 Interior – 1 coat Type 1 Exterior – 2 coats Type 2	Smooth, glossy, uniform coating. DFT Interior – Min. 50 micrometres DFT Exterior – Min. 75 micrometres

System	Substrate	Surface Preparation	Coating System	Requirements
A.4	Galvanised steel	Degrease, abrade, wash and allow to dry.	Water based vinyl chloride-vinylidene chloride copolymer zinc phosphate primer. Undercoat SANS 681 Type 2 Alkyd Enamel SANS 630 Type 1	Smooth, glossy, uniform coating. DFT min. 90 micrometres over galvanising.
A.5	Glass reinforced polyester Unplasticised PVC Acrylonitrile Butadiene Styrene	Abrade surface. Scrub with detergent solution. Wash thoroughly. Allow to dry.	Water based vinyl chloride vinylidene chloride copolymer primer containing zinc phosphate. One or two coats, as necessary to obtain uniform colour, of Alkyd Enamel SANS 620 Type 1.	Smooth, glossy, uniform coating.
NOTE: When used in environment containing chlorine or hypochlorous acid fumes, using vinyl systems in place of alkyd system the colour must be bleach resistant.				
B.1	Mild steel Cast iron	Blast clean SA3: Profile 50 – 100 micrometres. Water soluble salts max. 100. Dust and debris max. 0.3%. As above but in addition, no re-use of abrasive	3 or 4 coats solvent borne epoxy-polyamide to SANS 1217 Type 1A Final colour Red Oxide	Maximum DFT 85 microns per coat. Observe correct overcoating times. Total DFT min. 250 micrometres. No electrical insulation defects at 90 Volts 2 Megohm.

System	Substrate	Surface Preparation	Coating System	Requirements
B.2	Galvanised steel	Degrease, abrade or sweep blast	As for System B.1	As for System B.1
B.3	As for B.1	As for B.1	Solvent free two pack epoxy to SANS 1217 Type 1C.	DFT min. 250, max. 400 microns. No EID at 90V, 5 Megohm
B.4	As for B.1	As for B.1	As for System B.1 plus one or two coats two pack aliphatic polyurethane.	As for System B.1 but with improved colour retention and chalking resistance.
For Site Repairs of Systems B.1 to B.4 see the section following System B.4				
B.5	Any	As appropriate	As for B.1, plus one or two coats vinyl enamel.	As for System B.1 but for use on B.1 Systems partially exposed to air and adjacent to vinyl systems.
E.1	As for B.1	As for B.1	Metal primer for solvent free polyurethane. Approved 2-component solvent free aromatic polyurethane.	Minimum DFT 1,0mm. No EID when spark tested at 5kV.

For Site Repairs of vinyl systems see the section following System D.3
Attention is drawn to the need to read the appropriate general and detail sections of this document.

System	Substrate	Surface Preparation	Coating System	Requirements
E.2	As for B.1	As for B.1	As for E.1	Minimum DFT 3,0mm. No EID when spark tested at 15kV.
Note: This system may only be applied by Contractors with the necessary specialised equipment, supervision and experience to apply these materials. Contractors shall be approved by the Engineer.				
For site repairs of E.1 and E.2 see the section following E.2.				

NOTE: Attention is drawn to the need to read the appropriate general and detail clauses of this document.

NOTE: System C (Coal tar epoxies) not required in this specification.

C3.3.5 EMPLOYMENT AND TRAINING OF LABOUR – PARTICULAR SPECIFICATIONS

1 SCOPE

This specification covers the requirements for the employment and training of workers on the Contract

2 COMMUNITY LIASON OFFICER

The Project Steering Committee (PSC) will identify a Community Liaison Officer (CLO) to facilitate liaison between the Contractor and the community and amongst other things to ensure that the employment of local labour proceeds smoothly.

All decisions regarding identification and hiring of labour, relieving labour of their duties, local problems and any other matter of local importance related to the Contract, will be made in consultation with the CLO.

3 Appointment, office and replacement of CLO

- The CLO will be appointed for the duration of the construction phase of this Contract.
- The CLO will occupy his own office in the Contractors camp from where he will fulfil his duties to identify, screen and nominate labour from the community in accordance with the Contractor requirements.
- The CLO will communicate with the Contractor daily regarding labour requirements.
- Should it become apparent that the appointed fails to meet his duties, he may be relieved from his duties and replaced by a new CLO in consultation and approval with the PSC.
- One CLO will be appointed from the time that work starts until all work has been completed.

4 Duties of the CLO

- He will attend all meeting of the committee pertaining to this contract.
- He will be available on site daily between the hours 07:30 and 18:30 and at other times as the need arises
- He will consult with the Contractor and the Engineer Daily to determine the labour requirement regarding amount and skills, to identify possible labour disputes, and to inform local labourers timeously when they will be relieved.
- He is responsible to screen candidates, to inform them of their conditions of temporary employment and to ensure their timeously availability.
- He will ensure that all workers who are involved in activities where productivity rates have been agreed, are fully informed regarding the expected level of productivity for the given tasks to be assigned as part of this Contract.
- He will attend disciplinary proceedings to ascertain that hearings are fair and reasonable.
- In consultation with the Contractor, he will determine the needs of the local labour for relevant technical training. Again he will be responsible for the identification of suitable trainees. He will also be required to attend some of the training sessions
- He will keep a daily written record of his interviews and community liaison
- He will attend the first part of the monthly Contractual site meetings to report about the local community labour involvement as well as any other relevant problem that needs attention.

- He will be involved in all SMME related matters (Contracts, terminations etc.).

5 **Scheduled items**

PPS5.1 Community liaison officers' salaries Unit: Provisional Sum

The tendered sum shall include full compensation for the provision of the CLO including salary, provision of an office, transport costs, the cost of typing, printing and distribution notices, and for other obligations as specified by the engineer on site.

PPS5.2 Community liaison officers' cellular phone..... Unit: Provisional Sum

The contractor must supply the CLO with a cellular phone for the duration of CLO employment Contract and this rate must cover the cost of procuring and commissioning that phone.

PPS5.3 Community liaison officers' cellular phone calls.....Unit: Provisional Sum

The contractor must allow R 500, 00 per month for work related calls. Calls above this amount will be to the CLO account

SECTION POHS: OHSA 1993 HEALTH AND SAFETY SPECIFICATION

POHS.1 SCOPE

This specification covers the health and safety requirements to be met by the Contractor to ensure a continued safe and healthy environment for all workers, employees and subcontractors under his control and for all other persons entering the site of works.

This specification shall be read with the Occupational Health and Safety Act (Act No 85 and amendment Act No 181) 1993, and the corresponding Construction Regulations 2003, and all other safety codes and specifications referred to in the said Construction Regulations.

In terms of the OHSA Agreement in Section C1.2.4 of the Contract document, the status of the Contractor as mandatory to the Employer (client) is that of an employer in his own right, responsible to comply with all provisions of OHSA 1993 and the Construction Regulations 2003.

This safety specification and the Contractor's own Safety Plan as well as the Construction Regulations 2003, shall be displayed on site or made available for inspection by all workers, employees, inspectors and any other persons entering the site of works.

The following are possible risks associated with this project:

- Lifting and lowering of materials and equipment from the ground onto the pipe pedestals (sewer)
- Deep excavations in soils requiring shoring or reducing of slopes
- Blasting of hard rock or demolition of concrete
- Movement of construction vehicles on site, taking into consideration steep slopes, other traffic and existing services
- Exposure to possible injuries due to mishandling or failure of power and hand tools
- Falling debris, tools and materials from bridge
- Non-conformance to specifications with regards to fasteners and materials
- Risks related to general safety and security on site

Additional risks may arise from specific methods of construction selected by the Contractor which are not necessary covered in the above.

POHS.2 DEFINITIONS

For the purpose of this contract the following shall apply:

- (a) **Employer**, as used in the contract documents and in this specification, means the Employer as defined in the FIDIC Yellow Book 2017 Edition, and it shall have the exact same meaning as "**client**" as defined in the Construction Regulations 2003. "**Employer**" and "**client**" is therefore interchangeable and shall be read in the context of the relevant document.
- (b) "**Contractor**" wherever used in the contract documents and in this specification, shall have the same meaning as "**Contractor**" as defined in the FIDIC Yellow Book 2017 Edition .

In this specification the terms "**principal contractor**" and "**contractor**" are replaced with "**Contractor**" and "**subcontractor**" respectively.

For the purpose of this contract the **Contractor** will, in terms of OHSA 1993, be the mandatory, without derogating from his status as an employer in his own right.

- (c) "**Engineer**" where used in this specification, means the Engineer as defined in the FIDIC Yellow Book 2017 Edition . In terms of the Construction Regulations the Engineer may act as agent on behalf of the Employer (the client as defined in the Construction Regulations).

POHS.3 TENDERS

The Contractor shall submit the following with his tender:

- (a) a draft Health and Safety Plan as stipulated in Regulation 5 of the Construction Regulations. The Safety Plan must be based on the Construction Regulations 2003 and will be subject to approval by the Employer;
- (b) a declaration to the effect that he has the competence and necessary resources to carry out the work safely in compliance with the Construction Regulations 2003;
- (c) a declaration to the effect that he made provision in his tender for the cost of the health and safety measures envisaged in the Construction Regulations.
- (d) Failure to submit the foregoing with his tender, will lead to the conclusion that the Contractor will not be able to carry out the work under the contract safely in accordance with the Construction Regulations.

POHS.4 NOTIFICATION OF COMMENCEMENT OF CONSTRUCTION WORK

After award of the contract, but before commencement of construction work, the Contractor shall, in terms of Regulation 3, notify the Provincial Director of the Department of Labour in writing if the following work is involved:

- (a) the demolition of structures and dismantling of fixed plant of height of 3,0m or more;
- (b) the use of explosives;
- (c) construction work that will exceed 30 days or 300 person-days;
- (e) excavation work deeper than 1,0m; or
- (f) working at a height greater than 3,0m above ground or landings.

The notification must be done in the form of the pro forma included under Section 9 (Forms to be completed by Successful Tenderer) of the tender document.

A copy of the notification form must be kept on site, available for inspection by inspectors, Employer, Engineer, employees and persons on site.

POHS.5 RISK ASSESSMENT and SAFETY PLAN

5.1 Risk assessment

Before commencement of any construction work during the construction period, the Contractor shall have a risk assessment performed and recorded in writing by a competent person. (Refer Regulation 7 of the Construction Regulations 2003).

The risk assessment shall identify and evaluate the risks and hazards that may be expected during the execution of the work under the contract, and it shall include a documented plan of safe work procedures to mitigate, reduce or control the risks and hazards identified.

The risk assessment shall be available on site for inspection by inspectors, Employer, Engineer, subcontractors, employees, trade unions and health and safety committee members, and must be monitored and reviewed periodically by the Contractor.

6.1 Safety Plan

The Safety Plan will be compiled in order to amongst others address the finding made during the Risk Assessment phase. The Safety plan will be compiled and submitted to the Engineer and Client for

Approval. Construction work can only commence upon written approval of the Safety Plan by the Client.

POHS.6 APPOINTMENT OF EMPLOYEES AND SUBCONTRACTORS

6.1 Health and Safety plan

The Contractor shall appoint his employees and any subcontractors to be employed on the contract, in writing, and he shall provide them with a copy of his documented Health and Safety Plan, or relevant sections thereof. The Contractor shall ensure that all subcontractors and employees are committed to the implementation of his Safety Plan.

6.2 Health and safety induction training

The Contractor shall ensure that all employees under his control, including subcontractors and their employees, undergo a health and safety induction training course by a competent person before commencement of construction work. No visitor or other person shall be allowed or permitted to enter the site of the works unless such person has undergone health and safety training pertaining to hazards prevalent on site.

The Contractor shall ensure that every employee on site shall at all times be in possession of proof of the health and safety induction training issued by a competent person prior to commencement of construction work.

POHS.7 APPOINTMENT OF SAFETY PERSONNEL

7.1 Construction Supervisor

The Contractor shall appoint a full-time **Construction Supervisor** with the duty of supervising the performance of the construction work.

He may also have to appoint one or more competent employees to assist the construction supervisor where justified by the scope and complexity of the works.

7.2 Construction safety officer

Taking into consideration the size of the project and the hazards or dangers that can be expected, the Contractor shall appoint in writing a full-time or part-time **Construction Safety Officer** if so decided by the Inspector of the Department of Labour. The Safety Officer shall have the necessary competence and resources to perform his duties diligently.

Provision shall be made by the Contractor in his rates, to cover the cost of this dedicated construction safety officer appointed after award of the contract.

7.3 Health and safety representatives

In terms of **Section 17 and 18 of the Act (OHSA 1993)** the Contractor, being the employer in terms of the Act for the execution of the contract, shall appoint a **health and safety representative** whenever he has more than 20 employees in his employment on the site of the works. The health and safety representative must be selected from employees who are employed in a full-time capacity at a specific workplace.

The number of health and safety representatives for a workplace shall be at least one for every 100 employees.

The function of health and safety representative(s) will be to review the effectiveness of health and safety measures, to identify potential hazards and major incidents, to examine causes of incidents (in collaboration with his employer, the Contractor), to investigate complaints by employees relating to health and safety at work, to make representations to the employer (Contractor) or inspector on general matters affecting the health and safety of employees, to inspect the workplace, plant, machinery etc. on a regular base, to participate in consultations with inspectors and to attend meetings of the health and safety committee.

7.4 Health and safety committee

In terms of Sections **17 and 18 of the Act (OHSA 1993)** the Contractor (as employer), shall establish one or more **health and safety committee(s)** where there are two or more health and safety representatives at a workplace. The persons selected by the Contractor to serve on the committee shall be designated in writing.

The function of the health and safety committee shall be to hold meetings at regular intervals, but at least once every three months, to review the health and safety measures on the contract, to discuss incidents related to health and safety with the Contractor and the inspector, and to make recommendations regarding health and safety to the Contractor and to keep record of recommendations and reports made by the committee.

7.5 Competent persons

In accordance with the Construction Regulations the Contractor has to appoint in writing **competent persons** responsible for supervising construction work on each of the following work situations that may be expected on the site of the works.

- (a) Risk assessment and induction training as described in Regulation 7 of the Construction Regulations;
- (b) Fall protection as described in Regulation 8;
- (c) Formwork and support work as described in Regulation 10;
- (f) Excavation work as described in Regulation 11;
- (g) Demolition work as described in Regulation 12;
- (h) Scaffolding work as described in Regulation 14;
- (i) Suspended platform operations as described in Regulation 15;
- (j) Material hoists as described in Regulation 17;
- (k) Batch plant operations as described in Regulation 18;
- (l) Explosive powered tools as described in Regulation 19;
- (m) Cranes as described in Regulation 20;
- (n) Construction vehicle and mobile plant inspections on a daily basis by a competent person as described in Regulation 21(1);
- (o) Control of all temporary electrical installation on the construction site as described in Regulation 22;
- (p) Stacking and storage on construction sites as described in Regulation 26; and
- (q) Inspections of fire equipment as described in Regulation 27.

A competent person may be appointed for more than one part of the construction work with the understanding that the person must be suitably qualified and able to supervise at the same time the construction work on all the work situations for which he has been appointed.

The appointment of competent persons to supervise parts of the construction work does not relieve the Contractor from any of his responsibilities to comply with **all** requirements of the Construction Regulations.

POHS.8 RECORDS AND REGISTERS

In accordance with the Construction Regulations the Contractor is bound to keep records and registers related to health and safety on site for periodic inspection by inspectors, the Engineer, the Employer, trade union officials and subcontractors and employees. The following records and registers must be kept on site and shall be available for inspection at all times.

- (a) A copy of the OHSA 1993 Construction Regulations 2003;
- (b) A copy of this Health and Safety Specification;
- (c) A copy of the Contractor's Health and Safety Plan (Regulation 4);
- (d) A copy of the Notification of Construction Work (Regulation 3);
- (e) A health and safety file in terms of Regulation 5(7) with inputs by the Construction Safety Officer (Regulation 6(7));
- (f) A copy of the risk assessment described in Regulation 7;
- (g) A full protection plan and the corresponding records of evaluation and training of employees working from elevated positions as described in Regulation 8;
- (h) Drawings pertaining to the design of structures (Regulation 9(3)) and formwork and support work structures (Regulation 10(d)) must be kept on site;
- (i) Pronouncement of the safety of excavations must be recorded in a register to be kept on site (Regulation 11(3)(h));
- (j) A copy of the certificate of the system design for suspended platforms (Regulation 15(3));
- (k) A notice must be affixed around the base towers of material hoists to indicate the maximum mass load, which may be carried at any one time by material hoists (Regulation 7(5));
- (l) Maintenance records of material hoists and inspection results must be kept in a record book to be kept on site (Regulation 17(8));
- (m) A record of any repairs to or maintenance of a batch plant must be kept on site (Regulations 18(9));
- (n) A warning notice must be displayed in a conspicuous manner when and wherever an explosive powered tool is used (Regulation 19(2));
- (o) A register for recording of findings by the competent person appointed to inspect construction vehicles and mobile plant (Regulation 21(1)(j)).

POHS.9 CONTRACTORS RESPONSIBILITIES

For this contract the Contractor will be the mandatory of the Employer (Client), as defined in the Act (OHSA 1993), which means that the Contractor has the status of employer in his own right in respect of the contract. The Contractor is therefore responsible for all the duties and obligations of an employer as set out in the Act (OHSA 1993) and the Construction Regulations 2003.

Before commencement of work under the contract, the Contractor shall enter into an agreement with the Employer (Client) to confirm his status as mandatory (employer) for the contract under consideration.

The Contractor's duties and responsibilities are clearly set out in the Construction Regulations 2003, and are not repeated in detail but some important aspects are highlighted hereafter, without relieving the Contractor of any of his duties and responsibilities in terms of the Construction Regulations.

(a) Contractor's position in relation to the Employer (Client) (Regulation 4)

In accordance with Section 4 of the Regulations, the Contractor shall liaise closely with the Employer or the Engineer on behalf of the Employer, to ensure that all requirements of the Act and the Regulations are met and complied with.

(b) The Principal Contractor and Contractor (Regulation 5)

The Contractor is in terms of the definition in Regulation 2(b) the equivalent of Principle Contractor as defined in the Construction Regulations, and he shall comply with all the provisions of Regulation 5.

Any subcontractors employed by the Contractor must be appointed in writing, setting out the terms of the appointment in respect of health and safety. An independent subcontractor shall however provide and demonstrate to the Contractor a suitable, acceptable and sufficiently

documented health and safety plan before commencement of the subcontract. In the absence of such a health and safety plan the subcontractor shall undertake in writing that he will comply with the Contractor's safety plan, the health and safety specifications of the Employer and the Construction Regulations 2003.

(c) Supervision of construction work (Regulation 6)

The Contractor shall appoint the safety and other personnel and employees as required in terms of Regulation 6 and as set out in paragraph 7 above. Appointment of those personnel and employees does not relieve the Contractor from any of the obligations under Regulation 6.

(d) Risk assessment (Regulation 7)

The Contractor shall have the risk assessment made as set out in paragraph 7 above before commencement of the work and it must be available on site for inspection at all times. The Contractor shall consult with the health and safety committee or health and safety representative(s) etc. on a regular basis to ensure that all employees, including subcontractors under his control, are informed and trained by a competent person regarding health hazards and related work procedures.

No subcontractor, employee or visitor shall be allowed to enter the site of works without prior health and safety induction training, all as specified in Regulation 7.

(e) Fall protection (Regulation 8)

Fall protection, if applicable to this contract shall comply in all respects with Regulation 8 of the Construction Regulations.

(f) Structures (Regulation 9)

The Contractor will be liable for all claims arising from collapse or failure of structures if he failed to comply with all the specifications, project specifications and drawings related to the structures, unless it can be proved that such collapse or failure can be attributed to faulty design or insufficient design standards on which the specifications and the drawings are based.

In addition the Contractor shall comply with all aspects of Regulation 9 of the Construction Regulations.

(g) Formwork and support work (Regulation 10)

The Contractor will be responsible for the adequate design of all formwork and support structures by a competent person.

All drawings pertaining to formwork shall be kept on site and all equipment and materials used in formwork, shall be carefully examined and checked for suitability by a competent person.

The provisions of Regulation 10 of the Construction Regulations shall be followed in every detail.

(h) Excavation work (Regulation 11)

It is essential that the Contractor shall follow the instructions and precautions in the Standard Specifications and Project Specifications as well as the provisions of the Construction Regulations to the letter as unsafe excavations can be a major hazard on any construction site. The Contractor shall therefore ensure that all excavation work is carried out under the supervision of a competent person, that inspections are carried out by a Professional Engineer or Technologist, and that all work is done in such a manner that no hazards are created by unsafe excavations and working conditions.

Supervision by a competent person will not relieve the Contractor from any of his duties and responsibilities under Regulation 11 of the Construction Regulations.

(i) Demolition work (Regulation 12)

Whenever demolition work is included in a contract, the Contractor shall comply with all the requirements of Regulation 12 of the Construction Regulations. The fact that a competent person has to be appointed by the Contractor does not relieve the Contractor from any of his responsibilities in respect of safety of demolition work.

(j) Tunneling (Regulation 13)

The Contractor shall comply with Regulation 13 wherever tunneling of any kind is involved.

(k) Scaffolding (Regulation 14)

The Contractor shall ensure that all the provisions of Regulation 14 of the Construction Regulations are complied with. [Note: Reference in the Regulations to "Section 44 of the Act" should read "Section 43 of the Act"].

(l) Suspended platforms (Regulation 15)

Wherever suspended platforms will be necessary on any contract, the Contractor shall ensure that copies of the system design issued by a Professional Engineer are submitted to the Engineer for inspection and approval. The Contractor shall appoint competent persons as supervisors and competent scaffold erectors, operators and inspectors and ensure that all work related to suspended platforms are done in accordance with Regulation 15 of the Construction Regulations.

(m) Boatswain's chains (Regulation 16)

Where boatswain's chains are required on the construction site, the Contractor shall comply with Regulation 16.

(n) Material Hoists (Regulation 17)

Wherever applicable, the Contractor shall comply with the provisions of Regulation 17 to the letter.

(o) Batch plants (Regulation 18)

Wherever applicable, the Contractor shall ensure that all lifting machines, lifting tackle, conveyors, etc. used in the operation of a batch plant shall comply with, and that all operators, supervisors and employees are strictly held to the provisions of Regulation 18. The Contractor shall ensure that the General Safety Regulations (Government Notice R1031 of 30 May 1986), the Driven Machinery Regulations (Government Notice R295 of 26/2/1988) and the Electrical Installation Regulations (Government Notice R2271 of 11/10/1995) are adhered to by all involved.

In terms of the Regulations, records of repairs and maintenance shall be kept on site.

(p) Explosive powered tools (Regulation 19)

The Contractor shall ensure that, wherever explosive-powered tools are required to be used, all safety provisions of Regulation 19 are complied with.

It is especially important that warning notices are displayed and that the issue and return of cartridges and spent cartridges be recorded in a register to be kept on site.

(q) Cranes (Regulation 20)

Wherever the use of tower cranes becomes necessary, the provisions of Regulation 20 shall be complied with.

(r) Construction vehicles And mobile plant (Regulation 21)

The Contractor shall ensure that all construction vehicles and plant are in good working condition and safe for use, and that they are used in accordance with their design and intended use. The vehicles and plant shall only be operated by workers or operators who have received appropriate training, all in accordance with all the requirements of Regulation 21.

All vehicles and plant must be inspected on a daily basis, prior to use, by a competent person and the findings must be recorded in a register to be kept on site.

(s) Electrical installation and machinery on construction sites (Regulation 22)

The Contractor shall comply with the Electrical Installation Regulations (Government Notice R2920 of 23 October 1992) and the Electrical Machinery Regulations (Government Notice R1953 of 12 August 1993). Before commencement of construction, the Contractor shall take adequate steps to ascertain the presence of, and guard against dangers and hazards due to electrical cables and apparatus under, over or on the site.

All temporary electrical installations on the site shall be under the control of a competent person, without relieving the Contractor of his responsibility for the health and safety of all workers and persons on site in terms of Regulation 22.

(t) Use of temporary storage of flammable liquids on construction sites (Regulation 23)

The Contractor shall comply with the provisions of the General Safety Regulations (Government Notice R1031 of 30 May 1986) and all the provisions of Regulation 23 of the Construction Regulations to ensure a safe and hazard-free environment to all workers and other persons on site.

(u) Water environments (Regulation 24)

Where construction work is done over or in close proximity to water, the provisions of Regulation 24 shall apply.

(v) Housekeeping on Construction sites (Regulation 25)

Housekeeping on all construction sites shall be in accordance with the provisions of the environment Regulations for workplaces (Government Notice R2281 of 16 October 1987) and all the provisions of Regulation 25 of the Construction Regulations.

(w) Stacking and storage on construction sites (Regulation 26)

The provisions for the stacking of articles contained in the General Safety Regulations (Government Notice R1031 of 30 May 1986) as well as all the provisions Regulation 26 of the Construction Regulations shall apply.

(x) Fire precautions on construction sites (Regulation 27)

The provisions of the Environmental Regulations for Workplaces (Government Notice R2281 of 16 October 1987) shall apply.

In addition the necessary precautions shall be taken to prevent the incidence of fires, to provide adequate and sufficient fire protection equipment, sirens, escape routes etc. all in accordance with Regulation 27 of the Construction Regulations.

(y) Construction welfare facilities (Regulation 28)

The Contractor shall comply with the construction site provisions as in the Facilities Regulations (Government Notice R1593 of 12 August 1988) and the provisions of Regulation 28 of the Construction Regulations.

(z) Non-compliance with the Construction Regulations 2003

The foregoing is a summary of parts of the Construction Regulations applicable to all construction projects.

The Contractor, as employer for the execution of the contract, shall ensure that all provisions of the Construction Regulations applicable to the contract under consideration are complied with to the letter.

Should the Contractor fail to comply with the provisions of the Regulations 3 to 28 as listed in Regulation 30, he will be guilty of an offence and will be liable, upon conviction, to the fines or imprisonment as set out in Regulation 30.

The Contractor is advised in his own interest to make a careful study of the Act and the Construction Regulations as ignorance of the Act and the Regulations will not be accepted in any proceedings related to non-conformance to the Act and the Regulations.

POHS.10 MEASUREMENT AND PAYMENT

10.1 Principles

It is a condition of this contract that Contractors, who submit tenders for this contract, shall make provision in their tenders for the cost of all health and safety measures during the construction process. All associated activities and expenditure are deemed to be included in the Contractor's tendered rates and prices.

(a) **Safety personnel**

The Construction Supervisor, the Construction Safety Officer, Health and Safety Representatives, Health and Safety Committee and Competent Persons referred to in clauses 7.1 to 7.5 shall be members of the Contractor's personnel, and no additional payment will be made for the appointment of such safety personnel.

(b) **Records and Registers**

The keeping of health and safety-related records and registers as described in 8 is regarded as a normal duty of the Contractor for which no additional payment will be considered, and which is deemed to be included in the Contractor's tendered rates and prices.

PG

GENERIC LABOUR-INTENSIVE SPECIFICATION

The Generic Labour-intensive specification below is the same as SANS 1921-5, Construction and management requirement for works contracts- Part 5: Earthworks activities which are to be performed by hand and should be included in the scope of works without amendment or modification as set out below.

PG1 SCOPE

This specification establishes general requirements for activities which are to be executed by hand involving the following:

- a) trenches having a depth of less than 1.5 metres
- b) stormwater drainage
- c) low-volume roads and sidewalks

PG2 PRECEDENCE

Where this specification is in conflict with any other standard or specification referred to in the Scope of Works to this Contract, the requirements of this specification shall prevail.

PG3 HAND EXCAVATEABLE MATERIAL

Hand excavateable material is material:

a) granular materials:

- i) whose consistency when profiled may in terms of table 1 be classified as very loose, loose, medium dense, or dense; or
- ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100mm;

b) cohesive materials:

- i) whose consistency when profiled may in terms of table 1 be classified as very soft, soft, firm, stiff and stiff / very stiff; or
- ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100mm;

Note:

- 1) A boulder, a cobble and gravel is material with a particle size greater than 200mm, between 60 and 200mm.
- 2) A dynamic cone penetrometer is an instrument used to measure the in-situ shear resistance of a soil comprising a drop weight of approximately 10 kg which falls through a height of 400mm and drives a cone having a maximum diameter of 20mm (cone angle of 60° with respect to the horizontal) into the material being used.

Table 1: Consistency of materials when profiled

GRANULAR MATERIALS		COHESIVE MATERIALS	
CONSISTENCY	DESCRIPTION	CONSISTENCY	DESCRIPTION
Very loose	Crumbles very easily when scraped with a geological pick.	Very soft	Geological pick head can easily be pushed in as far as the shaft of the handle.
Loose	Small resistance to penetration by sharp end of a geological pick.	Soft	Easily dented by thumb; sharp end of a geological pick can be pushed in 30-40 mm; can be moulded by fingers with some pressure.
Medium dense		Firm	Indented by thumb with effort; sharp end of geological pick can be pushed

GRANULAR MATERIALS		COHESIVE MATERIALS	
CONSISTENCY	DESCRIPTION	CONSISTENCY	DESCRIPTION
	Considerable resistance to penetration by sharp end of a geological pick.		in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.
Dense	Very high resistance to penetration by the sharp end of geological pick; requires many blows for excavation.	Stiff	Can be indented by thumbnail; slight indentation produced by pushing geological pick point into soil; cannot be moulded by fingers.
Very dense	High resistance to repeated blows of a geological pick.	Very stiff	Indented by thumbnail with difficulty; slight indentation produced by blow of a geological pick point.

PG4 TRENCH EXCAVATION

All hand excavate-able material in trenches having a depth of less than 1,5 metres shall be excavated by hand.

PG5 COMPACTION OF BACKFILLING TO TRENCHES (AREAS NOT SUBJECT TO TRAFFIC)

Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100mm. Each layer shall be compacted using hand stampers

- a) to 90% Proctor density;
- b) such that in excess of 5 blows of a dynamic cone penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that backfill does not comprise more than 10% gravel of size less than 10mm and contains no isolated boulders, or
- c) such that the density of the compacted trench backfill is not less than that of the surrounding undisturbed soil when tested comparatively with a DCP.

PG6 EXCAVATION

All hand excavate-able material including topsoil classified as hand excavate-able shall be excavated by hand. Harder material may be loosened by mechanical means prior to excavation by hand.

The excavation of any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

PG7 CLEARING AND GRUBBING

Grass and small bushes shall be cleared by hand.

PG8 SHAPING

All shaping shall be undertaken by hand.

PG9 LOADING

All loading shall be done by hand, regardless of the method of haulage.

PG10 HAUL

Excavation material shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150 m.

PG11 OFFLOADING

All material, however transported, is to be off-loaded by hand, unless tipper-trucks are utilised for haulage

PG12 SPREADING

All material shall be spread by hand.

PG13 COMPACTION

Small areas may be compacted by hand provided that the specified compaction is achieved.

PG14 GRASSING

All grassing shall be undertaken by sprigging, sodding, or seeding by hand.

PG15 STONE PITCHING AND RUBBLE CONCRETE MASONRY

All stone required for stone pitching and rubble concrete masonry, whether grouted or dry, must be collected, loaded, off loaded and placed by hand.

Sand and stone shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150m.

Grout shall be mixed and placed by hand.

PG16 MANUFACTURED ELEMENTS

Elements manufactured or designed by the Contractor, such as manhole rings and cover slabs, precast concrete planks and pipes, masonry units and edge beams shall not individually, have a mass of more than 320kg. In addition, the items shall be large enough so that four workers can conveniently and simultaneously acquire a proper hand hold on them.

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C3.3.6 PARTICULAR SPECIFICATIONS – MECHANICAL

Particular Specifications: Mechanical Work

The Particular Specification is set out in two parts. The purpose of each of the two parts is as follows:

Part A : This part of the specification provides standard specifications for the equipment and services required for this project. The standard specifications detail the requirements to be complied with and the inspections and testing to be done in order to verify compliance with these specifications. Each standard specification also details the items, which form the basis for payment as reflected in the bill of quantities.

Part B : This part of the specification provides the detail of the equipment and services required for this project. The detail specification may also include descriptions of items, which form the basis for payment in the bill of quantities.

Parts A and B of this Mechanical Specification constitute the Employer's Requirements with respect to the Mechanical Works.

The standard specifications (Part A) covers the general, administrative, legal and organisational requirements and general technical requirements relating to the quality of Materials, construction, testing, commissioning and maintenance of the construction applicable to this contract.

Please refer to Particular specification C3.1: Description of Works for a general overview of the project and a description of the site conditions. In particular refer to Clause C3.1.5 for the site climatic conditions.

Part A: Standard Specification

SECTION 1:	CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS (FIDIC 2017)	468
SECTION 2:	CONTRACTOR'S ESTABLISHMENT ON SITE.....	479
SECTION 3:	GENERAL DESIGN.....	481
SECTION 4:	TESTING AND COMMISSIONING	486
SECTION 5:	CORROSION PROTECTION.....	487
SECTION 6:	ELECTRIC MOTORS	529
SECTION 7:	STRUCTURAL METALWORK	535
SECTION 8:	PIPEWORK	546
SECTION 9:	FLOW CONTROL VALVES AND SLUICE GATES.....	566
SECTION 10:	POWER TRANSMISSION COUPLINGS	572
SECTION 11:	GEARBOXES	575
SECTION 12:	EQUIPMENT FOR THE MEASUREMENT OF FLUID/FLOW PROPERTIES	579
SECTION 13:	DRY-WELL PUMPING	581
SECTION 14:	HOISTING EQUIPMENT.....	590
SECTION 15:	SUBMERSIBLE PUMPING EQUIPMENT.....	599
SECTION 16:	MECHANICAL FRONT-RAKED SCREEN.....	604
SECTION 17:	MANUALLY CLEANED SCREENS.....	611
SECTION 18:	SURFACE MOUNTED MECHANICAL MIXERS AND AERATORS	615
SECTION 19:	BAFFLES, WEIRS AND OTHER SPECIALLY FABRICATED DEVICES	620
SECTION 20:	MECHANICALLY SCRAPED SETTLING TANKS.....	625
SECTION 21:	GAS CHLORINATION EQUIPMENT	632
SECTION 22:	COMPRESSORS AND BLOWERS.....	642
SECTION 23:	MECHANICALLY CLEANED MICRO CHANNEL SCREEN	648
SECTION 24:	MECHANICAL DEGRITTER SYSTEMS	654
SECTION 25:	SCREENINGS HANDLING EQUIPMENT.....	662
SECTION 26:	DIFFUSED AERATION EQUIPMENT.....	670
SECTION 27:	CHEMICAL DOSING PLANT	687
SECTION 28:	LINEAR SCREENS AND BELT FILTER PRESSES	698
SECTION 29:	MEASURING INSTRUMENTS.....	709
SECTION 30:	PROPELLER PUMPING EQUIPMENT.....	724
SECTION 31:	PARSHALL FLUME.....	730

SECTION 32: INSTALLATION, ERECTION AND FIXING OF EQUIPMENT TO CONCRETE STRUCTURES
739

SECTION 1: CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS (FIDIC 2017)

CONTENTS

1.1	SCOPE	469
1.2	STANDARDS AND LEGISLATION	469
1.3	RESPONSIBLE PERSON	470
1.4	SAFETY	470
1.5	QUALITY	470
1.6	QUALITY MANAGEMENT SYSTEM AND COMPLIANCE VERIFICATION SYSTEM	471
1.7	NO-OBJECTION/CONSENT OF CONTRACTOR'S DOCUMENTS, MATERIALS AND PLANT	471
1.8	CONSTRUCTION PROGRAMME	472
1.9	SETTING OUT OF WORKS	472
1.10	SUBCONTRACTOR'S SITE REPRESENTATIVE	472
1.11	MEETINGS	473
1.12	SUBCONTRACTORS	473
1.13	HANDLING AND STORAGE OF PLANT	473
1.14	PRE-COMMISSIONING TESTING	473
1.15	INSPECTIONS	474
1.16	COMMISSIONING PERIOD AND COMMISSIONING TESTING	474
1.17	TAKING OVER	474
1.18	AS-BUILT RECORDS	474
1.19	OPERATION AND MAINTENANCE MANUALS	474
1.20	SPARES	474
1.21	MEASUREMENT AND PAYMENT	474

1.1 SCOPE

This standard specification covers the general, administrative, legal and organisational requirements and general technical requirements relating to the quality of Materials, construction, testing, commissioning and maintenance of the construction applicable to this contract.

1.2 STANDARDS AND LEGISLATION

1.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[1] Republic of South Africa - Act No 85 of 1993 and the Regulations promulgated in terms of the Act	Occupational Health and Safety Act In areas of jurisdiction where this act is not applicable the local equivalent Act shall apply. In the absence of a local equivalent Act – the provisions and regulations promulgated in terms of this act shall apply
[2] SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
[3] SANS 1186-1	Symbolic safety signs Part 1: Standard signs and general requirements
[4] SANS/ISO 9001	Quality Management Systems - Requirements

1.2.2 Standard Specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[5] STD-LRM-GN-0005	Testing and Commissioning
[6] SANS 1200 A	General (1986)
[7] SANS 1200 AB	Engineer's office (1986)

For avoidance of doubt, the SANS1200 A and AB standard specifications, and the particular specifications thereto as provided in Part C3.3 of this Contract, are also applicable.

1.2.3 Relevant Acts, Regulations and Standards

The entire construction shall comply with, and the work shall be executed in accordance with the latest editions of the following:

- a) The Occupational Health and Safety Act, 1993 (Act No 85 of 1993) **Error! Reference source not found.** and the regulations promulgated in terms of the Act.
- b) The Code of Practice for the Wiring of Premises [2] SANS 10142-1, with the latest amendments, issued by the South African Bureau of Standards (SABS).
- c) The regulations and bylaws of the local supply authorities.
- d) The applicable regulations of the relevant telecommunication authority.
- e) The local Fire Department Regulations.
- f) The relevant SANS, BS and IEC and ISO supporting specifications referred to in the standard specifications.

1.2.4 Terms and Definitions

- a) Please note the definitions of Plant, Materials, Contractor's Equipment and other defined terms in the FIDIC 2017 Conditions of Contract Sub-Clause 1.1.

- b) All references to the 'Contractor' in this Specification shall apply equally to any mechanical Subcontractor appointed by the Contractor, or to any mechanical contractor forming part of a Joint Venture.
- c) When considering the meaning of the word 'equipment' in this Specification, the context of the word shall be taken into account in determining whether the word refers to the contractual terms of Plant or Contractor's Equipment or neither. Similarly, the context of the word 'labour' shall be taken into account in determining whether the word refers to the contractual term of Contractor's Personnel, Employer's Personnel or neither. Similarly, the context of the word 'materials' shall be taken into account in determining whether the word refers to the contractual terms of Materials or Plant or neither.

1.3 RESPONSIBLE PERSON

The Contractor shall, before establishing on site, appoint and submit to the Engineer in writing the name(s) of the person(s) who is/are the responsible person(s) for the Occupational Health and Safety (OHS) of the project, in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) **Error! Reference source not found.** and the regulations promulgated in terms of the Act within 14 days from being appointed.

1.4 SAFETY

- a) Refer to Clause 22 of the Special Provisions of the Particular Conditions of Contract in Part C1.2.3 of the Contract, and the OHS Specification in Part C5.3 of the Contract, for Occupational Health and Safety obligations and requirements that are applicable to the Contract.
- b) Furthermore, the Contractor shall be responsible for supplying and installing the required safety signs as determined by the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) **Error! Reference source not found.**; and the regulations promulgated in terms of the Act or Factories, Machinery and Building Works Act, whichever is applicable. This needs to be carried out during the construction phase and for the completed works.
- c) All safety signs shall comply with the requirements of the latest edition of SANS 1186-1 [3] as applicable.

1.5 QUALITY

1.5.1 Material and Plant

- a) All Materials and Plant shall conform in respect of quality, manufacture, tests and performance, with the relevant requirements of the South African Bureau of Standards; or where no such standards exist, with the relevant current specification of the British Standards Institution; and/or relevant IEC; and/or ISO publications.
- b) All Materials and Plant shall be suitable for the conditions on site. These conditions shall include weather conditions and conditions under which Materials are installed, stored and used. Should the Materials not be suitable for use under temporary site conditions, then the Contractor shall at his own cost provide suitable protection until these unfavourable site conditions cease to exist.
- c) The Contractor shall, where requested to do so, submit samples of Plant and Materials to the Engineer for approval prior to the construction. The Engineer may retain these samples until the Contract is completed after which they will be returned.

1.5.2 Proprietary Materials

Where proprietary Materials are specified, it is to indicate the quality or type of Materials or articles required, and where the terms "or other approved" or "or approved equivalent" are used in connection with the proprietary Materials or articles. The approval shall be at the sole discretion of the Engineer after the appropriate samples have been submitted to the Engineer for his evaluation.

1.5.3 Voltage Rating of Appliances and Plant

The voltage rating of all appliances and Plant to be installed shall be in accordance with the nominal supply voltage of the supply authority except where otherwise stated in the detailed specification.

1.6 QUALITY MANAGEMENT SYSTEM AND COMPLIANCE VERIFICATION SYSTEM

- a) The Contractor shall implement a Quality Management (QM) System and a Compliance Verification System, in accordance with Clause 4.9 of the Conditions of Contract, to ensure adequate control of the total construction process. This includes those off-site activities that impact on the quality of the final constructed product. The QM System shall comply with the requirements of ISO9001.
- b) Before commencing with any procurement or construction work, the Contractor shall submit the updated QM and Compliance Verification Systems to the Engineer with the details of the quality management system.
- c) The QM and Compliance Verification Systems shall include a procedure for the nomination by the Contractor and acceptance by the Engineer of the names of the Contractor's management representative and quality auditor who are responsible for management and audit of the mechanical aspects of the QM and Compliance Verification Systems. When nominating such persons, the Contractor shall attached CVs, and the staff nominated shall be competent and sufficiently experienced to undertake these roles.
- d) The Contractor shall train staff in the requirements of the system to ensure that it is entrenched and being worked to.
- e) The Contractor shall ensure audit of all aspects of the system by a suitably experienced quality auditor to verify the successful entrenchment of the system.

1.7 NO-OBJECTION/CONSENT OF CONTRACTOR'S DOCUMENTS, MATERIALS AND PLANT

1.7.1 Engineer's Drawings and Specifications

- a) The Drawings prepared by the Engineer show the general layout of all Plant and systems, complete with schematic arrangements. These, together with the Specification, give sufficient information to enable the Contractor to estimate the cost and to determine how the system must be constructed, tested, inspected, operated, serviced and maintained.
- b) These Drawings are not dimensioned construction drawings and shall not be used as construction or shop drawings. Location dimensions shown are only indicative of the routes and zones in which the service shall be constructed.

1.7.2 Contractor's Documents

- a) Refer to Conditions of Contract Sub-Clause 4.1 and 4.4 for conditions, requirements and procedures related to Contractor's Documents. The following point b) elaborates on these conditions, requirements and procedures.
- b) Preparation and submission of drawings and Plant specifications
 - i) Drawings and Plant specifications (e.g. brochures and catalogues) of all Plant to be manufactured and installed shall be submitted to the Engineer for Review in the following formats and media:
 - (1) one paper print copy;
 - (2) one external hard drive with software copies in .pdf (portable document format) and native format.

These drawings shall indicate all Plant, distribution systems, instrumentation positions and access requirements.
 - ii) The Contractor shall review, stamp, date and sign to signify his approval prior to submission to the Engineer; and submit in the manner required by the Engineer, and with reasonable promptness and in an orderly sequence so as to cause no delay in the work. Contractor drawings shall be properly identified.
 - iii) By submitting drawings, Plant specifications and samples, the Contractor signifies that he has determined and verified all site measurements, site instruction criteria, Materials, catalogue numbers and similar data, or will do so. Furthermore, he needs to have checked and co-ordinated each Contractor's drawing and sample with the requirements of the works and of the Contract.
 - iv) At the time of submission, the Contractor shall inform the Engineer in writing of any deviation in the Contractor drawings or samples from the requirements of the Contract.

- v) The Contractor may, if he so desires, purchase software copies of the Engineer's Drawings in native format for modifications and updating if required. These drawings shall be retitled in accordance with the Contractors system and can thereafter be submitted as the Contractor's Documents.
- vi) The Engineer's No-objection of a separate item shall not indicate No-objection of an assembly in which the item functions.
- vii) After receiving a Notice under Conditions of Contract Sub-Clause 4.1 (ii), the Contractor shall revise the Contractor's Document and resubmit in the formats and media as stated in 1.7.2 b) i). When re-submitting drawings, the Contractor shall specifically direct the Engineer's attention (in writing) to revisions other than corrections that were identified in the Engineer's Notice.
- viii) 'As-built' drawings shall be submitted on completion of each component and system in the following formats and media:
 - (1) four paper print copies;
 - (2) four external hard drives with software copies in .pdf (portable document format) and native format.
- ix) 'As-built' drawings shall show all modifications made during the construction, and further system diagrams indicating the intended functioning, capacity data and control functioning of all systems.

1.7.3 Samples of Materials

- a) With reference to Conditions of Contract Sub-Clause 7.2, the Contractor shall submit the following manufacturer's standard samples of Materials to the Engineer for consent prior to using the Materials in or for the Works:
 - i) All samples requested in the Specifications.
 - ii) Any samples instructed by the Engineer to be provided, but returned to the Contractor.

1.7.4 Compliance with national and international standards

For all Materials and Plant that are required to conform to any national or international specification or publication, the Contractor shall submit a certificate to the Engineer, issued by an accredited testing laboratory. It needs to clearly state that the Materials and/or Plant complies with the required specification or publication.

1.8 CONSTRUCTION PROGRAMME

Refer to Conditions of Contract Sub-Clause 8.3 for conditions, requirements and procedures related to the Programme.

1.9 SETTING OUT OF WORKS

The Contractor shall arrange for the setting out of the works by a qualified professional land surveyor.

Refer to Conditions of Contract Sub-Clause 4.7 for conditions, requirements and procedures related to setting out.

1.10 SUBCONTRACTOR'S SITE REPRESENTATIVE

- a) The Contractor shall advise the Engineer in writing of the name of the person the Contractor intends using to supervise the carrying out of the works on Site. This person shall be termed hereafter the 'Subcontractor's site representative'.
- b) The content of Conditions of Contract Sub-Clause 4.3 paragraphs two to six shall apply *mutatis mutandi* to the Subcontractor's site representative.
- c) The Engineer reserves the right to stop all work on site in the event of the site representative not being on site at all times; or if the approved site representative is removed from site without the Engineer's approval. Work shall not re-commence until this condition is complied with.

1.11 MEETINGS

The Subcontractor's site representative or the Contractor's authorised representative shall attend all meetings held by the Employer or Engineer on the Site that include agenda items relating to mechanical matters, at dates and times to be determined by the Engineer.

The Contractor shall attend monthly progress meetings in either Gauteng or on the Site from the Commencement Date of the Contract until Taking Over of the Whole-of-the-Works.

1.12 SUBCONTRACTORS

Refer to Conditions of Contract Clause 5 for conditions, requirements and procedures related to Subcontractors.

1.13 HANDLING AND STORAGE OF PLANT

- a) Payment items have been provided for the storage of Plant either on site or at a location determined by the Engineer. These items will only be applicable if the Engineer has confirmed in writing that the Plant is ready to be installed, but that the other work on site has not advanced sufficiently to enable the equipment to be installed.
- b) Facilities for extended storage at site for Plant may not always be available and the Contractor shall therefore make his own arrangements for any off-site storage which may be required for the Plant which becomes available before installation thereof can be commenced.
- c) The Plant stored on site shall be adequately protected and insured against damage resulting from weather, vandalism, theft, etc. This also applies to tools and Contractor's Equipment required for construction.
- d) The Engineer reserves the sole authority to determine when Plant is damaged and what remedial actions, if any, are required. If the damage is extensive, the Plant shall be rejected and removed from site. Previous payments can then be revoked until the Contractor has replaced all such Plant.
- e) The Contractor shall be responsible for the necessary maintenance of the Plant during the period of storage. For example, the maintenance of breathers, rotation of gearboxes, etc.
- f) All Plant, shall where necessary, be protected against the elements and corrosion.
- g) Payment under this item will be according to the volume of the Plant and shall be determined by measuring the largest dimensions of the width, depth and length, including the packing material, of the packed Plant.
- h) Should the Contractor claim payment of a portion of the value of some or all of the tools and Plant held in off-site stores, the items concerned must be clearly marked: 'The property of (name of the Employer)' and a certificate to this effect shall accompany the claim detailing the items and serial numbers included in the claim as well as the street address of the store where the tools are held. In addition, a certificate must also be furnished by the company with whom the tools and Plant has been insured in terms of the requirements of the Conditions of Contract. Herein it is certified that the tools and Plant for which the Contractor is claiming payment is fully covered by the insurance policy concerned while the tools and Plant is stored away from the site (street address of store to be stated).
- i) The tendered rate shall include for double handling of the Plant, all packing material, insurance, maintenance, repair work where such repair work is not claimed from the insurance, storage costs, corrosion protection, administrative costs, additional transport, etc.
- j) The volume of the Plant and the duration of storage (in months) shall be agreed on in writing by the Engineer and the Contractor before payment for storage will be made.

1.14 PRE-COMMISSIONING TESTING

Pre-commissioning testing, including factory acceptance testing and on-Site testing shall be executed in accordance with the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract.

1.15 INSPECTIONS

Inspections shall be executed in accordance with the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract.

1.16 COMMISSIONING PERIOD AND COMMISSIONING TESTING

Commissioning testing shall be executed in accordance with the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract.

1.17 TAKING OVER

Refer to Conditions of Contract Sub-Clause 10.1. and the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract..

1.18 AS-BUILT RECORDS

Refer to Conditions of Contract Sub-Clause 4.4.2 and the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract for requirements and procedures relating to as-built records.

1.19 OPERATION AND MAINTENANCE MANUALS

Refer to Conditions of Contract Sub-Clause 4.4.3 and the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract for requirements and procedures relating to operation and maintenance (O&M) manuals.

1.20 SPARES

One month before commissioning and handover of a system or functional unit, the Contractor shall submit a detail priced list of recommended spares and consumables required for the system. The list shall indicate which spares are consumable spares and which are strategic spares together with an expected monthly consumption.

1.21 MEASUREMENT AND PAYMENT

- a) The measurement and payment items in this section are provided to enable separation of the preliminary and general charges associated with the mechanical Works from the remainder of the preliminary and general charges in this Contract, to facilitate payment commensurate with the timing of effort associated with the mechanical Works. It is envisaged that these charges would be those associated with any mechanical Subcontractor appointed by the Contractor or to any mechanical contractor forming part of a Joint Venture.
- b) The measurement and payment clauses of SANS1200A shall be applicable to the measurement and payment items below. The content provided below should thus be read as particular clauses to the associated SANS1200A measurement and payment clauses.
- c) These measurement and payment items are applicable to the Construction Period only. Separate measurement and payment items for the Commissioning Period and Defects Notification Period are provided in the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract.

FIXED-CHARGE ITEMS:

Item	Description	Unit
1.21.1	Contractual Requirements (SANS1200A 8.3.1)	Lump sum

The unit of **measurement** shall be a lump sum.

The sum shall include full compensation for all fixed-charge requirements of this section of the Specification and all requirements of SANS1200 A (as amended) as applicable to the mechanical Works.

Payment for the lump sum tendered will be made in three instalments, as follows:

- 1) The first instalment, 30% of the lump sum, will be paid after the Contractor has placed orders for manufacture of 50% of the mechanical Plant by value.
- 2) The second instalment, 50% of the lump sum, will be paid when the value of mechanical work certified reaches 50% of the total tendered value of Part C [Mechanical] of the BoQ.
- 3) The third and final instalment, 20% of the lump sum, will be paid when the Taking-Over Certificate for Ready for Commissioning has been achieved.

Item	Description	Unit
1.21.2	Other Fixed-Charge Obligations (SANS1200A 8.3.3)	Lump sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all fixed-charge requirements of this section of the Specification and all fixed-charge requirements of SANS1200 A (as amended) as applicable to the mechanical Works, not already covered under Clause 1.20.1 above.

Payment for the lump sum tendered will be made in three instalments, as follows:

- 1) The first instalment, 30% of the lump sum, will be paid after the Contractor has placed orders for manufacture of 50% of the mechanical Plant by value.
- 2) The second instalment, 50% of the lump sum, will be paid when the value of mechanical work certified reaches 50% of the total tendered value of Part C [Mechanical] of the BoQ.
- 3) The third and final instalment, 20% of the lump sum, will be paid when the Taking-Over Certificate for Ready for Commissioning has been achieved.

TIME-RELATED ITEMS:

Item	Description	Unit
1.21.3	Contractual Requirements (SANS1200A 8.4.1)	Lump sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all such requirements as related to the mechanical Works, and all time-related charge requirements of this section of the Specification, as related to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the mechanical contractor has fully established on Site.

Item	Description	Unit

1.21.4	Supervision for Duration of Construction (SANS1200A 8.4.3)	Lump sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all such requirements as related to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the mechanical contractor has fully established on Site.

Item	Description	Unit

1.21.5	Company and Head Office Overhead Costs for the Duration of the Contract (SANS1200A 8.4.4)	Lump sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all such requirements as related to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the mechanical contractor has placed orders for manufacture of 50% of the mechanical Plant by value.

Item	Description	Unit

1.21.6	Other Time-related Obligations (SANS1200A 8.4.5)	Lump sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all such requirements as related to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the mechanical contractor has fully established on Site.

Item	Description	Unit

1.21.7	Storage of Plant where storage space is provided by:	
1.21.7.1	The Contractor	m ³ - month
1.21.7.2	The Employer	m ³ - month

The unit of measurement shall be the cubic metre - month.

The tendered rate for sub-item 1.21.7.1 shall include full compensation for all double handling of the Plant, all packing material, insurance, maintenance, repair work where such repair work is not claimed from the insurance, storage costs, corrosion protection, administrative costs, additional transport, etc of the Plant as specified.

The tendered rate for sub-item 1.21.7.2 shall include full compensation for all the obligations as described for sub-item 1.21.7.1 except that storage for the Plant will be supplied free of charge by the Employer.

PROVISIONAL SUMS:

Item	Description	Unit
1.21.8	Maintenance spares	Prov sum

The unit of measurement shall be a provisional sum.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The provisional sum shall provide for the acquisition at the sole discretion of the Employer of maintenance spares (as related to clause 1.20). The provisional sum does not include provision for overhead charges, profit and handling by the Contractor, which shall be measured separately under payment item 1.21.9 below. Payment shall be effected on actual invoiced amounts.

Item	Description	Unit
1.21.9	Charges and profit on maintenance spares	%

The unit of measurement shall be the % tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit **and handling of maintenance spares ordered under item 1.21.8 above.**

Item	Description	Unit
1.21.10	Additional samples of Materials kept by the Employer	Prov sum

The unit of measurement shall be a provisional sum.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The provisional sum shall provide for any additional samples instructed by the Engineer to be provided under Conditions of Contract Sub-Clause 7.2 (b), and not returned to the Contractor.

The provisional sum does not include provision for overhead charges, profit and handling by the Contractor, which shall be measured separately under payment item 1.21.11 below.

Payment shall be effected on actual invoiced amounts.

Item	Description	Unit
1.21.11	Charges and profit on Additional samples of Materials kept by the Employer	%

The unit of measurement shall be the % tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of item 1.21.10 above.

Item	Description	Unit
1.21.12	WWTW Operation and Maintenance	Prov sum

The unit of measurement shall be a provisional sum.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The provisional sum shall provide for the operation and maintenance of the entire BlackRock WasteWater Treatment Works for a period of 6 months. This provision is made for circumstances where the Employer is not yet ready or desirous to operate and maintain the WWTW at the time when the Taking Over Certificate for Whole-of-the-Works is issued. i.e. during the Defects Notification Period.

The inclusion (and possible execution) of this provisional sum does not in any way relieve the Contractor of his responsibilities detailed elsewhere in the Contract.

The provisional sum does not include provision for overhead charges, profit and handling by the Contractor, which shall be measured separately under payment item 1.21.13 below.

Payment shall be effected on actual invoiced amounts.

Item	Description	Unit
1.21.13	Charges and profit on WWTW Operation and Maintenance	%

The unit of measurement shall be the % tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of item 1.21.12 above. For avoidance of doubt, note that in the event of the provisional sum being instructed under Conditions of Contract Sub-Clause 13.4 (b), then the percentage under Sub-Clause 13.4 (b) (ii) is understood to include all the Contractor's preliminary and general costs associated with the execution of the provisional sum.

Item	Description	Unit
1.21.14	Shop Drawings	Prov sum

The unit of measurement shall be the % tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of item 1.21.14 above. For avoidance of doubt, note that in the event of the provisional sum being instructed under Conditions of Contract Sub-Clause 13.4 (b), then the percentage under Sub-Clause 13.4 (b) (ii) is understood to include all the Contractor's preliminary and general costs associated with the execution of the provisional sum.

Item	Description	Unit
1.21.15	Charges and profit on Shop Drawings	%

The unit of measurement shall be the % tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of item 1.21.15 above. For avoidance of doubt, note that in the event of the provisional sum being instructed under Conditions of Contract Sub-Clause 13.4 (b), then the percentage under Sub-Clause 13.4 (b) (ii) is understood to include all the Contractor's preliminary and general costs associated with the execution of the provisional sum.

SECTION 2: CONTRACTOR'S ESTABLISHMENT ON SITE

DOCUMENT NO.: STD- LRM-GN-0003

CONTENTS

2.1	SCOPE	ERROR! BOOKMARK NOT DEFINED.
2.2	APPLICABLE STANDARDS AND LEGISLATION	ERROR! BOOKMARK NOT DEFINED.
2.3	GENERAL REQUIREMENTS.....	ERROR! BOOKMARK NOT DEFINED.
2.4	MEASUREMENT AND PAYMENT	ERROR! BOOKMARK NOT DEFINED.

2.1 SCOPE

This specification covers, as related to the Works:

- a) all work and costs involved in the establishment of the Contractor's organisation, camp and plant on the site and the removal thereof; and
- b) Dayworks

2.2 APPLICABLE STANDARDS AND LEGISLATION

[8] C3.3.2.2 Particular Specification for Dayworks

2.3 GENERAL REQUIREMENTS

- a) The Contractor shall establish his facilities (and remove them thereafter) in accordance with SANS1200A (as amended).
- b) No additional requirements for facilities for the Engineer specific to the mechanical Works are applicable over and above those facilities already specified in SANS1200AB (as amended).
- c) Refer to Conditions of Contract Sub-Clause 13.5 and Particular Specification PB: Dayworks for specification of Dayworks.

2.4 MEASUREMENT AND PAYMENT

- a) The measurement and payment items in this section are provided to enable separation of the preliminary and general charges associated with the mechanical Works from the remainder of the preliminary and general charges in this Contract, to facilitate payment commensurate with the timing of effort associated with the mechanical Works. It is envisaged that these charges would be those associated with any mechanical Subcontractor appointed by the Contractor or to any mechanical contractor forming part of a Joint Venture.
- b) The measurement and payment clauses of SANS1200A shall be applicable to the measurement and payment items below. The content provided below should thus be read as particular clauses to the associated SANS1200A measurement and payment clauses.

FIXED-CHARGE ITEMS:

Item	Description	Unit
2.4.1	Establishment of facilities on the Site (SANS1200A 8.3.2)	Lump Sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all fixed-charge requirements of SANS1200 AB (as amended) as applicable to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.1.

Item	Description	Unit
2.4.2	Removal of Site Establishment (SANS1200A 8.3.4)	Lump Sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all fixed-charge requirements of SANS1200 AB (as amended) as applicable to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.1.

TIME-RELATED ITEMS:

Item	Description	Unit
2.4.3	Operation and Maintenance of Facilities on Site, for Duration of Construction (SANS1200A 8.4.2)	Lump Sum

The unit of measurement shall be a lump sum.

The sum shall include full compensation for all time-related requirements of SANS1200 AB (as amended) as applicable to the mechanical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the mechanical contractor has fully established on Site.

DAYWORKS:

Item	Description	Unit
2.4.4	Daywork - Labour	Hours
2.4.5	Daywork – Contractor's Equipment	Hours

Daywork shall be measured and paid in accordance with Conditions of Contract Sub-Clause 13.5 and Particular Specification PB: Dayworks.

SECTION 3: GENERAL DESIGN

DOCUMENT NO.: STD-LRM-GN-0004

CONTENTS

3.1	SCOPE	481
3.2	STANDARDS AND LEGISLATION	481
3.3	RELEVANT ACTS, REGULATIONS AND STANDARDS.....	482
3.4	DESIGN	482
3.5	QUALITY OF MATERIAL	482
3.6	INTERCHANGEABILITY	483
3.7	BOLTS AND NUTS.....	483
3.8	FIRE PRECAUTIONS.....	483
3.9	GALVANISING	483
3.10	WELDING	483
3.11	ELECTROMAGNETIC INTERFERENCE	484
3.12	LABELS AND NOTICES.....	484
3.13	CLEANING AND PAINTING	484
3.14	WATER AND DEBRIS ACCUMULATION	485
3.15	INSPECTION AND TESTS.....	485
3.16	MEASUREMENT AND PAYMENT	485

3.1 SCOPE

This standard specification covers general design criteria and standards applicable to all sections of work. Should the requirements of this standard specification be in conflict with any other standard specification or the detailed specification, the other standard specification or detailed specification shall govern; and the Tenderer/Contractor shall seek information of such precedence from the Engineer.

3.2 STANDARDS AND LEGISLATION

3.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[9] Republic of South Africa - Act No 85 and the Regulations promulgated in term of the Act	Occupational Health and Safety Act In areas of jurisdiction where this act is not applicable the local equivalent Act shall apply. In the absence of a local equivalent Act – the provisions and regulations promulgated in terms of this act shall apply.
[10] SANS 10142-1	The wiring of premises Part 1: Low-voltage installations.
[11] SANS 1700-7-3	Fasteners Part 7: External drive hexagon bolts and screws Section 3: Hexagon head bolts - Product grade C.
[12] SANS 1700-7-5	Fasteners Part 7: External drive hexagon bolts and screws Section 5: Hexagon head screws - Product grade C.
[13] SANS 1700-14-3	Fasteners Part 14: Hexagon nuts Section 3: Product grade C.

[14] SANS 1700-14-4	Fasteners Part 14: Hexagon nuts Section 4: Hexagon thin nuts (chamfered) - Product grades A and B.
[15] ANS 32/ EN 10240	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants.
[16] SANS 121/ ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles - specifications and test methods.
[17] IEC 61000 Parts 1 to 6	Electromagnetic compatibility (EMC).

3.2.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[18] STD-LRM-GN-0005	Testing and Commissioning

3.3 RELEVANT ACTS, REGULATIONS AND STANDARDS

- a) All electrical Plant shall be of an approved manufacturer and its construction, design and testing shall be in accordance with the requirements of the most recent South African National Standards, British Standards or IEC publications including all amendments issued thereto up to the date of tender.
- b) The installation of Plant shall also comply with the relevant clauses of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) [9] and the regulations promulgated in terms of the Act, and with the Code of Practice for The Wiring of Premises, SANS 10142-1 [10].
- c) Notwithstanding references in this specification to South African National Standards, British Standards, IEC or ISO standards, the supplier may submit for approval Materials and designs conforming to other technically equivalent national standards, provided that the supplier supplies the Engineer with a translation of the standards into English and satisfactory proof of actual compliance therewith.

3.4 DESIGN

- a) The works shall be designed to facilitate easy accessibility, Plant replacement, maintenance, handling, inspection cleaning and repairs and to ensure satisfactory operation in which safety of the Plant, personnel and public, and continuity of service is the first consideration.
- b) All tools, Plant and apparatus shall operate satisfactorily under the ambient and other conditions prevailing at the site.
- c) All apparatus shall be designed to prevent the risk of accidental short circuits due to animals, birds, ants and vermin.
- d) All moving, rubbing or wearing surfaces shall be machined or ground where they bear upon each other.
- e) The tools and Plant shall be designed and constructed to keep maintenance costs and the number of persons employed for maintenance to a minimum.
- f) All the Plant needs to approved by the Engineer and shall, unless otherwise specified, be suitably designed for operation on normal electrical supply systems, with voltage fluctuations of plus and minus 10%; and under such sudden variations of load and voltage as may be met with under working conditions.
- g) The design of Plant shall include as a major consideration the absolute safety of the general public, operating and maintenance personnel.
- h) All dimensions, units and design parameters shall be in accordance with the international metric (SI) system.

3.5 QUALITY OF MATERIAL

All Materials shall be new and of a design and class suitable for working under the conditions specified. It shall also withstand the variations of temperature and atmospheric conditions arising under working

conditions without distortion, deterioration, or the setting up of undue stresses in any part, such as to affect the efficiency and reliability of the Plant. Furthermore, conditions should not affect the strength and suitability of the various parts for the duty which they have to perform.

3.6 INTERCHANGEABILITY

Corresponding parts throughout the works shall be made to such close tolerances that all similar components and spares shall be fully interchangeable without any further alterations or adjustments being necessary.

3.7 BOLTS AND NUTS

- a) The threads of all bolts, nuts and studs shall be in accordance with SANS 1700-7-3 [11], 1700-7-5 [12], 1700-14-3 [13], 1700-14-4 [14] (in part).
- b) No brass bolt or stud shall have a diameter of less than 6 mm.
- c) All nuts and studs shall be locked in position by lock washers and where necessary, lock nuts.
- d) Each bolt shall protrude by at least one but not more than five threads through the nut with all washers in position.
- e) All bolts, nuts and washers used outdoors shall be of approved Materials and treated to prevent corrosion of the threads.
- f) The Contractor shall provide special tools if any bolt, nut, screw or other fastener is used in a position which is not accessible, using conventional tools. This also applies where the size or shape of the fastener is not conventional.

3.8 FIRE PRECAUTIONS

All apparatus, connections and cabling shall be designed and arranged to minimise the risk of fire and any damage, which might be caused in the event of fire.

3.9 GALVANISING

- a) Where galvanising is specified, or is a requirement of the design, such galvanising shall be performed by the hot-dip process to SANS 32/ EN 10240 [15] (in part) and SANS 121/ ISO 1461 [16].
- b) For all parts, other than wires, the equivalent zinc coating thickness shall not be less than 455 g of zinc per square metre of surface area.
- c) The galvanising must be clean, smooth, of uniform thickness, unblemished and free from defects.
- d) The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.
- e) All drilling, welding, cutting, sawing, punching, filing and bending shall be complete, and the metal shall be cleaned of any machining blemishes, mill scale, rust and lubricants, before galvanising.
- f) Galvanised areas must be kept free of lubricants. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.
- g) Electrolytic deposition of zinc is not acceptable.
- h) Where it is not practicable to coat the surface of metal by the hot-dip galvanising process, such Plant may be zinc-sprayed instead. The surface being zinc-sprayed shall be suitably prepared in accordance with the requirements of the process adopted and the rate of deposition of zinc shall not be less than 760 g per square metre of surface area. After zinc spraying, the surface shall be painted with a suitable paint to render it completely impervious.

3.10 WELDING

- a) The welding shall be executed in accordance with modern accepted practice for welding and shall be sound, full strength and free from undercut and slag inclusions. Crater effects at the ends of weld runs shall be eliminated.
- b) Intermittent welding and incomplete penetration butt-welding will not be accepted.
- c) All fabricated items shall be stress-relieved after welding.

- d) The supplier shall submit for approval details of proposed welding procedures, well in advance of the commencement of fabrication.

3.11 ELECTROMAGNETIC INTERFERENCE

- a) All Plant installed under this contract shall comply with the requirements of IEC 61000 Parts 1 to 6 [17] electromagnetic compatibility (EMC).
- b) Any Plant found producing electromagnetic emissions, in excess of the limits specified by IEC, subsequent to commissioning, shall be suppressed or replaced to the satisfaction of the Engineer without any cost to the Employer.

3.12 LABELS AND NOTICES

- a) Identification labels must be attached to all Plant, motors, control gear and all panels and the equipment contained therein.
- b) Labels shall consist of either:
 - i) an engraved sandwich board ("Trifoliate", "Darvic" or equal);
 - ii) reverse engraved acrylic material ("Perspex") with filled letters and reverse sprayed; or
 - iii) for outdoor applications (where specified) labels shall be brass or aluminium (with letters filled in black), lightly sanded with fine grit paper and clear lacquered.
- c) Labels shall have a matt or satin finish to minimise reflection.
- d) Labels shall be rectangular in form with proportions appropriate to the wording, and shall have true, parallel, lightly bevelled edges and shall be neatly and squarely fixed.
- e) Engraving shall be of uniform height, character and line width.
- f) The type of material or process shall be such as to finish with black letters against a white background, except in the case of cautionary labels where the letters shall appear white on a red background.
- g) The label material used shall be appropriately selected according to the size and fixing methods of the label, and the label shall not warp in service.
- h) Labels shall be fixed by the use of either:
 - i) self-tapping screws;
 - ii) metal-thread screws and nuts; or
 - iii) these shall be nickel plated in either case and adequate clearance shall be allowed around the lettering to accommodate them. Adhesive fixing alone will not be accepted. Extruded aluminium section is preferred, provided the label is firmly held.
- i) Cables shall be labelled at both ends, at through joints and at regular intervals.
- j) Cables shall be labelled on both sides of the place where the cable passes through a permanent obstruction.
- k) All lettering shall be in uppercase letters except where standard abbreviations of units are used, e.g. kWh, kVA, etc.
- l) The wording of labels and character height shall be approved by the Engineer.
- m) All labels shall be in English and in the local language, if other than English, as specified in the detailed specification.

3.13 CLEANING AND PAINTING

- a) The cleaning and painting of all exposed surfaces of all Plant and accessories, unless otherwise specified or approved, shall be carried out as follows:
 - i) Surface preparation

All metal work shall be thoroughly cleaned by blast cleaning or pickling so as to be free of all mill scale, dirt, rust, welding slag and spatter, grease and all other contaminants, so as to present a dry, bright metallic finish.

- ii) Priming

The metal work shall be primed with an approved primer, which for Plant intended for outdoor use, shall be red-lead-based and for indoor mounted Plant shall be phosphate-based.

iii) Finishing

The primed surfaces shall be finished with a minimum of two coats of approved alkyd-based enamel of which each coat shall be of a different shade.

- b) Epoxy powder coating will be considered as alternative for indoor applications, subject to the approval of the application procedure by the Engineer.
- c) Top and bottom plates of chassis compartments assemblies and chassis runners may be protected against corrosion in an alternative approved manner (e.g. by passivated cadmium plating) due to the likelihood of damage to paint work on removal and replacement.
- d) All painting shall be spray applied using dry oil-free air.
- e) The final paint thickness shall be not less than 0,1 mm as determined by a magnetic film thickness gauge.

3.14 WATER AND DEBRIS ACCUMULATION

All outdoor Plant must be designed so that water and debris will not readily accumulate on it, and so cause deterioration of the Plant or an electrical discharge hazard. Where this cannot be avoided, such places shall be made easily accessible for cleaning.

3.15 INSPECTION AND TESTS

- a) All Plant will be inspected and tested, both in the factory during manufacturing and on site during installation. The tests required are prescribed in the standard and detailed specification. The Engineer will do all inspections accompanied by the Contractor, and the Contractor shall perform all tests with the Engineer as a witness.
- b) Inspections and test shall be executed in accordance with the standard specification on Testing and Commissioning [18].

3.16 MEASUREMENT AND PAYMENT

Full compensation for the Contractor's obligations to comply with the general design criteria shall be included in the tendered rates for the relevant items of Plant specified in other sections of these specifications.

SECTION 4: TESTING AND COMMISSIONING

DOCUMENT NO.: STD-LRM-GN-0005

CONTENTS

4.1 SCOPE 486

4.1 SCOPE

All references to this Section 4 shall be deemed to be references to the relevant clauses of the Particular Specification for Testing and Commissioning in Part C3.3.6 of the Contract.

SECTION 5: CORROSION PROTECTION

DOCUMENT NO.: STD-LRM-GN-0006

CONTENTS

5.1	SCOPE	487
5.2	STANDARDS AND LEGISLATION	487
5.3	GENERAL.....	489
5.4	DESIGN	490
5.5	COATING MATERIALS	491
5.6	FETTLING OR DRESSING BY THE FABRICATOR	491
5.7	SURFACE PREPARATION FOR PAINTING	492
5.8	THE APPLICATION OF PAINTS.....	494
5.9	HOT DIP GALVANIZING	495
5.10	STAINLESS STEEL FABRICATIONS	497
5.11	CORROSION RESISTANT STEEL 3CR12.....	497
5.12	ALUMINIUM.....	498
5.13	COATING SYSTEMS	498
5.14	QUALITY ASSURANCE REQUIREMENTS	516
5.15	SPECIFIC APPLICATIONS	517
5.16	MEASUREMENT AND PAYMENT	518

5.1 SCOPE

This section covers corrosion protection of electrical components in general and materials or coatings for specific components. The requirements of this specification are additional to any corrosion protection that may be covered under any other section of these specifications. In the case of discrepancies between this section and the drawings, this section shall have preference.

Where alternative specifications are given to cover areas of high or low corrosivity and the environment of the component in service is not known, the specification for high corrosivity shall be used.

5.2 STANDARDS AND LEGISLATION

5.2.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

5.2.2 Codes of Practice

The following Codes of Practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[19] SANS 10044-3	The fusion welding of steel (including stainless steel) - tests for the approval of welding procedures and production welds.
[20] SANS 10044-4	Tests for the approval of welders working to approved procedures.

[21] SANS 10044-5	Tests for the approval of welders where weld procedure approval is not required.
[22] SANS 10044-6	The fusion welding of aluminium and aluminium alloys - tests for the approval of welding procedures and production welds.
[23] SANS 10044-7	The fusion welding of aluminium and aluminium alloys - tests for the approval of welders working to approved welding procedures.
[24] SANS 10064	Preparation of steel surfaces for coating.
[25] SANS 10140	Identification of colour marking.
[26] SANS 9000	Quality management systems - fundamentals and vocabulary.
[27] SANS 10214	The design, fabrication and inspection of articles for hot-dip galvanising.
[28] SANS 801	Epoxy-tar paints.

5.2.3 Standard Specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[29] SANS 630	Decorative high gloss enamel paint for interior and exterior use.
[30] SANS 681	Undercoats for paints.
[31] SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles — specifications and test methods.
[32] SANS 14788	Continuous hot-dip zinc-5 % aluminium alloy coated steel sheet.
[33] SANS 999	Anodised coatings on aluminium (for architectural purposes).
[34] SANS 12944-5	Paints and varnishes — corrosion protection of steel structures by protective paint systems: Part 5: Protective paint systems.
[35] SANS 1407	Anodised aluminium (general applications).
[36] SANS 1274	Coatings applied by the powder coating process.
[37] SANS 1319	Zinc phosphate primer for steel.
[38] SANS 1217	The production of painted and powder-coated steel pipes.
[39] SANS 723	Wash primer.
[40] SANS 935	Hot-dip zinc coatings on steel wire.
[41] SANS 5763	Efficacy of cleaning plant, equipment and utensils: swab technique.
[42] SANS 5772	Profile of blast-cleaned steel surfaces for painting (determined by a micrometer profile gauge).

5.2.4 Standard Test Methods

The following standard test methods shall be read in conjunction with this specification and shall be deemed to form part thereof:

[43] DS/EN ISO 2808	Paints and varnishes - determination of film thickness.
[44] SANS 5767	Cleanliness of blast cleaned steel surfaces for painting.
[45] SANS 5769	Cleanliness of blast cleaned steel surfaces for painting (assessed by freedom from dust and debris).

[46] SANS 5776	Adhesion of coatings (direct pull off method).
[47] SANS 5159	Adhesion of paint and varnish films (cross-cut test).
[48] ISO 8505-1	Pictorial surface preparation standards for painting steel surfaces.
[49] SANS 10141	The processing, testing and storage of silver-gelatin microfilm for archival purposes.
[50] SANS 10159	Measurement and calibration systems.

5.2.5 British Standards

The following British Standards shall be read in conjunction with this specification and shall be deemed to form part thereof:

[51] BSI BS EN ISO 15607	Specification and qualification of welding procedures for metallic materials' general rules.
[52] BS 6496	Powder organic coatings for application and stoving to aluminium alloy extrusions, etc.

5.2.6 USA Specifications

The following American Standards shall be read in conjunction with this specification and shall be deemed to form part thereof:

[53] ASME-IX 2010	Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

5.3 GENERAL

- a) The Contractor shall ensure that he and his relevant Sub-Contractors have the latest editions of all the relevant Specifications and Codes of Practice available, both SANS and others. These are listed in the sub-clause titled "List of Relevant National and International Codes of Practice, Standards and test Methods" in this Section. The latest issues of the manufacturer's data sheets for the materials also need to be used.
- b) All paints in a paint system shall be purchased from one paint manufacturer. Identical paints used at one time or on one item shall be of the same batch number.
- c) The Contractor shall proceed with the purchase of the paints only upon receipt of written approval of the brand or manufacturer from the Engineer.
- d) The materials and procedures shall comply with the appropriate SANS Specifications and Codes of Practice when relevant, and with the manufacturer's printed data sheets.
- e) Strict attention shall be paid to fettling of surfaces by the Fabricator (refer to the clause titled "Fettling or Dressing by the Fabricator") prior to coating. Surface preparation requirements and the need for strict cleanliness and adherence to specification requirements are emphasised.
- f) Areas which are, or potentially may be inaccessible after assembly, shall be prepared and fully coated with the specified system and according to the specified requirements before assembly. The coating shall be fully hard and dry before assembly.
- g) Mating surfaces shall be coated with primer or first coat only. The coating shall be uniform in thickness and shall not interfere with the mechanical tolerances. After assembly, the outside surface of the joint shall be fully coated and sealed where necessary, in accordance with the relevant specification.
- h) The painting Sub-Contractor shall provide evidence of his competence to apply the specified materials in the prescribed manner and to apply the necessary quality control procedures. The Engineer, at his discretion, may demand a quality audit of the Contractor's facilities by a

technically competent and independent organisation (refer to the clause titled "Quality Assurance Requirements").

- i) The Contractor shall provide a quality plan to show the stages at which quality control will be carried out. Further details are given in the clause titled "Quality Assurance Requirements". The quality plan is subject to approval by the Engineer, who may require it to be revised if considered inadequate.
- j) The Contractor shall furnish material suppliers with the specified descriptions of materials to be used and shall receive from them a written assurance that the materials to be supplied comply with the requirements specified in the project specifications.
- k) If the Contractor wishes to offer an alternative to the specified system, he shall supply to the Engineer adequate technical information to enable a proper evaluation of the proposed system (see Form Q.1.). He shall not proceed with the application of the system until authorised by the Engineer in writing.

5.4 DESIGN

5.4.1 General

All items shall be designed to minimise corrosion in outdoor environments, under immersion conditions, and in interior aggressive situations such as in chlorination rooms. The following notes may be used as guidelines:

5.4.2 Water retention areas

Avoid water retention areas wherever possible. For example, angle or U-section steel shall be used with the toes pointing downwards and the concrete base of columns shall be sloped away from the steel. Where water retention cannot be avoided, drain holes, suitably radiused, shall be fitted at the lowest point. Joints between steel and concrete shall be sealed with a suitable sealant.

5.4.3 Crevices

Accelerated corrosion results from crevices when water is present. Crevices may be avoided by using:

- a) continuous welding, not space welding;
- b) mastics or sealants to seal unavoidable crevices such as bolted connections; and
- c) insertion rubber or suitable plastic between mating surfaces.

5.4.4 Bimetallic couples

Electrical contact between dissimilar metals gives rise to a corrosion cell when an electrolyte such as water is present. Joints between dissimilar metals shall be electrically insulated, or effectively sealed to prevent water ingress.

5.4.5 Accessibility

Whenever possible, the surfaces of corrodible materials such as mild steel shall be accessible for maintenance. The use of angles back-to-back, partially open box sections or inaccessible stiffeners, shall be avoided.

5.4.6 Differential aeration

Posts buried in soil are subject to accelerated corrosion due to differential aeration. Additional protection shall be given to that part which is buried and up to at least 100 mm above ground. Similarly, tanks should not stand on the ground or on a concrete bed but shall be fitted with legs to ensure that there is no contact between the tank base and its bed. Where legs cannot be used, the tank shall stand on a concrete base, the edges of which shall be sloped away from the tank. The joint between tank and base shall be sealed with a suitable mastic or sealant.

5.4.7 Sharp edges, weld spatter and weld slag

The designer shall specify that all sharp edges shall be ground to a radius not less than 2 mm and that all weld spatter and weld slag shall be removed by the fabricator.

5.4.8 Hot dip galvanising

The design of articles to be galvanised shall be referred to the galvaniser and shall comply with SANS Code of Practice SANS 10214 [27]. Articles to be painted or powder coated after galvanising shall not be passivated. For galvanised articles to be powder coated, refer also to System F, detailed in the clause titled "System F - Powder Coatings".

5.4.9 Vapour corrosion inhibitors

Where vapour corrosion inhibitors are specified, the form, chemical composition and quantity of VCI shall be suitable for the metals used in the cabinet and shall be adequate for at least 12 months protection in the environment in which the cabinet will be situated.

5.4.10 Cathodic protection

Where cathodic protection is required, the components to be protected shall be of all-welded construction or shall be fitted with bonding lugs to enable bonding cables to be cad-welded on site.

5.5 COATING MATERIALS

- a) No variation in materials to be used shall be permitted without the approval of the Engineer in writing.
- b) All coating materials shall be delivered in the manufacturer's original sealed containers, clearly marked with the following:
 - i) Manufacturers name.
 - ii) Product brand name and reference number.
 - iii) Batch number, which may incorporate the date of manufacture.
 - iv) Date of manufacture, unless already incorporated in the batch number.
 - v) Abbreviated instructions for storage and use of the material, which shall include the mixing ratios of components of multi-component materials; the minimum temperature of application; and the method of application.
 - vi) The SABS mark where applicable.
- c) Coating materials shall be kept in an approved store, which shall be dry and enclosed and in which the temperature is unlikely to exceed 40°C or drop below 0°C.
- d) Usage of materials shall be on a first in, first out basis and no materials may be used which have exceeded the shelf life recommended by the manufacturer.

5.6 FETTLING OR DRESSING BY THE FABRICATOR

- a) Before any surface preparation or painting is carried out, dressing shall be carried out to remove projections, sharp edges, weld slag and spatter that will interfere with the corrosion protection.
- b) All weld flux and weld spatter shall be removed before painting. Flux is best removed by washing with clean water, whilst weld spatter is normally removed by grinding to a smooth surface.
- c) Sharp edges shall be ground to a radius not less than 2 mm, except where otherwise permitted by the Engineer, e.g. cable racking.
- d) Welds shall be continuous and shall have a smooth contour. Rough welds shall be ground where necessary to achieve the required smooth profile. Undercuts shall not be permitted. Discontinuous welds shall not be permitted except by the written approval of the Engineer.
- e) Articles for hot dip galvanising shall not have any overlapping joints. Closed sections shall be suitably vented.

5.7 SURFACE PREPARATION FOR PAINTING

5.7.1 Mild steel, minimum 2 mm thickness

- Oil and grease contamination, when present, shall be removed by degreasing before blast cleaning.
- Mild steel shall be blast cleaned in accordance with Section 4.3 of SANS 10064 [24] Code of Practice for "The Preparation of Steel Surfaces for Coating". An additional requirement is that water soluble salts present in the steel after blast cleaning shall not exceed the appropriate values given in Table 1 below. Should these values be exceeded, the steel shall be cleaned by washing with clean potable water or by water-shrouded or water-injected blast cleaning until the soluble salts are within the limits specified in Table 1. The steel shall then be allowed to dry, after which it shall be flash-blast cleaned to achieve the required degree of cleanliness.
- The standards of blast cleaning required are given in Table 1: Standards for Blast Cleaning

Table 1: Standards for Blast Cleaning

PROPERTY	ABOVE WATER SURFACES	IMMERSED SURFACES	TAPE WRAPPING	INORGANIC ZINC
Cleanliness to ISO 8501/1 (SIS 05 5900) (min)	Sa 2.5	Sa 3	Sa 2	Sa 2.5
Residual dust and debris (SANS Method 769)	0,5%	0,3%	0,5%	0,3%
Oil grease and perspiration	Nil	Nil	Nil	Nil
Surface Profile min	25	50	-	50
(micrometres) max	50	100	-	100
Water soluble iron salts:				
- Maximum at any point	500 mg/m ²	100 mg/m ²	500 mg/m ²	500 mg/m ²
- Average of any 250 cm ²	100 mg/m ²	10 mg/m ²	100 mg/m ²	100 mg/m ²

- The time interval between blast cleaning and the application of the first coat of paint shall not exceed that timeframe given in Table 2: Maximum Time Intervals below:

Table 2: Maximum Time Intervals

AMBIENT RELATIVE HUMIDITY	MAXIMUM TIME (HOURS)
Below 50%	6
50 - 70%	4
70 - 85%	2
Over 85%	Coating not permitted - reblast and coat when RH below 85%

5.7.2 Mild steel, less than 2 mm thickness

Mild steel less than 2 mm thickness, may distort by blast cleaning. Such steel shall be cleaned by degreasing, pickling and phosphating in accordance with SANS 10064 [24], Section 5, or by a proprietary multi-stage chemical pickling and passivating process approved by the Engineer. The specified primer shall be applied immediately after completion of phosphating, rinsing and drying (see Table 2 above).

5.7.3 Cast iron and cast alloys

Cast surfaces shall be blast cleaned with iron slag, copper slag, or platinum slag abrasives designed for blast cleaning. The abrasive shall not be re-cycled or re-used. Cast iron shall be blast cleaned until all sand particles, residual burnt-on-sand and casting skin have been completely removed. When castings are required to be painted, especially for immersion applications, all blowholes and omegas shall be

opened up and filled with a suitable solvent free epoxy filler or putty. The finished level shall be smooth with, or proud of the surrounding surface. Proud putty, after curing, shall be abraded to be flush with the surrounding surface.

5.7.4 Galvanised Steel Surfaces

- a) The galvaniser shall be advised of components to be painted after galvanising. Such surfaces shall not be passivated. Galvanised steel surfaces shall be thoroughly degreased prior to painting, using either a water rinseable solvent degreaser, or a mild acid-detergent degreasing solution. In both cases, care shall be taken to avoid entrapment of cleaning agent in the recesses or other retention areas. In both cases, the surfaces shall be thoroughly washed until a water break free surface is achieved. If necessary, the process shall be repeated until a water break-free surface is obtained.
- b) A water break-free surface is one on which a continuous film of water is obtained when potable water is brushed thereon. The film of water shall not break up into islands or globules.
- c) After degreasing, the surface shall be abraded to obtain a uniform matt finish by one of the following methods:
 - i) The use of abrasive paper not coarser than grade 120, or by using non-metallic abrasive pads.
 - ii) By "sweep blast cleaning", using a nozzle pressure not greater than 300 kPa and a very fine abrasive. Cracking, flaking, or any form of delamination of the zinc coating due to excessive blast cleaning shall not be permitted. The thickness of zinc removed by blast cleaning shall not exceed 10 micrometres.
- d) Finally, all dust and debris shall be removed by vacuum cleaning, or by dry brushing to attain a level of residual dust and debris not exceeding the values given in Table 1.
- e) Alternatively, an approved multi-stage chemical treatment may be used. The instructions of the chemical supplier shall be strictly followed. The composition of the various treatment baths shall be regularly checked and adjusted where necessary. Since the rate of chemical attack on finely divided zinc is different from that on galvanising, no repair of galvanising prior to chemical treatment is permitted.

5.7.5 Stainless and Corrosion Resisting Steel

- a) Components fabricated from stainless or corrosion resisting steel shall be supplied in the fully passivated condition. Sheared edges, welds or surfaces subjected to any form of heat treatment or contamination with iron or mild steel, shall be pickled and passivated.
- b) Surfaces shall be thoroughly degreased with a water rinseable solvent detergent, then rinsed with potable water to obtain a water break-free surface.
- c) When it is required to paint stainless steel exceeding 1,5 mm thickness, the surface shall be blast cleaned in accordance with the parameters given in Table 1, using non-metallic abrasive such as iron slag, copper slag or platinum slag. The use of steel shot, steel grit or cast-iron grit is strictly prohibited. Any contamination with iron or mild steel is prohibited. Dust and debris shall be removed before painting to achieve residual values not greater than those given in Table 1.
- d) Where blast cleaning is impractical, the surface shall be cleaned with a detergent solution and roughened manually using non-metallic abrasive pads, followed by washing with clean potable water to a water break-free surface. If a water break-free surface is not obtained, detergent cleaning shall be repeated until the surface is water break-free. Allow the surface to dry before coating.

5.7.6 Aluminium

- a) Generally, aluminium surfaces will be anodised or powder coated and will require no further treatment. Where painting is required, the aluminium surface shall be thoroughly degreased then rinsed with clean potable water. If the surface is not water break-free, repeat the degreasing process until a water break-free surface is obtained. Allow to dry completely, then apply a thin coat (8 to 13 micrometres dry film thickness) of wash primer which complies with SANS 723 [39], mixed and applied in accordance with the manufacturer's instructions.
- b) NOTE: wash primer is an adhesion promoter and does not replace the primer specified in the paint system.

5.7.7 Painted Surfaces

- a) Fully painted surfaces to be repaired or overcoated
 - i) Exposed metal shall be cleaned with abrasive paper not coarser than 220 mesh to a bright metal surface. The surrounding paint, which must be intact, shall be feathered for a distance of 20 mm beyond the damaged area. Dust and debris shall be removed by using a clean rag dampened with water, or a clean solvent that will not attack the coating. Damaged areas shall be allowed to dry, after which spot repairs shall be carried out with all the coats previously applied and shall overlap the undamaged area by 20 mm. The requirements of the spot repair shall be not less than that specified for the undamaged coating.
 - ii) Where additional coats are required over the entire surface, the entire surface shall be abraded to a uniform matt finish, the dust and debris removed, and the surface allowed to dry.
 - iii) All further coats shall then be applied as specified to give a uniform finish.
- b) Shop applied primers to be overpainted

Primers shall be thoroughly sanded with fine abrasive paper to achieve a uniform matt surface, then scrubbed with a solution of a suitable water-based detergent-degreaser using a bristle brush. This is followed by clean water rinses to remove all grease and water-soluble matter. The surface shall be allowed to dry completely before application of the specified coating system over the whole surface.

5.7.8 Plastic Surfaces such as uPVC and Polyester GRP

Treat as specified for painted surfaces with shop applied primers to be overpainted. The cleaned surface shall have a uniform matt finish, free from scratches and local glossy patches.

5.7.9 Concrete and Plaster Surfaces

- a) Concrete and plaster surfaces to be painted shall be clean, dry and free from laitance, dust or similar friable surface layers and from mould oil, or similar contaminants that will interfere with the adhesion of the coating.
- b) Loose surface dust is one of the main causes of poor adhesion to concrete.
- c) Mould oil shall be removed by using a water-based detergent such as Shell Teepol Lensex (or similar), followed by high pressure water washing. When all contaminants have been removed, the surface shall be allowed to dry either to a damp condition; or to a completely dry condition, depending on the coating to be applied.
- d) For immersion or other heavy-duty applications laitance shall be totally removed by water blast cleaning with abrasive injection; by mechanical scabbling of the surface; or by acid pickling, followed by a very thorough washing with potable water.
- e) Off shutter concrete usually shows surface blowholes or omegas. Omegas shall be drilled or chipped open to the full hole diameter. Blowholes and opened omegas shall be filled with a suitable filler such as an acrylic or solvent-free epoxy. The use of gypsum or cellulose-based fillers is not permitted for underwater or humid conditions. Shutter kicks and similar projections shall be removed by grinding to a smooth surface.
- f) For coatings of low water permeability, such as solvent borne epoxies, vinyls and chlorinated rubber, the moisture content of the concrete or plaster shall be not more than an indicated 5% when tested with an approved electrical conductivity meter, designed for use on concrete or plaster (such as the Delmhorst meter). The pins of the meter shall penetrate the concrete or plaster to a depth not less than 5 mm.
- g) The first coat of the coating system may require thinning with the manufacturer's recommended solvent to assist in penetration of the substrate.

5.8 THE APPLICATION OF PAINTS

5.8.1 Environmental Conditions

Paint shall not be applied under the following conditions: dusty conditions; when the steel surface temperature is less than 3°C above dew point; when the surface temperature is higher than that advised

by the paint manufacturer; when humidity is greater than 85%; and when the ambient temperature is less than the minimum or greater than the maximum specified by the manufacturer of the coating material.

5.8.2 Mixing

- a) All coating materials shall be very thoroughly mixed until they are completely homogeneous. In the case of two-pack materials, each component containing pigments shall be thoroughly mixed. The two components shall then be mixed together in the proportions supplied by the manufacturer until the mixture is completely homogeneous. In the case of solvent-based epoxy materials, it is recommended that the mixed material be allowed to stand for an induction period of 20 to 30 minutes before use.
- b) For two-pack materials, the use of part of the contents (split packs) is strictly forbidden.

5.8.3 Method of Application

Application shall be by brush, roller, airless spray, or other suitable equipment as appropriate for the material for the surfaces to be coated, and in accordance with the recommendations of the manufacturer. Application equipment shall be maintained in a clean condition and in good working order. The use of equipment not maintained in good clean condition may lead to rejection of the coating.

5.8.4 Overcoating

- a) Overcoating times shall be not less than the minimum nor greater than the maximum specified by the manufacturer relevant to the ambient temperature. Strict adherence to overcoating times is particularly important for coatings which are subsequently immersed. The Contractor will be held responsible for blistering of paint coatings on immersed surfaces.
- b) All surfaces shall be clean and free from dust, oil, moisture and perspiration before overcoating. Operatives handling blast cleaned or partially painted surfaces shall wear clean gloves to avoid contamination of the surfaces.

5.8.5 Permissible variations of film thickness

- a) Minimum film thickness: Not more than 10% of readings shall be less than the minimum specified and no reading shall be less than 90% of the specified minimum.
- b) Maximum film thickness: Unless otherwise agreed by the Engineer, no reading shall exceed the mean specified thickness by more than 50%.

5.8.6 Handling

- a) Coated components shall not be handled earlier than the hard-dry time recommended by the manufacturer, relevant to the ambient temperature. Coated components shall be handled with broad band slings and suitable packing to minimise damage to the coating.
- b) All damage caused in handling, transportation, and erection, shall be repaired to the satisfaction of the Engineer and at no extra cost. Storage on site shall be in suitable covered stores, where available, and on suitable soft packing to prevent damage to the coating.

5.9 HOT DIP GALVANIZING

5.9.1 Design and Fabrication

- a) Components for hot dip galvanising shall be designed and fabricated in accordance with the recommendations of SANS 10214 [27], with the exception that the use of lead plugs is not permitted.
- b) It is recommended that the manufacturer consults the galvaniser or the Executive Director of the South African Hot Dip Galvaniser's Association before design and fabrication to ensure that the fabrication will be suitable for galvanising.
- c) The main requirements are as follows:
 - i) Overlapping joints shall be avoided wherever possible. If essential, such overlapping joints shall be thoroughly degreased before assembly and shall be vented by holes being drilled through one or both overlapping materials.

- ii) Closed sections shall be suitably vented. If the inside of a closed section is not to be galvanised, a snorkel vent tube of suitable length and bore, shall be attached to the vent hole.
- iii) Gussets and internal baffles in tanks or boxes shall be cropped to allow free flow of zinc and air.
- iv) Joints shall be continuously welded, using balanced welding techniques to avoid stresses. Welds shall be free from cavities, undercutting, weld slag and spatter.
- v) A symmetrical design shall be used whenever possible and the use of thin gauge steel adjacent to heavy sections shall be avoided.
- vi) Openings and flanges of manholes and bosses shall finish flush on the inside to ensure complete drainage.
- vii) Castings shall be designed to be of as uniform section as possible and shall be blast cleaned in accordance with the requirements of the clause titled "Surface Preparation for Painting", sub-clause "Cast Iron and Cast Alloys" before they are despatched to the galvaniser.

5.9.2 The Hot Dip Galvanising Process

- a) Hot dip galvanising shall comply with the appropriate SANS specifications, such as SANS 121 [31] for fabricated articles, SANS 14788 [32] for pre-galvanised sheet, or SANS 935 [40] for wire.
- b) Mating surfaces on fabricated or cast-iron components shall be wiped or centrifuged immediately after they are removed from the galvanising bath to remove blobs, runs, or excess metal that may impair the gas or liquid tightness of the joint.
- c) Bolts, nuts and washers used for fixing shall be hot dip galvanised according to SANS 121 [31]. Electroplated fasteners will not be accepted unless otherwise agreed by the Engineer in writing.
- d) When organic coatings such as paint or powder are to be applied to galvanised articles, the galvaniser shall be so advised. Passivation after galvanising is not permitted. Special requirements may also apply for galvanised articles to be painted. Refer to specifications for painted or powder coated galvanised steel.

5.9.3 Mechanical Treatment of Galvanised Articles

Welding, flame cutting, or other heat processes shall not be carried out on galvanised articles unless permission has been granted by the Engineer. If damage has been caused, then repair to the damaged galvanising shall be carried out as described below.

5.9.4 Repair of Galvanised Articles

- a) Repairs shall be carried out as follows:
- b) All scale, spatter and flux shall be removed by grinding and washing with clean water. Edges shall be ground to a radius not less than 2 mm.
- c) The repair process shall be by blast cleaning of the surface to bare steel and applying zinc by the thermal spray process in accordance with SANS 1319 [37], Grade Zn150. On completion of metal spraying, the surface shall be burnished by means of a mechanical wire brush to give a uniform appearance. Such burnishing shall remove not more than 10 micrometres of zinc.
- d) Where small areas are to be repaired, the surface shall be thoroughly cleaned with fine abrasive paper, all debris removed with a damp cloth, and the surface allowed to dry. An approved one-pack zinc rich primer containing not less than 90% by mass of zinc in the dry film shall then be applied. A sufficient number of coats (usually three or four) shall then be applied such that the repair coating thickness is not less than the average zinc thickness specified in SANS 121 [31], SANS 14788 [32] or SANS 935 [40], as appropriate. The repair shall extend not less than 5 mm beyond the damaged area.
- e) On completion of the repair and when the zinc rich primer is completely dry, one coat of alkyd resin-based aluminium paint may be applied to obtain a uniform appearance.

NOTE (i) The repair of galvanised surfaces by application of aluminium paint alone IS NOT PERMITTED.

- (ii) For repair of painted or powder coated galvanised articles, refer to the painting or powder coating specification.

5.9.5 The Storage of Galvanised Components

- a) Galvanised components shall be stored so as to avoid the formation of "white rust" or other forms of storage staining.
- b) Components shall be separated and supported on wooden battens to ensure adequate ventilation of all surfaces, and in such a manner as to avoid "ponding" by rainwater.
- c) If storage staining does occur, repairs may not be necessary if the residual zinc thickness meets the requirements of the specification. When necessary, to meet the requirements of the specification, or when so instructed by the Engineer, repairs shall be carried out as specified in the clause titled "Repair of Galvanised Articles" above.

5.10 STAINLESS STEEL FABRICATIONS

5.10.1 Grades and Welding Techniques

- a) The grade of stainless steel to be used shall be as specified in the appropriate section of the electrical specification or on the drawings.
- b) Where welding is necessary, the appropriate "L" grade (low carbon content) shall be used.
- c) Welding procedures shall be only those recommended by the manufacturer of the stainless steel or by the South African Stainless Steel Development Association. Only suitably coded welders shall be employed (Refer BSI BS EN ISO 15607 [51] or ASME-IX 2010 [53]).
- d) The fabrication of stainless steel components shall be carried out in clean workplaces where contamination by mild steel does not occur. Grinding and polishing equipment shall be dedicated for this purpose only and shall not be contaminated with iron or mild steel.
- e) Stainless steel shall be suitably handled to avoid any scratching of the surface.

5.10.2 Pickling and Passivation

- a) The cut edges, welds and heat-treated surfaces of all stainless steel components shall be pickled and passivated to remove all discolouration. Proprietary pickling and passivating pastes shall be used in accordance with the manufacturer's recommendations. Care shall be taken not to exceed the maximum recommended contact time.
- b) After passivation, surfaces shall be very thoroughly washed with clean potable water to remove all traces of acid. The surface shall be allowed to dry, then polished where necessary, using polishing compounds recommended by the manufacturer of stainless steel or the SASSDA.
- c) NOTE: See safety precautions at the end of Paragraph "Pickling and Passivation" of "Corrosion Resistant Steel 3CR12".

5.11 CORROSION RESISTANT STEEL 3CR12

5.11.1 Welding Techniques

- a) Welds shall be full-penetration welds, using 309 austenitic electrodes or filler wire, as recommended by the manufacturers.
- b) Welders shall be suitably coded for welding similar thickness of austenitic stainless steel (Refer BSI BS EN ISO 15607 [51] or ASME-IX 2010 [53]).
- c) Welding procedures shall comply with the recommendations of the manufacturers of 3CR12.
- d) Welds shall be smooth and free from blowholes, undercuts, sharp projections and similar visual defects.

5.11.2 Pickling and Passivating

- a) After completion of welding, both weld and heat affected zones shall be cleaned, pickled and passivated. Heat scale on steel shall also be pickled and passivated.
- b) The procedure shall be as follows:

- i) Blast clean with non-metallic grit, or grind or wire brush, using dedicated grinders or stainless steel wire brushes to achieve the required smooth profile, or remove scale.
- ii) Pickle with a thixotropic paste containing 15-20% nitric acid and 1-2% hydrofluoric acid, for a contact time of 15 to 20 minutes.
- iii) Rinse copiously with clean water.
- iv) Repeat the above process, if necessary, to remove all discolouration.
- v) Passivate with 10% nitric acid solution, or a proprietary passivating paste, for a contact time of 10-15 minutes, keeping the surface wet during this period.
- vi) Rinse copiously with clean potable water until the washings are neutral.

5.11.3 Safety Precautions

- a) Operatives shall wear protective aprons, gloves and safety glasses during pickling and passivating operations. The reason for this is that the solutions used are strongly acidic.
- b) Acidic splashes on skin shall be copiously washed with clean water immediately after contact. A weak solution of sodium bicarbonate shall be kept available for neutralisation.
- c) Seek medical attention if in doubt.

5.11.4 Effluent

- a) Disposal of effluent shall be in accordance with the requirements of the local authority in whose area the work is being carried out.
- b) Generally, the effluent is stored in drums containing an excess of lime (calcium carbonate) before disposal at an approved disposal site.

5.12 ALUMINIUM

5.12.1 Anodising

- a) Aluminium components that are specified as anodised, shall be natural anodised and sealed in accordance with SANS 999 [33] or SANS 1407 [35], and in both cases to Grade AA25 or AG25. The corrosion resistance of the coating shall be not less than 8 when tested in accordance with Section 3.6 of the specification SANS 999 [33]. Anodising shall be carried out after completion of all welding.
- b) When coloured anodising is specified, the aluminium components shall be anodised in accordance with SANS 999 [33], Grade AA25.

5.12.2 Powder Coating

When specified by the Engineer, aluminium components may be coated with polyurethane powder. Such coating shall only be carried out by Contractors with the necessary tools, equipment and experience to pre-treat and powder coat aluminium effectively. The coating shall comply with BS 6496 [52].

5.12.3 Fixing

- a) Fixing of aluminium components shall be carried out with Stainless Steel 304 bolts, nuts and washers. When fixed to steel components such as bridges, there shall be an effective insulation layer between aluminium and steel, such as PVC or polyethylene tape, not less than 0,25 mm thickness between aluminium base and steel. A nylon washer of adequate size shall be used between the steel main component and the nut in order to insulate aluminium from steel.
- b) Whenever aluminium components, such as stop log frames, come into contact with concrete, the surface of the aluminium in contact with concrete shall be coated with two coats epoxy tar composition, as specified in System C2. The epoxy tar coating shall be fully cured before grouting in to the concrete.

5.13 COATING SYSTEMS

5.13.1 System A - Alkyd Systems

- a) General

Alkyd systems are intended for use in environments of low corrosivity, where a good decorative finish is required. Materials shall therefore be applied with due cognisance of appearance and protection. Visual defects such as runs, sags, curtaining, shrivelling or wrinkling will not be permitted.

b) System A1 - Alkyd system on to bare steel surfaces

Procedure

- i) The surface to be coated shall be prepared as specified for the surface preparation for painting of mild steel of the appropriate thickeners.
- ii) Apply one coat zinc phosphate primer complying with SANS 1319 [37], to a dry film thickness not less than 30 micrometres. Allow to dry for a minimum of 16 hours.
- iii) Apply one coat alkyd-based undercoat complying with SANS 681 [30] Type 2, to give a dry film thickness of not less than 30 micrometres. Allow to dry for a minimum of 16 hours.
- iv) Apply one coat alkyd enamel complying with SANS 630 [29] Type 2, in the colour specified by the Engineer, to give a dry film thickness of not less than 25 micrometres, nor greater than 40 micrometres. Allow to dry for a minimum of 16 hours.
- v) On exterior surfaces, apply a second coat of alkyd enamel, within 30 hours, to give a dry film thickness of not less than 25 micrometres, nor greater than 40 micrometres in the final colour as specified by the Engineer. Allow to dry for a minimum of 16 hours.

c) System A2 - Surfaces already cleaned and primed

Procedure

- i) Clean and prepare the surface as specified for painted surfaces with shop applied primers to be overpainted.
- ii) Touch up bare areas with zinc phosphate primer complying with SANS 1319 [37]. Allow to dry for a minimum of 16 hours.
- iii) Apply one coat all over of zinc phosphate primer to SANS 1319 [37].
- iv) Continue the system as given in System A1 (3) to (5) inclusive.

d) System A3 - Factory finished components

Procedure

- i) The Contractor shall ensure that the existing coating is compatible with the system to be applied.
- ii) Prepare the surface as specified for painted surfaces with fully painted surfaces to be repaired or overcoated.
- iii) On interior non-aggressive surfaces apply one coat alkyd enamel complying with SANS 630 [29] Type 1, in the colour specified by the Engineer. The applied dry film thickness must not be less than 25 micrometres. The total dry film thickness is not to be less than 75 micrometres.
- iv) On interior surfaces in an aggressive environment, use System B1 rather than an alkyd system.
- v) On exterior surfaces, apply two coats alkyd enamel complying with SANS 630 [29] Type 2. The applied dry film thickness must not be less than 50 micrometres. The total thickness shall not be less than 100 micrometres.
- vi) If the total dry film thickness is less than the appropriate value given in (3) or (5), apply a further coat of alkyd enamel.

e) System A4 - Galvanised surfaces - above water and in non-corrosive environments

Procedure

- i) Prepare the surface as specified for galvanised steel surfaces.

- ii) Apply one coat of an approved water-based vinyl chloride-vinylidene chloride copolymer primer containing zinc phosphate to give a dry film thickness of not less than 30 micrometres and not greater than 60 micrometres. Allow 16 hours to cure in dry conditions before overcoating. Since this material is water based, drying time will be extended under humid conditions.
 - iii) Continue the system as given in A1 (3) and (4) (one undercoat, one enamel coat).
- f) System A5 - Plastic surfaces

If required to paint for identification or decorative purposes, the following system shall be used:

- i) Prepare the surface by thorough abrasion as specified for painted surfaces with shop applied primers to be overpainted.
 - ii) Apply a water-based primer as specified in System A4 (2).
 - iii) Apply an alkyd undercoat and finish as specified in System A1 (3) and (4).
- g) Requirements of the finished alkyd system
- i) The finished system shall be smooth, glossy, free from excessive runs, sags, blisters, wrinkling, dirt, occlusions or other visual defects. The colour shall be a commercial match to the colour specified by the Engineer.
 - ii) The total dry film thickness shall not be less than 75 micrometres in the case of interior surfaces and not less than 100 micrometres in the case of exterior surfaces.
- h) Site repair of alkyd systems
- i) It is anticipated that alkyd systems will generally be applied on site, either onto bare steel (see System A1); or onto prepared and primed steel (see System A2); or onto fully coated components (see System A3); or onto galvanised steel (see System A4); or onto plastic surfaces for the purpose of colour coding (see System A5).
 - ii) Any site repair required by the Engineer shall be carried out in accordance with a surface preparation method given in the clause of the surface preparation for fully painted surfaces to be repaired; or overcoated followed by all the coats required to restore the damaged area to the original system requirements.
 - iii) Since patch application of the final coat rarely gives an acceptable uniform finish, the whole area in which damage has occurred shall be cleaned, abraded with fine wet or dry abrasive paper (not coarser than 200 mesh); and given one coat of enamel all over, unless otherwise accepted by the Engineer.

5.13.2 System B – Two-Pack Epoxy / Polyurethane System for Exterior Surfaces, Steel Substrates

- a) General
- i) Epoxy systems have good chemical resistance and physical properties. When exposed to sunlight they degrade on the exposed surface, a defect known as "chalking". To overcome this defect, the epoxy system may be overcoated with an aliphatic polyurethane, which has very good colour and gloss retention. This combination is therefore recommended for exposed, chemically polluted environments.
 - ii) Two component materials are chemically cured, and when fully cured, are difficult to recoat. It is therefore important to adhere to the overcoating times, both minimum and maximum given in the manufacturer's data sheets. Two-pack epoxy polyamide materials such as in System C1 contain solvents. It is also important to note that this solvent must be allowed to escape and the chemical reaction to complete fully before being subjected to water immersion. All solvent-based epoxy resin-based materials shall be allowed 28 days to cure before immersion. At temperatures below 20 °C longer periods shall be allowed, as in the case of overcoating times.
 - iii) Ambient and substrate temperatures must be measured, especially during winter months, in order to avoid dew deposition and to ensure adequate cure. Since overcoating times are frequently quoted at 20°C or 25°C, longer overcoating times shall be allowed at lower temperatures. As a rough guide, increase time by 50% for a 5° decrease (or by 100% for a 10° decrease) in the ambient temperature below the temperature quoted in the data sheet.

- iv) Two component epoxy materials should not be applied when the ambient temperature is below 10°C.
 - v) Polyurethanes are sensitive to moisture in the uncured state. Containers shall be kept in a dry store. Application shall be carried out in dry conditions. Air used for spray application shall be dry.
 - vi) Since solvent free epoxies do not have to allow solvent to escape, the overcoating and immersion time intervals are shorter than those quoted for System B1. As a guide, the period between completion of coating and immersion in water can be as short as seven days.
 - vii) However, solvent free epoxy materials require special equipment for application. Only experienced applicators may be used.
- b) System B1 – Steel substrates
- i) Materials
 - (1) Two-pack epoxy primer for steel.
 - (2) Two-pack epoxy high build intermediate coat, in different colours.
 - (3) Two-pack aliphatic isocyanate cured polyester based polyurethane.
 - ii) Procedure
 - (1) Fettle all welds and sharp edges as specified in the clause on Fettleing or Dressing by the Fabricator.
 - (2) Prepare the surface by a method appropriate to the fabrication. For hot rolled steel, refer to the clauses on the surface preparation for painting of mild steel. For cold rolled steel refer to the clause on the surface preparation for mild steel less than 2 mm thick. For cast iron, refer to the clause on surface preparation for painting of cast iron and cast alloys.
 - (3) Apply one coat of a two-pack epoxy primer for steel at a dry film thickness of 30 to 45 µm.
 - (4) Apply one coat of a two-pack high build epoxy intermediate coat at a dry film thickness of 60 to 90 µm.
 - (5) Apply a second coat of a two-pack high build epoxy intermediate coat, in a different colour from the first coat, at a dry film thickness of 60 to 90 µm.
 - (6) Apply one coat of a two-pack aliphatic polyurethane enamel at a dry film thickness of 30 to 50 µm as top coat.
 - (7) NOTE: The time interval between all coats shall be in accordance with the paint manufacturer's data sheet.
 - iii) Repair

For repair procedures refer to the clause on surface preparation for painting of fully painted surfaces to be repaired or overcoated.

Requirements:

 - (1) Each coat shall be uniformly applied at the appropriate wet film thickness to give a dry film thickness within the range specified.
 - (2) The completed system shall be smooth, glossy, uniform in colour, free from runs, sags, bubbles, occluded dust, and other visible defects.
 - (3) The colour shall be a commercial match to the colour specified by the Engineer.
 - (4) The dry film thickness, tested by DS/EN ISO 2808 [43], shall not be less than 180 nor greater than 280 µm. When tested by SANS 5159 [47] the adhesion shall not be less than 9.
- c) System B2 – Galvanised substrates
- i) Materials:

- (1) Two-pack epoxy primer for galvanised surfaces.
- (2) Two-pack epoxy high build intermediate coat.
- (3) Two-pack aliphatic isocyanate cured polyester based polyurethane.

ii) Procedure:

- (1) Prepare the galvanised surface as specified in the clause on surface preparation for painting of galvanised steel surfaces. Dross, ash occlusions and surface roughness are only permitted if the peak to valley profile (measured by SANS 5772 [42]) does not exceed 100 μm . Spikes of zinc shall be removed before coating.
- (2) Apply one coat of two-pack epoxy primer for galvanised steel at a dry film thickness of 20 to 30 μm .
- (3) Apply one coat of a two-pack high build epoxy intermediate coat at a dry film thickness of 60 to 90 μm .
- (4) Apply one coat of a two-pack aliphatic polyurethane enamel at a dry film thickness of 30 to 50 μm .
- (5) NOTE: Time interval between all coats shall be in accordance with the manufacturer's data sheets.

iii) Repair:

For the repair procedure refer to the clause on preparation for painting of fully painted surfaces to be repaired or overcoated.

iv) Requirements

- (1) Each coat shall be uniformly applied at the appropriate wet film thickness to give a dry film thickness within the range given.
- (2) The completed system shall be smooth, glossy, uniform in colour, free from runs, sags, bubbles, occluded dust, and other visible defects.
- (3) The colour shall be a commercial match to the colour specified by the Engineer.
- (4) The dry film thickness of the organic system, tested by DS/EN ISO 2808 [43], shall not be less than 110 nor greater than 170 μm . The total dry film thickness shall not be less than 150 μm .
- (5) When tested by SANS 5159 [47] the adhesion shall not be less than 9.

5.13.3 System C – Two-Pack Epoxy Systems for use on Surfaces to be Submerged

General:

- a) Two-pack epoxy polyamide materials in System C, contains a solvent. It is important to note that this solvent must be allowed to escape and the chemical reaction to complete fully before being subjected to water immersion.
- b) For these reasons it is imperative that the applicator does not exceed the maximum film thickness per coat applied, nor must the overcoating be carried out earlier than the minimum time specified by the manufacturer. Since overcoating times are frequently quoted at 20°C or 25°C, longer overcoating times shall be allowed at lower temperatures. As a rough guide, increase time by 50% for a 5° decrease (or by 100% for a 10° decrease) in the ambient temperature below the temperature quoted in the data sheet.
- c) These materials shall not be applied when the ambient temperature is below 10 °C.
- d) All solvent based epoxy resin-based materials shall be allowed 28 days to cure before immersion. At temperatures below 20 °C longer periods shall be allowed, as in the case of overcoating times.
- e) Since solvent free epoxies do not have to allow solvent to escape, the overcoating and immersion time intervals are shorter than those quoted for System B1. As a guide, the period between completion of coating and immersion in water can be as short as seven days.
- f) However, solvent free epoxy materials require special equipment for application. Only experienced applicators may be used.

5.13.4 System C1 – On bare steel or cast iron surfaces

a) Material:

Material used shall be based on epoxy-polyamide resins and shall comply with the performance requirements of SANS 1217 [38] Type 1A – solvent borne chemically cured coating material.

b) Procedure:

- i) Prepare the surface as specified in the relevant clause.
- ii) Apply three or four coats of the epoxy-polyamide material, mixed as recommended by the manufacturer and as required, to give a total dry film thickness not less than 250 micrometres.
- iii) Each coat shall differ in colour from the preceding and succeeding coats in order to identify the number of coats applied.
- iv) Each coat shall be applied to a thickness not less than the minimum nor greater than the maximum recommended by the manufacturer.
- v) The time interval between coats shall be not less than the minimum time nor greater than the maximum recommended by the manufacturer for the prevailing ambient temperature. This requirement is very important, in order to avoid solvent entrapment. Solvent entrapment may give rise to blistering, corrosion and poor adhesion on immersion.

c) Requirements of the finished system:

- i) The coating system shall be smooth, glossy and free from an orange peel effect, bubbling, or excessive runs and sags.
- ii) The total dry film thickness shall be a minimum of 250 micrometres and a maximum of 400 micrometres.
- iii) The coating shall be free from electrical insulation defects when tested with a wet sponge detector set to operate at 90 Volts, 2 Megohms. Repair of defects is permissible provided that the repaired area complies with all the requirements of this specification.

5.13.5 System C2 - Galvanised steel surfaces

a) Procedure:

- i) Prepare the surface as specified in Sub-clause 2.4.
- ii) Apply a two-pack epoxy primer specifically designed for use on galvanised steel, to a thickness of 25 - 30 micrometres.
- iii) Apply two coats of solvent borne epoxy-polyamide as specified for System C1 to give a total dry film thickness of minimum 150 micrometres and maximum 250 micrometres.

b) Requirements:

All other requirements shall be as for System C1.

5.13.6 System C3 - Solvent free epoxy on bare steel or cast-iron surfaces

a) Material

Material used shall be based on solvent free epoxy resins and shall comply with the performance requirements of SANS 1217 [38] Type 1C – solvent free chemically cured coating material.

b) Procedure

- i) Prepare the surface as specified in the relevant clause.
- ii) Apply one or two coats by means of a two-component hot airless spray machine suitable for the material to be used and as recommended by the manufacturer. Alternatively, where recommended in the manufacturer's data sheet, a high-ratio airless spray machine may be used. The machine shall be maintained in a clean condition and in good working order. The Contractor may be required to demonstrate to the Engineer that the machine is delivering components in the correct mixing ratio.

- iii) The Engineer may require an application onto test substrates which can be subsequently tested for the correct mixing ratio. Should the mixing ratio be found to be incorrect, all coated components will be rejected, after which the surfaces shall be blast cleaned and re-coated.
- iv) For lining of pipes, the spray head shall be mounted on a boom of sufficient length to traverse the full pipe length; and the pipe shall be constantly and uniformly rotated during application.
- c) Requirements of the finished system
 - i) The coating system shall be smooth, glossy and free from an orange peel effect, bubbling, or excessive runs and sags.
 - ii) The dry film thickness shall be not less than 250 micrometres nor greater than 500 micrometres.
 - iii) The coating shall be free from electrical insulation defects when tested with a wet sponge pinhole detector set to operate at 90 volts 10 Megohms. Repairs of defects is permissible provided that the procedure given below is followed, and that the repaired area meets all the requirements of the specification.
- d) Repair of epoxy systems
 - i) Fully cured epoxy coatings are more difficult to repair due to chemical cure of the coating. Careful attention to the following repair procedure is therefore necessary to ensure adequate adhesion of the material used for repair.
 - ii) Prepare the surface by abrasion as specified in the relevant clause, wiping the surface with methyl ethyl ketone solvent, to give a contact time of approximately 30 seconds.
 - iii) Wipe off any surplus solvent with a clean rag, then apply as many coats of repair material as are necessary to achieve the specified film thickness.
 - iv) When using solvent borne materials, note the need for adequate time between coats as specified under System C1.

5.13.7 System C4 - Epoxy with acrylic modified aliphatic polyurethane topcoat

a) General:

All epoxy resin-based materials show severe "chalking" when exposed to ultra violet light. This problem may be minimised by the application of a top coat of aliphatic isocyanate cured polyurethane. The pure polyurethanes are difficult to re-coat once they are fully cured. Acrylic modified polyurethanes, whilst slightly less water resistant than the pure polyurethanes, have the advantage of facilitating subsequent maintenance.

b) Material:

The material to be used shall be an approved two component acrylic modified aliphatic isocyanate cured polyurethane.

c) Procedure:

- i) Prepare the surface and apply a two-pack polyamide as specified in System C1.
- ii) Within the overcoating time specified by the manufacturer, apply one or two coats of polyurethane, as required to achieve the colour specified by the Engineer. Each coat shall be applied to a dry film thickness not less than 30 micrometres nor greater than 50 micrometres.

d) Sensitivity to moisture:

Polyurethanes are sensitive to moisture in the uncured state. Containers shall be kept in a dry store. Application shall be carried out in dry conditions with dry compressed air for spray application.

e) Requirements for the finished system

- i) The coating shall be smooth, glossy and free from an orange peel effect, bubbling, and excessive runs or sags.
- ii) The total dry film thickness (epoxy plus polyurethane) shall be not less than 250 micrometres nor greater than 450 micrometres.
- iii) For immersion conditions, the coating shall be free from electrical insulation defects when tested with an approved wet sponge detector set to operate at 90 volts, 2 Megohms. The repair of defects is permissible provided that the repaired area complies with all the requirements of SANS 1217 [38].

5.13.8 System D - Coal-Tar Epoxy for use Underwater

General:

- a) Coal-tar epoxy materials are two-pack chemically cured epoxy coatings containing special coal-tar. The function of the latter is to improve the water and acid-resistance of the epoxy composition and to reduce cost.
- b) The presence of coal-tar has disadvantages in that the composition is available only in black or dark brown. It is not recommended for exposure to South African sunshine as it chalks rapidly and may show more severe actinic degradation by crocodiling.
- c) It can be recommended as a relatively low-cost coating for underwater or underground use.
- d) As in the case of solvent-borne two-pack epoxies, care shall be taken to strictly observe the film-thickness limitations and overcoating times specified by the manufacturer to avoid solvent retention, blistering and delamination in service.
- e) These materials shall not be applied when the ambient temperature or the temperature of the steel surface is below 12 °C.
- f) Solvent-borne epoxy-tar compositions shall be allowed a minimum of 28 days to cure before immersion.

5.13.9 System D1 - On bare steel or cast-iron surfaces

a) Materials

Materials used shall comply with the requirements of SANS 801 [28] Type 1 or Type 2, solvent-borne chemically cured epoxy tar.

b) Procedure

- i) Prepare the surface as specified in the relevant clause, as may be appropriate.
- ii) Apply three or four coats of the epoxy-tar composition, mixed as recommended by the manufacturer, and as required to give a total dry film thickness of not less than 250 micrometres.
- iii) Each coat shall differ in colour from the preceding and succeeding coats so that the number of coats applied can be identified. The sequence of black-brown-black is acceptable.
- iv) Each coat shall be applied to a thickness of not less than the minimum or greater than the maximum recommended by the manufacturer.
- v) The time interval between applying the coats shall be not less than the minimum time or greater than the maximum time recommended by the manufacturer in respect of the prevailing ambient temperature. This requirement is very important in order to prevent entrapment or poor adhesion.

c) Requirements of the finished system

- i) The finished coating system shall be smooth, glossy and free from an orange-peel effect, bubbling, or excessive runs and sags.
- ii) The dry-film thickness shall be a minimum of 250 micrometres and a maximum of 400 micrometres.
- iii) The coating shall be free from electrical-insulation defects when tested with a wet-sponge detector set to operate at 90 volts 2 megohms. The repairing of defects is permissible

provided that the repaired area complies with the requirements as set out in SANS 1217 [38].

5.13.10 System D2 - On galvanised steel, galvanised cast-iron or aluminium surfaces

a) Materials:

Materials as specified in System D1 shall be used.

b) Procedure

- i) Prepare the surface as specified in the relevant clause, as appropriate.
- ii) Apply System C2, except that the dry-film thickness shall be a minimum of 200 micrometres and a maximum of 300 micrometres.

c) Site repair of epoxy-tar systems

- i) Fully cured epoxy-tar coatings are especially difficult to repair on account of the chemical curing of the coating. Careful attention to the following repair procedure is therefore necessary to ensure the adequate adhesion of the material used for repair work.
- ii) Prepare the surface by means of very thorough abrasion as specified in the relevant clause. This is to be followed by wiping the surface with the manufacturer's epoxy solvent, using clean rags or with a clean brush, to give a contact time of approximately 10 seconds. Wipe off any surplus solvent with a clean rag, then apply as many coats of repair material as are necessary to achieve the specified film thickness. When using solvent-borne materials, the need for adequate time between the coats as specified in System B1 shall be taken into account.

5.13.11 System E - Vinyl Resin-Based Systems

General:

- a) Single component vinyl resin-based paints have excellent resistance to water, chemicals, dilute acids and hypochlorites. Their resistance to heat is poor and must never be used on surfaces continually subjected to a temperature of 70°C or higher. They are not resistant to solvents and should not be used where there may be contact with oils, grease, kerosene, petrol etc.
- b) The main advantage of vinyls is their easy maintainability. Whereas epoxies are difficult to recoat after about one month's exposure, vinyls may be recoated after any period of time, provided that the surface is cleaned by the removal of chalking, dust, grease and general grime.
- c) Vinyls are therefore recommended for use above water; and for interior and exterior use where they will be subject to chemical fumes, as in chlorination rooms.
- d) For exterior use the topcoat may be modified with acrylic resin for improved colour retention. Such modified types usually have a semi-gloss rather than full-gloss finish.

5.13.12 System E1 - On bare steel or cast iron surfaces

a) Material

- i) The material used shall be based on polymerised vinyl-chloride co-polymer, adequately plasticised and containing sufficient UV stabiliser for South African conditions.
- ii) The final coat may be acrylic modified to give improved colour and gloss retention when exposed to ultra violet light.

b) Procedure

- i) Prepare surfaces as specified in the relevant system as may be appropriate.
- ii) Apply one coat of the manufacturer's recommended primer to a dry film thickness of not less than 30 micrometres and not greater than 60 micrometres. Allow at least 16 hours for curing, or longer in humid conditions.
- iii) Apply one or two coats of high-build vinyl intermediate coat, in different colours, to a dry film thickness of not less than 75 micrometres and not more than 125 micrometres per coat. Do not allow less than 16 hours to lapse between coats. One coat will be used for mildly corrosive conditions and two coats for highly corrosive conditions.

- iv) Apply one coat of vinyl enamel to a dry film thickness of not less than 25 micrometres or greater than 35 micrometres.
- c) Requirements of the finished system:

The finished system shall be smooth, glossy or semi-glossy, free from excessive runs, sags, blisters, wrinkling or other visual defects. The total dry film thickness shall be not less than 200 micrometres nor greater than 300 micrometres in the case of the system for highly corrosive conditions; or have a minimum of 125 micrometres and a maximum of 225 micrometres for the milder conditions.

5.13.13 System E2 - On painted or plastics items in chlorination rooms

- a) Material
 - i) Material used as a primer/barrier coat shall be a water-based vinyl-chloride-vinylidene-chloride-copolymer primer which contains zinc phosphate.
 - ii) Being water-based, the drying time is extended in humid conditions.
 - iii) Care shall be taken to avoid excessive film thickness and to allow adequate drying time before overcoating.
 - iv) Full drying and coalescence throughout the thickness of the film is essential.
 - v) Do not apply any coats at temperatures below 5 °C or where such temperatures are likely to be encountered before full curing has taken place.
 - vi) Do not apply to any wet surfaces.
- b) Procedure
 - i) Prepare the surfaces as specified in the relevant clause.
 - ii) Apply one coat of water-based vinyl-chloride-vinylidene-chloride-co-polymer primer which contains zinc phosphate to give a dry film thickness of not less than 30 micrometres and not greater than 60 micrometres. Allow a minimum of 16 hours for curing before the overcoat is applied. Since this material is water-based, the drying time shall be longer under humid conditions.
 - iii) Apply two coats of vinyl enamel. The medium shall not contain any alkyd resin or other saponifiable matter. Pigments used shall be light fast and shall not be affected by bleach solutions. The dry film thickness of each coat shall not be less than 25 micrometres or greater than 35 micrometres. The time interval between coats shall be not less than 16 hours.
 - iv) NOTE: The paint manufacturer shall be consulted before specifying the colour, because the range of pigments which meet the above-mentioned requirements are limited and strong colours may be costly.

5.13.14 System E3 - On galvanised steel

- a) Material:

Material used as a primer shall be either an approved water-based vinyl-chloride-vinylene-chloride-co-polymer which contains zinc phosphate (for above-water use only), or a two-pack epoxy resin-based primer specifically designed for use on galvanised steel and suitable for underwater service.
- b) Surface Preparation

Prepare the surfaces as specified for above-water surfaces, or for underwater surfaces, or highly corrosive environments as set out in the relevant clauses.
- c) Application
 - i) Apply the appropriate primer, as specified above, to the clean surface at a thickness within the range specified by the paint manufacturer.
 - ii) Apply one coat of vinyl high-build intermediate coat which complies with that specified in System C2 at a dry film thickness of not less than 75 micrometres or greater than 125

micrometres, followed by one coat of vinyl enamel at a dry film thickness of not less than 25 micrometres or greater than 35 micrometres.

- iii) The time interval between coats shall be not less than 16 hours.
- d) Requirements of completed system
 - i) The completed system shall be smooth, uniform, glossy or semi-glossy, free from runs, sags, bubbles and other visible defects.
 - ii) The dry film thickness of the vinyl system over the galvanised surfaces shall be 125 micrometres to 180 micrometres.
- e) Site repair of vinyl systems
 - i) Since vinyl systems are not chemically cured, only the abrasion of exposed steel is required for preparation. Abrasion of the coating and solvent wiping are unnecessary.
 - ii) Prepare the surface as specified in the relevant clause and remove all debris by brushing it with a clean dry brush.
 - iii) Apply the specified primer to the bare steel, followed by the required number of coats to restore the damaged area to meet the requirements of the appropriate specification.

5.13.15 System F - Two component solvent free polyurethane

- a) General:
 - i) The solvent-free polyurethanes constitute a relatively new class of coating with some outstanding properties. They may be divided into two main types, each of which is subject to a wide variation in properties which depends on the particular formulation.
 - ii) Elastomeric types

These are similar to rubber in that they have an elongation up to 300%, with good recovery. They have very high resistance to abrasion but need a primer with good water barrier properties when used on steel, on account of their relatively high water permeability. As the coating has a low co-efficient of friction and high resilience, it is suitable for lining containers for stones, grit and similar abrasive materials.
 - iii) Elastoplastic types

These are less like rubber but are still very much more flexible than epoxies, and have an elongation at break of about 25%. Their water permeability is much lower than that of the elastomeric types, and hence they are more suitable for underwater use.
 - iv) The method of application of the elastomeric types is by their being cast in a mould, or in the case of pipes, by their being spin cast.
 - v) The elastoplastic types are applied by brush, trowel or by a special two component hot airless spray unit in which the two components are metered to the spray head. It is imperative that the equipment be stripped and thoroughly cleaned periodically during use. Frequent checks shall be carried out to ensure that the correct mix ratio is maintained.
 - vi) Both types must be applied to dry surfaces under dry conditions.
- b) System F1 – Elastoplastic polyurethane on mild steel, underwater, mildly abrasive
 - i) Materials:

Primer for steel:

The primer shall be a suitable primer for steel supplied by the manufacturer of the coating material, and shall be applied at the manufacturer's specified thickness, and shall be overcoated within the specified overcoating time.
 - ii) Coating material:

The coating material shall be a solvent-free two component polyurethane hybrid, based on the polyether type polyol and the aromatic isocyanate. The cured coating shall comply with the following requirements:

- (1) Tensile strength at a 3mm thickness (ASTM D 638) - not less than 15 MPa.
- (2) Adhesion to correctly primed steel – not less than 10 MPa.
- (3) Impact resistance direct (ASTM G 14) – not less than 8 Joules.
- (4) Dielectric strength – not less than 10 kV/mm.
- (5) Elongation at break – not less than 25%.
- (6) Compressibility – not less than 25 MPa.
- (7) Surface hardness of 5 mm thick sample – not less than 60 or greater than 80 Shore 'D'.
- (8) Water vapour permeability – not greater than 0,5g/24h/m²/mm.
- (9) Cathodic disbanding – when tested in accordance with ASTM G8 Method A, for 60 days, the disbanded area shall not exceed 500 mm.

iii) Procedure

- (1) Prepare the surface as specified in the relevant clause.
- (2) Prime the surface with the coating manufacturer's primer for steel.
- (3) Within the minimum and maximum overcoating time interval specified for the primer by the manufacturer apply one coat or two coats by means of an airless spray machine fitted with metering pumps that dispenses the correct mix ratio at the spray head. The machine shall be maintained in a clean condition and in good working order. The Contractor may be required to demonstrate to the Engineer that the machine is delivering components in the correct mixing ratio. Test panels shall be coated during the application to enable a test to be carried out for adhesion and for Shore Hardness. Adhesion test panels shall be coated at the specified thickness but for Shore Hardness, and the coating shall be not less than 5mm in thickness.

iv) Requirements of the finished system

- (1) The coating shall be smooth, glossy, free from an excessive orange peel effect, bubbling, or excessive runs or sags.
- (2) The dry film thickness shall be not less than 1,0 mm.
- (3) The coating shall be free from electrical insulation defects when it is tested with a high voltage Holiday detector set at 5 kV.

5.13.16 System F2 – On mild steel in underwater highly abrasive conditions

As for System F1, except that the coating thickness shall not be less than 2 mm, no electrical insulation defects shall be detected when it is tested with a high voltage Holiday detector set at 10 kV.

5.13.17 System F3 – On mild steel in underwater very abrasive or cavitation conditions

As for System F1, except that the coating or lining thickness shall be not less than 3mm, no electrical insulation defects shall be detected when it is tested with a high voltage Holiday detector set at 15 kV.

5.13.18 Repair procedure for polyurethane systems

- a) Since polyurethane systems are chemically cured, very thorough abrasion of damaged or defective coating is required to ensure an adequate physical bond.
- b) If repair is carried out within 16 hours of application of the last coat of polyurethane, the surface shall be abraded with abrasive paper. Wipe it free from dust and debris, then apply the brush grade polyurethane thoroughly mixed in the correct proportions. The required number of coats shall be applied to achieve the specified thickness and freedom from holidays.
- c) If the repair is carried out later than 16 hours after the application of the last coat, the surface shall be abraded as given above and the debris removed. Thereafter, the manufacturer's

adhesive, thoroughly mixed in the correct proportions shall be applied to the abraded surface only, NOT to any area which has not been abraded. Allow not less than 30 minutes nor more than 4 hours before the brushing grade polyurethane, thoroughly mixed in the correct proportions, is applied to achieve the total thickness and freedom from holidays as required by the specification.

5.13.19 System G – Powder Coatings

a) General:

- i) Powder coatings comprise a wide range of polymeric materials, which are supplied in powder form and are converted to a coating by appropriate heating.
- ii) The materials may be divided into thermoplastic, which can be repeatedly melted and revert to solid on cooling; or thermoset which are resins that chemically cured when heated to the appropriate temperature for the appropriate time. After curing, they no longer become liquid on reheating.
- iii) Since thermoset materials have excellent adhesion to correctly prepared surfaces, this type is preferred at the present time.
- iv) Curing of thermoset materials requires heating up to 220°C. It is therefore important that the substrate be free from blowholes, cracks, crevices, surface roughness and similar sources of air entrapment. All blowholes and omegas in castings shall be filled flush with the surrounding surface (refer to the clause on surface preparation for painting of cast iron and cost alloys). Rough surfaces shall be suitably prepared and primed with a liquid two-pack epoxy primer, suitable for the substrate, prior to the application of the powder. Blisters, pinholes and fish eyes in the final coating will not be accepted.
- v) The correct heating schedule is essential to ensure the full cure of the powder. The mass of the article being coated affects the rate of heating and hence due allowance must be made for heavy components such as those made from cast-iron.

b) Surface preparation of articles fabricated from steel plate

- i) Fettling and dressing by the fabricator shall be in accordance with the requirements of the clause on Fettling or Dressing by the Fabricator.
- ii) The surface preparation required, as referred to in the clause on surface preparation for painting of mild steel less than 2 mm thickeners shall be carried out as follows:
- iii) A recognised chemical pre-treatment shall be carried out on the steel just prior to priming. (See SANS 10064 [24].).
- iv) The chemical pre-treatment shall consist typically of a seven-stage zinc phosphate process.
- v) The process shall result in the complete removal of all foreign matter, e.g. scale, grease, cutting oil, soil, weld flux, rust etc. The pre-treatment shall impart a uniform texture to the surface so as to render it suitable for the coating which is to be applied.
- vi) A fine-grained crystalline zinc phosphate is recommended at a coating weight of 1,5 - 2,5 g/m².
- vii) Great care shall be taken with water rinsing so as not to contaminate the next cleaning process. The last rinse shall be sufficiently thorough to remove all water-soluble material and any residual smuts.
- viii) After phosphating, the articles shall be primed as soon as possible after drying. In any event this time shall not be longer than 16 hours if the phosphated items are kept under dry cover. Clean cotton gloves shall be used for any manual handling prior to coating.

c) Surface preparation of galvanised articles

i) Galvanising

The fabricator shall observe the recommendations of SANS 10214 [27]. Galvanising shall be carried out after fabrication by the hot dip process in accordance with SANS 5763 [41] except that:

- (1) dross and other inclusions that give a surface roughness exceeding 100 µm maximum peak to valley height shall not be permitted (SANS 5772 [42]);

- (2) runs, drips and spikes shall be removed by filing before coating. Such filing shall produce a smooth surface with a residual zinc coating not less than the specified minimum thickness; and
- (3) repairs by zinc metal spray or by zinc rich primer are not permitted. Repairs by special solder are acceptable only if the solder does not interfere with the pickling and passivating process.

ii) Surface preparation of the galvanised surface

The galvanised surface shall be degreased, etched and phosphated by a recognised seven-stage dip or spray process for chemical treatment of galvanised steel to give a surface suitable for painting. The process shall remove all foreign matter such as grease, oil, soil and white rust. It shall impart a uniform texture to the surface, free from loose particles, smuts, water soluble salts and other contaminants that will impair performance of the coating system.

d) Priming

- i) The specified primer shall be applied in accordance with the manufacturer's instructions to give a dry film thickness of 20 to 30 micrometres.
- ii) Curing time for primer:
 - (1) The primer shall be left for the period recommended by the manufacturer, relevant to ambient temperature and humidity.
 - (2) It is essential that all solvent shall have evaporated before the application of powder.
 - (3) Low temperature baking is permissible if recommended by the manufacturer.

e) Application of powder coating

- i) General:
 - (1) All dust shall be removed.
 - (2) The primer shall be cured as set out above.
 - (3) The powder coating shall be applied by the electrostatic spray application method to a dry film thickness of 75 micrometres to 100 micrometres.

ii) Stoving

The powder coated items shall be exposed to the stoving schedule recommended by the powder manufacturer. The oven conveyor speeds or oven temperatures shall be adjusted to accommodate various metal thicknesses to ensure that every part is ultimately exposed to the minimum stoving schedule. Preference will be given to Contractors using travelling oven recorders.

iii) Test Plate

- (1) To avoid or minimise the use of destructive tests on the finished article, the Contractor may run a test plate, of identical steel and approximately 150 mm x 100 mm in area. The test plate shall be attached to the article such that it is subjected to all the processes of cleaning, phosphating, priming, powder coating and stoving identical to the processes applied to the article. A second test plate of powder only, without primer, shall also be prepared for powder cure tests.
- (2) To check the curing of the stoved coatings, sample chips of the coating shall, if necessary, be subjected to a differential scanning calorimetry (DSC) test, when delta-T_g shall be not greater than 3°C.

f) Requirements of the finished system

i) Appearance

The coating shall be smooth, glossy and free from excessive orange peel, bubbling, runs or sags, and shall comply with the requirements of SANS 1274 [36] of the appropriate type.

ii) Coating Thickness

The dry film thickness shall not be less than the minimum specified, when tested non-destructively on the article(s) coated, using the requirements of SANS 10141 [49]

iii) Adhesion

Adhesion shall not be less than 9 when tested on the test plate by SANS 10159 [50]. In case of doubt, the test shall be repeated on the article or representative samples. Test areas shall be repaired to the satisfaction of the Engineer.

g) Repair of powder coating

i) Any chipped or damaged areas of the coating shall be repaired as follows:

- (1) The area shall be abraded to white metal or to a uniform matt finish of the powder by using a 350 - 220 grit waterproof paper and water as a lubricant.
- (2) Dry the area with a clean cloth.
- (3) Apply by brush or spray the epoxy-polyamide primer, recommended by the manufacturer, of the powder, to a dry film thickness of minimum of 30 micrometres and a maximum of 50 micrometres to the bare metal.
- (4) After the recommended minimum and before the recommended maximum overcoating time, apply a top coat of polyurethane acrylic, as recommended by the powder manufacturer, and tinted to the same colour as the powder coating. Care shall be taken not to overlap the abraded area by more than 10 mm.
- (5) When cured, the repair may be burnished.
- (6) The aesthetic appearance of the patch shall be subject to approval by the Engineer. If not approved, the whole item shall be returned to the manufacturer for stripping and recoating.

ii) Handling of powder coated items

Powder coated items shall be packed and handled so as to prevent damage up to the point of completion of installation.

h) System G1 – Polyurethane powder coating on primed mild steel for exterior exposure

i) General

- (1) The primer used shall be a solvent-based polyamide cured epoxy material containing strontium chromate as an anti-corrosive pigment. It shall be a material designed for use as a primer for polyurethane powder coating, and which will withstand the maximum stoving cycle associated with the powder coating process.
- (2) The powder coating shall be a thermosetting polyurethane based material suitable for constant exterior exposure. The product shall comply with the requirements of SANS 1274 [36] Type 6. The powder coating shall be suitable for application over the primer specified above.

ii) Surface preparation prior to powder coating

Refer to the sub-clause on surface preparation of articles fabricated from steel plate for System G – Powder Coating.

iii) Primer

Apply the primer described above in accordance with the sub-clause on Priming for System G – Powder Coating.

iv) Powder

Apply the powder described above in accordance with the sub-clause on the application of Powder Coating for System G – Powder Coating to a dry film thickness of 75 to 100 µm.

v) Requirements of the coating system

The system shall comply with the requirements of the sub-clause on the requirements of the finished system for System G – Powder Coating and with the requirements of SANS 1274 [36] Type 6. The total dry film thickness shall not be less than 95 µm.

i) System G2 – Corrosion resistant powder coatings for interior and exterior use

i) Materials

The powder to be used shall comply with the requirements of SANS 1274 [36], Type 5, Thermosetting.

ii) Surface preparation

Refer to the sub-clause on surface preparation of articles fabricated from steel plate for System G – Powder Coating.

iii) Primer

No primer is required for this system.

iv) Application of powder coating

Refer to the sub-clause on the application of powder coating for System G – Powder Coating.

v) Requirements

The system shall comply with the requirements of the sub-clause on the requirements of the finished system for System G – Powder Coating with a minimum dry film thickness of 75 µm, and with the requirements of SANS 1274 [36] Type 5.

j) System G3 – Powder coating on aluminium for interior or exterior exposure

i) Material

The powder to be used shall comply with the requirements of Section 2 of BS 6496 [52].

ii) Pre-treatment

- (1) An approved chemical pre-treatment dedicated only to the pre-treatment of aluminium shall be carried out just prior to powder coating.
- (2) The pre-treatment shall comply with the requirements of BS 6496 [52], Section 3, Clause 8.
- (3) This is the only type of pre-treatment acceptable prior to powder coating onto aluminium components.
- (4) NOTE: The conductivity of the demineralised water draining off the rinsed work pieces shall not exceed 10 mS/m at 20°C. The metal surface after the pre-treatment and prior to coating shall be free from dust and powdery deposits.
- (5) After pre-treatment the articles shall be powder coated as soon as possible after drying. In any event this time shall not be longer than 2 hours if the items are kept under cover.

iii) Application of powder coating

- (1) The powder coating shall be applied to the clean pre-treated aluminium so as to result in a dry film thickness of a minimum of 50 micrometres. The thickness on any significant surface that requires a limited thickness of finish as indicated on suitably marked drawings, shall not exceed 120 micrometres.
- (2) The stoving temperatures shall be such that the heat history of the final product is in accordance with the manufacturer's recommendations, and takes into account the effect of varying metal thicknesses.

iv) Requirements of the finished system

- (1) The coating shall be smooth, glossy and free from excessive orange peel, bubbling, runs or sags. The coating shall comply with the requirements of Section Three of BS 6496 [52].
- (2) The dry film thickness shall be not less than 50 micrometres and where necessary, shall not be greater than 120 micrometres.
- (3) Tests for full cure of thermosetting materials shall be carried out. If the full cure is not achieved, the articles shall be re-heated or may be totally rejected, as determined by the Engineer.

v) Touch up and repair of damaged areas

Polyurethane and epoxy powders, when fully cured, are hard and impervious and difficult to overcoat without risk of delamination. The procedure given in the sub-clause on the repair of powder coating System G – Powder Coating shall be strictly adhered to.

k) System G4 – Polyurethane powder on galvanised mild steel for exterior exposure

i) Materials

- (1) The primer shall be a two-pack epoxy primer containing strontium chromate, designed for application to properly prepared galvanised steel.
- (2) The powder coating shall be a polyurethane powder complying with all the requirements of SANS 1274 [36] Type 6, Thermosetting.

ii) Surface preparation

Refer to the sub-clause on surface preparation of galvanised articles for System G – Powder Coating.

iii) Priming

Apply the primer specified above in accordance with the requirements of the sub-clause on primary for System G – Powder Coating.

iv) Powder coating

Apply the powder coating specified above in accordance with the sub-clause on the application of powder coating for System G – Powder Coating.

v) Requirements of the System

The system shall comply with the requirements of the sub-clause on the requirements of the finished system for System G – Powder Coating and SANS 1274 [36] Type 6. The minimum thickness of an organic coating shall be 95 μm and the total coating thickness (galvanising plus organic coating) shall be minimum 135 μm .

l) System G5 - Polyester powder coating on galvanised steel

The system shall be the same as specified for System G4, except that SANS 1274 [36] Type 6 shall be replaced by SANS 1274 [36] Type 4.

5.13.20 System H - Heat Resistant Systems

a) General:

- i) Systems given in this section are for application to surfaces which may become hotter than 100°C in service and which may remain at a high temperature; or which may fluctuate between ambient and high operating temperatures.
- ii) Corrosion only becomes a problem if the time at ambient temperature is long, relative to the heated time. Since allowance must be made for thermal expansion and contraction,

thin coats are preferred, even though thick coats give the best corrosion protection. All heat resisting systems are therefore a compromise between flexibility and corrosion protection.

- iii) Since most organic media and most pigments discolour when heated, the most popular and practical finish is an aluminium paint, the medium of which may vary according to the maximum service temperature.
 - iv) Blast cleaning is essential to ensure optimum adhesion to the substrate and so avoid peeling and flaking in service.
- b) System H1 – Phenolic aluminium for resistance up to 400 °C maximum

i) General

This system utilises the excellent corrosion and heat resistance of inorganic zinc silicate primer combined with the attractive appearance, relatively low cost and heat resistance of phenolic aluminium.

ii) Materials

- (1) The primer shall be a two-component zinc silicate based on self-curing ethyl silicate medium.
- (2) The aluminium top coat shall be a specially formulated phenolic aluminium guaranteed by the manufacturer to be suitable for temperatures up to 400 °C.

iii) Surface Preparation

The surface shall be prepared as specified in the relevant clause as appropriate, to the standards required for immersed surfaces given in Table 1.

iv) Primer

The primer shall be mixed and applied strictly in accordance with the manufacturer's instructions. Particular note shall be made of the following factors that can profoundly affect performance:

- (1) The whole of the zinc dust shall be mixed with the whole of the liquid component by slowly sifting the powder into the constantly agitated medium.
- (2) The mixed material shall be sieved to remove any unwetted lumps, which should be minimal in quantity.
- (3) The mixed material shall be constantly agitated during application.
- (4) The application of the primer to the prepared surface shall take place within the maximum times specified in Table 1.2.
- (5) The primer shall be applied uniformly by an applicator skilled and experienced in the application of the zinc silicate. The dry film thickness shall be not less than the minimum nor greater than the maximum given in the manufacturer's data sheet. In the absence of this information, the dry film thickness shall be not less than 50 micrometres nor greater than 100 micrometres. During application, the film shall appear wet. Dry spray is not permitted.
- (6) When relative humidity is below 60%, cure may be prolonged. In this case, allow not less than 4 hours after application, then spray the surface of the primer with a gentle mist of water.
- (7) Overcoating of the zinc silicate shall not take place until the primer is cured sufficiently to resist 30 double runs with a pad soaked in methyl ethyl ketone (MEK test); and shall not show any fracture when scraped with the edge of a coin under pressure (coin test).

Care shall be taken to avoid damage to the primer during transportation and erection of the primed components.

v) Top coat

- (1) Except where the component can be heat cured at the point of application, the top coat of heat resistant aluminium shall be applied on site after erection, since the top coat does not fully harden until subjected to heat. It is therefore not suitable for transportation and erection in the partially cured or uncured state.
 - (2) The primer shall be cleaned as specified in the relevant clause, except that abrasion is not necessary. However, it is imperative that the primer is completely dry before overcoating.
 - (3) To clean, dry primer surface, apply the Heat Resistant Aluminium Paint strictly in accordance with the manufacturer's instructions.
- vi) Requirements of the finished system
- (1) The finished system shall be smooth and uniform, with a metallic lustre, free from excessive runs, sags, blisters, bubbles, wrinkling or other visible defects.
 - (2) The total dry film thickness shall be not less than 70 micrometres nor greater than 120 micrometres. Since the coating will not be fully cured until it is put into service, the dry film thickness shall be measured by the use of a plastic shim of known thickness, placed between the painted surface and the probe of the electromagnetic thickness gauge. The thickness of the shim should then be deducted from the total thickness readings obtained.

5.14 QUALITY ASSURANCE REQUIREMENTS

5.14.1 Contractor Qualification

- a) The Engineer may, at his discretion, require a quality audit of the painting Sub-Contractor to ensure that he has the management, facilities and skilled staff, to meet all the requirements of the specification. He must also have the facilities and staff to carry out quality control during application of coatings to ensure compliance with the specification.
- b) The Contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by the Engineer or his representative.

5.14.2 Data Sheets, Specifications and Codes of Practice

The Contractor shall have available the latest issues of manufacturer's data sheets for materials to be used, National Specifications and Codes of Practice relevant to the work to be carried out, as well as a copy of this specification, all of which shall be available to the Contractor's Quality Control Manager, who shall read the relevant documents and follow the relevant instructions.

5.14.3 Quality Control

- a) The Contractor shall have the necessary equipment and staff knowledgeable in test procedures to carry out all the quality control required to ensure compliance with the specification. The Contractor will be required to produce a quality plan and a program for carrying out the work. The Contractor shall maintain quality control records of all stages of the work, batch numbers of materials used, environmental conditions, as required by the specification. Quality control shall be inclusive in the Contractor's tender price.
- b) NOTE: The SANS ISO 9000 series should be used to develop the required quality control procedures.

5.14.4 Quality Control Records

Proper and adequate quality control records shall be maintained by the Contractor for all stages of the work. These records shall be available for inspection by the Engineer or his representative at the time of quality surveillance. Incomplete, inaccurate or inadequate records shall be regarded as non-conformance with the specification.

5.14.5 Alternative Systems

Products or specifications considered to be equivalent to those specified may be submitted for approval by the Engineer. This approval will only be considered if the manufacturer of the products provides

adequate written evidence of equivalence. Form Q.1. shall be completed in duplicate and submitted to the Engineer with supporting evidence. Use of the system may not commence until approval in writing is given by the Engineer.

5.14.6 Quality Surveillance

- a) Independent surveillance - The Engineer may employ an independent technically qualified organisation to carry out quality surveillance of the work.
- b) Program – The Contractor shall advise the Engineer timeously and in writing, when and where the following processes will be carried out:
 - i) Completion of fettling or dressing prior to leaving the Fabricator's works.
 - ii) Blast cleaning and application of the primer coat.
 - iii) Completion of factory painting.
 - iv) Commencement of site painting.
- c) Failure of the Contractor to advise the Engineer of his program may result in rejection of the work.

5.14.7 Access for Surveillance

For the purpose of carrying out quality surveillance, the Engineer or his representative shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time. The Contractor shall provide, at his own cost, any equipment or labour necessary to gain access to surfaces which are coated, to be coated, or are in the process of being coated.

5.14.8 Samples

The Engineer or his representatives may remove any reasonable samples of materials to be used in the coating application. Rejection of the sample will place a hold on the use of materials of the same batch number and may lead to rejection of all that batch of material, and the reworking of any components that have already been coated with rejected material.

5.14.9 Destructive Testing

The Engineer or his representative may carry out reasonable destructive tests to ascertain compliance with the specification. Areas thus damaged shall be repaired by the Contractor to the satisfaction of the Engineer at no additional cost.

5.14.10 Cost of Quality Surveillance

The cost of quality surveillance shall be borne by the Employer, except when surveillance results in rejection of the lot for non-conformance with the specification; or when notice by the Contractor results in a fruitless trip, in which cases the cost of the surveillance shall be debited against the Contractor's account.

5.15 SPECIFIC APPLICATIONS

5.15.1 Enclosures

- a) Outdoor applications – for large cabinets in non-corrosive environments, use System A1. In corrosive environments, use System B.
- b) For enclosures small enough to be powder coated and in non-corrosive environments, use System G1.
- c) In corrosive environments, use System G4.
- d) Indoor applications, use System A1 (Interior) for non-corrosive conditions; or System B for corrosive environments.
- e) Where powder coating is practical, use System G2 for non-corrosive conditions; or System G4 for corrosive environments.
- f) For all corrosive conditions, add a Vapour Corrosion Inhibitor (VCI) emitter after completion of installation.

- g) After completion of installation, install Vapour Corrosion Inhibitors in the form of emitters. The size, number and chemical composition of the emitters shall be adequate for at least 12 months protection of all the metals inside the cabinet. Replacement of VCI emitters shall be included as part of the maintenance manual for the equipment.

5.15.2 Cable trays and ladders

- a) Due to many edges, cable trays and ladders must always be hot dip galvanised. In corrosive environments, or when so specified by the Engineer, they shall also be coated. Note the special requirements for galvanising to be coated, in addition to the requirements of SANS 121 [31].
- b) Galvanising or System G5 is required for interior conditions.
- c) Galvanising or System G4 is required for exterior conditions.

5.15.3 Supports for cable racks

Use the same system for cable trays and ladders, or if an air drying system is required, use System A1 for non-corrosive conditions or System G5 for corrosive conditions.

5.15.4 Switch gear

- a) Refer to the systems prescribed for enclosures.
- b) In corrosive conditions, indoor or outdoor, add VCI emitters after installation. Reference to replacement of VCI emitters must be made in the maintenance manual.

5.15.5 Transformers

These are normally coated with specialist materials designed for flood coating. The system used shall be designed for a 25 years maintenance-free life and shall have a coating thickness not less than 100 micrometres, except in the case of hot dip galvanising, when the requirements of SANS 121 [31] will be acceptable.

5.16 MEASUREMENT AND PAYMENT

Full compensation for the Contractor's obligations regarding all corrosion protection as described in this section shall be included in payment, at the tendered rates, for the relevant items of equipment as specified in other sections of this specification.

Table 3: Summary of Coating Systems

System A – Alkyd Systems

Scope: For application to surfaces in non-corrosive environments for attractive appearance or colour coding. **NOT** to be used for immersion, splash-zone protection or in very humid environments.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
A1	Bare steel	Degrease Blast clean Degrease, pickle and passivate	Cleanliness Sa 2.5. Dust & debris 0,5%. No oil or grease. Profile 25-50 µm.	Zinc phosphate SANS 1319	GP undercoat SANS 681 Type 2	Enamel SANS 630 Type 2 (ext) Type 1 (int) 1 coat (int) 2 coats (ext)	Smooth, glossy finish, free from visible defects. DFT minimum 75 µm - interior 100 µm - exterior	Light fast pigments for exterior use. Colour as specified by the Engineer .
A2	Factory cleaned and primed steel surfaces	Abrade the surface, degrease, wash and dry.	Dust & debris 0,5%. No oil & grease. Water-break-free surface. Dry.	Zinc phosphate SANS 1319. Touch up, plus 1 coat all over.	GP undercoat SANS 681 Type 2	As A1	As A1	As A1
A3	Factory finished surfaces	Sand surface. Touch up damaged areas. Sand the entire surface.	As above.	Touch up only.	Touch up only.	Enamel SANS 630 Type 1 (int) 1 coat (int) 2 coats (ext)	As A1 but total DFT not less than 50µm - interior. Type 2 (ext) 75µm - exterior.	Do not use in chlorination rooms - see specification E2.
A4	Galvanized steel	Degrease, abrade or sweep-blast. Remove debris.	Zinc removal not more than 10 µm. Water-break-free surface. Allow to dry.	Special primer - see specification	GP undercoat. One coat SANS 681 Type 2	As A1	As A1	Thorough degreasing necessary and complete drying of primer before applying undercoating.
A5	Plastic surfaces.	Abrade the surface, degrease, wash and dry.	Matt clean surface.	As A4	None.	Two coats SANS 630 Type 1 or Type 2	As A1. Alkyd enamel.	DO NOT USE SOLVENT DEGREASER - only water-based detergent type. Primer must be completely dry before applying enamel.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 4: Summary of Coating Systems (continued)

System C - Two-Pack Epoxy Systems

Scope: For application to surfaces to be submerged, in splash zone or in corrosive environments.

Surfaces exposed to sunlight shall be protected from UV light by applying acrylic modified polyurethane - see C4.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
C1	Bare steel	Blast clean	Sa 3	Three or four coats of solvent-borne Epoxy-Polyamide SANS 1217 Type 1A. Each coat to differ in colour from the previous coat. Each coat to be applied within the thickness and time limits specified by the manufacturer.			Smooth, glossy, free from visible defects. DFT min 250 max 400µm Underwater surfaces free from EID at 90 volts 2 megohms.	Precautions required on overcoat times to avoid solvent retention. Repairs permissible if correct procedure is followed. Note overcoat times.
	Cast iron	Blast clean (non re-used abrasive). Fill all blow-holes.	Sa 3					
C2	Galvanized steel or cast iron	Degrease, abrade, remove debris.	Water-break free. Not more than 10µm of zinc removed.	Special two pack epoxy primer followed by 2 coats epoxy polyamide as used in C1.			As B1, except that DFT shall be min 150 max 250µm.	As for C1.
C3	Mild steel	Blast clean	Sa 3	One or two coats (wet on wet) of solvent free epoxy SANS 1217 Type 1C. Mix ratio of components is critical - machine must be frequently stripped to maintain cleanliness internally.			Smooth, glossy, free from visible defects. DFT min 250 max 500µm Free from EIDs at 90 volts 10 megohms.	Special spray equipment required. Contractor may be required to demonstrate that machine delivers the correct ratio of components
	Cast iron	Blast clean (non re-used abrasive)	Sa 3					
C4	Mild steel	Blast clean	Sa 3	System B1 plus - Topcoat - Acrylic modified Polyester Aliphatic Polyurethane emulsion.			Smooth, glossy, free from visible defects. DFT min 250 max 450µm	Precautions required on overcoat times to avoid solvent retention.
	Cast iron	Blast clean (non re-used abrasive)	Sa 3					

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 5: Summary of Coating Systems (continued)

System D - Two-Pack Epoxy-Tar Systems

Scope: For application only to surfaces to be submerged and not exposed to UV light.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
D1	Mild Steel	Blast clean	Sa 3	Three or four coats of Epoxy-tar composition SANS 801 Type 1 or Type 2. Alternative colours for each coat.			Smooth, glossy, free from visible defects. DFT - minimum 250 µm maximum 400 µm Free from EIDs at 90 volts 2 megohms	Precautions required on overcoat times to avoid solvent retention. Repairs permissible if correct procedure is followed.
	Cast Iron	Blast clean (non re-used abrasive)	Sa 3					
D2	Galvanized steel or aluminium surfaces	Degrease, abrade, remove debris.	Water-break free. Not more than 10µm of zinc removed.	Two or three coats of Epoxy-tar composition - SANS 801 Type 1 or Type 2. Alternative colours each coat.			Smooth, glossy, free from visible defects. DFT - minimum 150 µm maximum 300 µm	Precautions required on overcoat times to avoid solvent retention.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 6: Summary of Coating Systems (continued)

System E - Vinyl Systems

Scope: For application to surfaces exposed to chemical pollution by chlorine, ferric-chloride solutions or similar corrosive environments. For immersed service, use epoxy systems, such as C1 or C4.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
E1	Mild Steel	Blast clean	Sa 2.5	Vinyl	Two coats of high-build vinyl	Vinyl enamel	Smooth, glossy or semi-glossy, no visual defects. DFT 200 - 300 µm or 125 - 225 µm	Note definition of vinyl. Saponifiable matter not permitted.
	Cast iron	Blast clean (non re-used abrasive)	Sa 2.5	Vinyl				
E2	Painted or plastic items in chlorination rooms	Degrease, abrade, remove debris.	Uniform matt grease-free surface.	Water-based vinyl.	None.	Two coats of vinyl enamel.	Smooth, glossy or semi-glossy, no visual defects.	Pigments shall be unaffected by chlorine or bleach solution.
E3	Galvanized steel	Degrease, abrade or sweep blast clean	Uniform matt grease free surface	Water-based vinyl high-build vinyl	One coat of high-build vinyl	One coat of vinyl enamel	Smooth, glossy or semi-glossy no visual defects DFT - 125 - 180 µm	See E1.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 7: Summary of Coating Systems (continued)

System F – Two Component Solvent-Free Polyurethane

Scope: For abrasive and acidic underwater conditions.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
F1	Mild Steel	Blast clean	Sa 3	Special primer	One or two coats of solvent free polyurethane applied by special two-component hot spray machine.		Smooth, glossy, no visual defects. DFT - minimum 1 mm. Free from EIDs at 5 kV.	Surface and ambient conditions must be DRY. For MILD abrasive conditions.
F2	Mild Steel	Blast clean	Sa 3	Special primer	One or two coats of solvent free polyurethane applied by special two-component hot spray machine		Smooth, glossy, no visual defects. DFT - minimum 2mm. Free from EID's at 10 Kv	Surface and ambient conditions must be DRY. For HEAVY abrasive conditions.
F3	Mild Steel	Blast clean	Sa 3	Special primer	Multicoats of solvent free polyurethane applied by special two-component hot spray machine.		Smooth, glossy, no visual defects. DFT - minimum 3 mm. Free from EID's at 15 kV.	Surface and ambient conditions must be DRY. For VERY HEAVY abrasive conditions.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 8: Summary of Coating Systems (continued)

System G – Powder Coatings

Scope: Powder coating of cable racks, handrails, control boxes etc.

SYSTEM NO.	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM			NOTES
		METHOD	REQUIREMENTS	PRIMER	POWDER	REQUIREMENTS	
G1	Mild steel	Chemical phosphating	Fine grain zinc or iron phosphate.	Special epoxy polyamide.	Polyurethane SANS 1274, Type 6.	Smooth, glossy. DFT 80 - 140 μ m. See also SANS 1274, Type 6, Table 7.	For exterior use.
G2	Mild Steel	Chemical phosphating	As G1	Nil	Thermoset or Thermoplastic	Thermoset - DFT min 75 μ m. Thermoplastic - DFT min 300 μ m. See also SANS 1274, Type 5.	Interior and exterior use.
G3	Aluminium	Chemical BS 6496, Section 3, Clause 8.	See BS 6496.	Nil	Special powder. See BS 6496, Section 2.	DFT min 50 max 120 μ m. Full cure BS 6496, Section 10	For aluminium door and window frames, handrails and similar hardware.

NOTE: For Fusion Bonded Epoxy Powder Coating of pipes, valves and pumps. See Civil Specification S0105.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 9: Summary of Coating Systems (continued)

System H - Heat Resistant Systems

Scope: Compressor heads, incinerators, mufflers and stacks. Resistance up to 400 °C maximum.

SYSTEM NO.	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM			NOTES
		METHOD	REQUIREMENTS	PRIMER	TOP COAT	REQUIREMENTS	
G1	Mild steel	Chemical phosphating	Fine grain zinc or iron phosphate.	Special epoxy polyamide.	Polyurethane SANS 1274, Type 6.	Smooth, glossy. DFT 80 - 140 µm. See also SANS 1274, Type 6, Table 7.	For exterior use.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

Table 10-Summary of Recommended Electrical Applications

ARTICLE	INDOOR		OUTDOOR	
	Non-Corrosive	Corrosive	Non-Corrosive	Corrosive
Enclosures – large	SYSTEM A1 (Interior)	SYSTEM G5 plus VCI after installation	SYSTEM A1 (exterior)	SYSTEM G5 plus VCI after installation
Enclosures – small	SYSTEM G2	SYSTEM G5 plus VCI after installation	SYSTEM G1	SYSTEM G4 plus VCI after installation
Cable Trays and Ladders	GALVANISED		GALVANISED	
	or SYSTEM G5	SYSTEM G5	or SYSTEM G4	SYSTEM G4
Pedestals	SYSTEM A1 (interior)	SYSTEM C4	SYSTEM A1 (exterior)	SYSTEM C4
	or SYSTEM F2	or SYSTEM G5	or SYSTEM G1	or SYSTEM G4
TAKE NOTE OF THE CLAUSES ON WATER RETENTION AREAS AND SERVICES IN THE GENERAL SPECIFICATION				
Supports for Cable Racks	SYSTEM A1 (interior)	SYSTEM C4	SYSTEM A1 (exterior)	SYSTEM C4
	or SYSTEM F5	or SYSTEM B5	or SYSTEM G4	or SYSTEM G4
Switch Gear	SYSTEM A1 (interior)	SYSTEM C4	SYSTEM A1 (exterior)	SYSTEM C4
	or SYSTEM G2	or SYSTEM G5 plus VCI after installation	or SYSTEM G1	or SYSTEM G4 plus VCI after installation

NOTE: Table 10 is for convenient reference only. Its use does not absolve the Contractor from compliance with all clauses of the detailed specification.

Table 11 – Summary of Coating Systems

SYSTEM	GENERIC TYPE	SURFACE PREPARATION	TOTAL No OF COATS	BROAD ENVIRONMENT
A1	Alkyd	Blast clean or chemical	3	Interior non-corrosive
			4	Exterior non-corrosive
A2	Alkyd	Already primed	3	Interior non-corrosive
			4	Exterior non-corrosive
A3	Alkyd	Factory finished	As required	Interior non-corrosive
				Exterior non-corrosive
A4	Alkyd over vinyl primer	Galvanised	3	Interior and exterior non-corrosive
C1...C4	Two-pack epoxy	Blast clean	Varies	Undercoated applications not required for this specification
D Systems	Epoxy Tar	Blast clean	Varies	Underwater applications only
E Systems	Vinyl	Blast clean	Varies	Chemical environments - not required for this specification
F Systems	Solvent-free polyurethane	Blast clean	Varies	Special applications only - not required for this specification
G1	Polyurethane powder on primed steel	Chemical	2	Exterior use ; non or mildly corrosive
G2	Epoxy polyester powder	Chemical	1	Interior and exterior - non-corrosive
G3	Special powder	Special chemical	1	For aluminium surfaces only
G4	Polyurethane powder on galvanised steel	Chemical	2	Exterior use - corrosive
G5	Polyester powder on galvanised steel	Chemical	2	Interior use - corrosive

NOTE: Table 11 is for convenient reference only. Its use does not absolve the Contractor from compliance with all clauses of the detailed specification.

FORM Q.1. - QUESTIONNAIRE TO BE COMPLETED BY CONTRACTORS OFFERING ALTERNATIVE
CORROSION PROTECTION

Name of Supplier: Contract No. :

Equipment to be Supplied:

Materials of construction, for example, mild steel, cast-iron, cast-aluminium, bronze etc. Give grade of material for example: 316 L stainless steel.

CORROSION PROTECTION TO BE APPLIED

Galvanise or metal spray	
Surface preparation	
Primer	
Top Coats (1)	
(2)	
(3)	
Are all coats from same supplier	
* Generic type of coating	
Primer thickness (micrometres)	
Top Coats (1)	
(2)	
(3)	
Total dry film thickness – min (µm)	
Total dry film thickness – max (µm)	
QUALITY ASSURANCE: Were QC documents completed? Were the components subject to a Third Party inspection? If so, please supply documentation	

* Specify alkyd, chlorinated rubber, phenolic, epoxy, etc.

COMPANY STAMP

SECTION 6: ELECTRIC MOTORS

DOCUMENT NO.: STD-LRM-MM-0008

CONTENTS

6.1	SCOPE	529
6.2	STANDARDS AND LEGISLATION	529
6.3	GENERAL REQUIREMENTS.....	530
6.4	WORKING VOLTAGE AND SUPPLY SYSTEMS	530
6.5	TEMPERATURE RISE	530
6.6	EFFICIENCY AND POWER FACTOR	531
6.7	VIBRATION	531
6.8	NOISE LEVEL	531
6.9	ENCLOSURE AND FRAME	531
6.10	MOTOR TYPE	531
6.11	RATING AND STARTING REQUIREMENTS	531
6.12	BEARINGS	532
6.13	EARTHING	532
6.14	HEATERS AND DRAINAGE	532
6.15	TERMINAL ARRANGEMENTS	532
6.16	MOTOR/LOAD COUPLING	533
6.17	ADDITIONAL SPECIFICATIONS FOR TWO-SPEED MOTORS	533
6.18	SUBMERSIBLE MOTORS	533
6.19	ADDITIONAL REQUIREMENTS	534
6.20	TESTING	534
6.21	MEASUREMENT AND PAYMENT	534

6.1 SCOPE

This specification covers all electric motors that may be incorporated in any of the items of equipment to be supplied under the contract.

6.2 STANDARDS AND LEGISLATION

6.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[54] SANS 60034	Three-Phase Induction Motors (all parts)
[55] SANS 60034-1	Rating and Performance
[56] SANS 60034-2-1	Standard Methods for Determining Losses And Efficiency From Tests (excluding Machines For Traction Vehicles)
[57] SANS 60034-7	Classification of types of Construction, mounting arrangements and terminal box position (IM Code)

[58] SANS 60034-9	Noise limits
[59] SANS 60034-12	Starting Performance of Single-speed Three-phase Cage Induction Motors
[60] SANS 60034-14	Mechanical Vibration of Certain Machines With Shaft Heights 56 Mm And Higher - Measurement, Evaluation And Limits Of Vibration Severity
[61] SANS 60034-22	Rotating electrical machines
[62] SANS 60034-30	Efficiency classes of single-speed, three-phase, cage-induction motors
[63] SANS 60072	Dimensions and output series for rotating electrical machines
[64] SANS 60529	Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
[65] SANS 1701-2-8	Rolling bearings section 8: dynamic load ratings and rating life
[66] SANS 1804-2	Low-voltage three-phase standard motors
[67] DIN 3404	Lubricating nipples; button head

6.2.2 Standard Specifications Included in this Contract Document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[68] STD- LRM-GN-0005	Testing and commissioning
[69] STD- LRM-GN-0006	Corrosion protection

6.3 GENERAL REQUIREMENTS

- Electric motors shall comply with the requirements of SANS 60034 [54] and shall as minimum be of efficiency class IE3.
- All motors shall be standard catalogue models and shall be readily available.
- All motors shall where possible, be from the same manufacturer, and shall have the same interchangeable frames. Variations in type and size shall where possible, be limited, to prevent stocking a variety of special spares.

6.4 WORKING VOLTAGE AND SUPPLY SYSTEMS

- The motors shall be capable of operating within $\pm 10\%$ of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified 3-phase voltage system under actual service conditions. This must include the $\pm 10\%$ voltage tolerance, without exceeding the specified temperature rise, determined by the resistance on a basic full load heat run.
- At +10% voltage, the magnetic circuit shall be over fluxed and continuous operation at +10% V shall not result in deleterious heating.
- All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz, together with any voltage between plus and minus 5 per cent of the nominal supply voltage.
- The slip-in speed of any motor at 80 per cent of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer. The motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

6.5 TEMPERATURE RISE

The temperature rise, as determined by resistance, of all motors, shall not exceed the following de-rated values:

Old IEC 60085 Thermal class	E	B	F	H
IEC 60085 Thermal class	120	130	155	180
Temperature rise (K)	50	60	80	100

6.6 EFFICIENCY AND POWER FACTOR

- The efficiency of all motors shall be guaranteed by the Contractor, and shall comply with the requirements of SANS 60034-30 [62], and shall as minimum, be of efficiency class IE3. Deviations from the guaranteed efficiency shall be within the limits specified in SANS 60034-30 [62].
- The guaranteed efficiency of each size and rating of the motor shall be as determined in accordance with SANS 60034-2-1 [56], and shall be of the high confidence class. A basic test certificate of efficiency will be accepted for a motor of identical size and rating, or a basic test of efficiency shall be conducted if no certificate is available.
- The power factor of motors with a capacity of 20 kW or more shall not be less than 0,85 under all operating conditions.

6.7 VIBRATION

- Motors shall be statically and dynamically balanced.
- All motors shall be checked for vibration without load and at full rated voltage at the manufacturer's works. The vibration amplitude as measured, shall be in accordance with SANS 60034-14 [60], quality grade 'Special'.
- The ratio of axial to radial vibration shall not exceed 0,5.

6.8 NOISE LEVEL

Unless otherwise specified, motors shall be of 'normal sound power' and in compliance with SANS 60034-9 [58].

6.9 ENCLOSURE AND FRAME

- Each motor shall be protected to the degree required by its application, and its enclosure shall be designed for the system of cooling associated therewith.
- Notwithstanding the requirements above, the minimum degree of protection shall be IP55 to SANS 60529 [64], and unless otherwise required, motors shall preferably be of the totally enclosed fan-cooled (TEFC) type.
- All motors of the vertical-spindle type and those exposed to the weather, shall be provided with a robust canopy of approved design.
- Medium-length motors are preferred, but short-length motors may be accepted where space is limited and where written permission has been granted by the Engineer. Motor frame sizes shall be in accordance with SANS 60529 [64], SANS 1804-2 [66] and SANS 1804-2 [66].

6.10 MOTOR TYPE

Motors shall be of the squirrel-cage induction motor type. Slip-ring induction motors or other approved types will be considered if the Contractor is of the opinion that better results could be obtained by using such motors. Full electrical and mechanical details of each alternative shall be submitted with the tender documents.

6.11 RATING AND STARTING REQUIREMENTS

- Motors shall be adequately rated for the service for which they are intended, and due allowance shall be made for the temperature, altitude, climatic conditions and variations in the supply voltage. Motors shall however, not exceed 120% of the required capacity, without prior approval having been obtained from the Engineer.
- Not only shall motors be based on the full load requirements, but the motor capacity and starting characteristics shall be compatible with the requirements of the driven equipment.

- c) Where motors are required to drive high-inertia loads, the starting torque of the motor and the torque curve of the driven load shall be submitted to the Engineer for approval prior to manufacture. Such motors shall be capable of three starts per hour, with two consecutive starts from normal operating temperature, or more frequently if required by the Engineer.
- d) Motors shall be of the continuously running duty class S1, unless otherwise specified in the detailed specification, or if a more onerous duty is dictated by the drive requirement.
- e) All squirrel-cage induction motors shall be suitable for direct on-line starting at full voltage. Single-speed motors shall conform to SANS 60034-12 [59], Design B characteristics, unless otherwise approved by or dictated by the drive requirements.
- f) All motors shall be capable of starting its associated load with a minimum accelerating torque, of not less than 5 per cent of full-load torque, when the voltage at the motor terminals during starting is reduced to 80 per cent of the nominal value.
- g) Unless otherwise approved, the -15 per cent tolerance on locked-rotor torque permitted by SANS 60034-1 [55] will not be accepted and shall be limited to -10%.
- h) Documentation shall include performance curves to suit the expected working conditions.

6.12 BEARINGS

- a) All motors, shall wherever possible, be provided with pre-lubricated sealed bearings.
- b) Re-greaseable bearings shall require only one lubrication per year. Grease lubrication of ball or roller bearings, where approved, shall be by means of hexagonal button-type grease nipples to DIN 3404 [67].
- c) Grease-lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed, which holes shall be positioned so that the excess grease can be easily removed. Cups shall be fitted to contain excess grease.
- d) Bearings shall be protected against eddy currents, and shall be capable of withstanding vibrations caused by unbalanced loads.
- e) All bearings shall be designed for a minimum L10h, basic life rating of 50 000 hours at the rated load and speed for the application, in accordance SANS 1701-2-8 [65].

6.13 EARTHING

All motors shall be provided with a machined or spot-faced boss, tapped to receive a bolt of not less than 10 mm in diameter for earthing purposes. This needs to be located on one side between the mounting feet.

6.14 HEATERS AND DRAINAGE

- a) Non-submersible motors which will be located out of doors or in a damp location such as in a drainage sump, shall be provided with suitable means of drainage to prevent the accumulation of water due to condensation. They shall also be fitted with anti-condensation heaters suitable for a 230V AC supply if considered advisable by the manufacturer.
- b) Where specified in the detailed specifications, motors shall be supplied with anti-condensation heaters to keep the motor temperature at 23°C when the motor is not operational, in order to prevent moisture from condensing in the motor.
- c) Heater terminal boxes shall be fitted on the motor frame, and shall be of robust design, liberally sized and be complete with a suitable terminal block, and mechanical cable gland or conduit entry.

6.15 TERMINAL ARRANGEMENTS

- a) The line connections of each motor shall be brought out to a terminal box located in an approved position. In the case of two-speed motors, separate terminal boxes shall be provided for each speed.
- b) Terminal boxes shall be of the totally enclosed type and designed to exclude the ingress of dust and moisture. It needs to be sealed from the internal circuit of the motor, and shall be manufactured from sand-cast metal. The terminal boxes need to be as specified in SANS 60529 [64] and SANS 60034 [54]. The terminal box shall also be so designed that the cable entry may be made in any one of four positions placed at right angles to one another.

- c) Terminal boxes shall be of ample size to allow the cable to be terminated in the box. Under no circumstances will the cable be allowed to be in contact with the inside of the box or lid.
- d) Terminals shall be of a substantial design and shall be suited to receive cable lugs. Pinch-screw connections will not be accepted.
- e) The terminal arrangement shall permit the motor to be disconnected from its supply cable without damaging the cable tails. Furthermore, it shall allow for the supply cable and motor windings to be tested separately.
- f) The electrical clearance and creepage distances, with the correct cable terminations in position, shall comply with the requirements of SANS 60034 [54].
- g) Terminal markings shall be clear and permanent, and shall comply with SANS 60034-7 [57]. Irrespective of the direction of rotation required on the site, the connections shall be such that, when the supply leads L1-L2-L3 are connected to the motor terminals, U-V-W respectively, the motor shall rotate in a clockwise direction when viewed from the driving end.
- h) Motors suited for only one-directional rotation, shall be clearly marked as such by an arrow fixed to the motor frame at the driving end.
- i) Before the Contractor orders terminal boxes for electrical equipment, he shall supply details of the proposed boxes to the Engineer for approval. These precautions are necessary to ensure that the size of the connecting blocks installed is sufficient to accommodate the cables supplied and connected by another Contractor. In addition, sufficient space needs to exist within the box to route cables conveniently.

6.16 MOTOR/LOAD COUPLING

- a) Motors shall be coupled directly to the equipment to be driven, by means of approved couplings and/or gearboxes. Refer to the relevant sections for general specifications on transmission couplings and gearboxes. Vee-belt and chain drives will be considered only if direct coupling of the motor to the equipment is impossible or impractical. Motors driving vee-belt or chain drives shall be fitted with heavy-duty bearings suited to the full side-thrust at 120% of full load torque, and short-term overloads of up to 250% of the full load torques during starting. The stiffness of the rotor shaft shall be checked to ensure that resonance and fatigue do not occur.
- b) Where applicable, the flanges of the motors and equipment shall be identical.
- c) The precision tolerance class shall apply to all flange-mounted motors, with regard to concentricity, perpendicularity and shaft run-out.

6.17 ADDITIONAL SPECIFICATIONS FOR TWO-SPEED MOTORS

The following additional specifications apply to all two-speed motors:

- a) Terminal markings shall be as per SANS 60034-7 [57].
- b) The starting current shall not exceed six times the full load current of the high-speed rating.

6.18 SUBMERSIBLE MOTORS

- a) The following additional requirements apply specifically to all submersible motors:
- b) All submersible motors shall be suited for submersion up to a depth of 1,5 times the depth of submersion shown on the drawings for each application, or as specified in the detailed specifications. Where no depth is specified, the Contractor shall request the relevant information from the Engineer.
- c) All submersible motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- d) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- e) All terminal boxes shall be waterproof, and suited for submersion up to the depth as specified for the motors.
- f) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1,0 m above the

maximum water level, by means of a purpose-made, weather-proof, outdoor junction box. The submerged cable shall be supported to minimise any movement of the cable, which may result from turbulence caused by the operation of the equipment, or the flow of the water.

- g) Thermistor protection or Klaxon type temperature switches shall be provided for submersible motors.
- h) Seal monitors shall be provided for submersible motors, together with the required seal monitor relays. The cost for the seal monitor relays shall be deemed to be included in the rates tendered for the equipment.

6.19 ADDITIONAL REQUIREMENTS

- a) The rotation speed of motors shall not exceed 1 500 r/m unless approved otherwise by the Engineer.
- b) Thermistor protection shall be provided for each winding of each motor.
- c) The preferred class of insulation is Class F, and de-rated in accordance with the relevant clause above.

6.20 TESTING

Tests on completion (commissioning tests) shall be performed as described in the standard specifications covering testing and commissioning [68].

6.21 MEASUREMENT AND PAYMENT

No separate payment will be made for electric motors for equipment.

SECTION 7: STRUCTURAL METALWORK

DOCUMENT NO.: STD-LRM-GN-0007

CONTENTS

7.1	SCOPE	535
7.2	STANDARDS AND LEGISLATION	535
7.3	GENERAL REQUIREMENTS.....	536
7.4	MATERIALS	536
7.5	WORKSHOP DETAILS	539
7.6	FABRICATION AND ASSEMBLY.....	539
7.7	ERECTION	542
7.8	CORROSION PROTECTION	543
7.9	TESTING	543
7.10	TOLERANCES	543
7.11	MEASUREMENT AND PAYMENT	544

7.1 SCOPE

This section covers the manufacture, transportation and erection of structural ferrous and non-ferrous metalwork for minor structures such as light trusses, ladders, catwalks, prefabricated open-grid floors, handrails, etc, that are usually fabricated from commercial quality metals.

7.2 STANDARDS AND LEGISLATION

7.2.1 National and International Standards

The latest edition, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[70] SABS 965	Welded austenitic stainless steel tubes.
[71] SABS 728	Electroplated coatings of nickel and chromium.
[72] SABS 1431	Weldable structural steels.
[73] SABS 657, Part I	Steel tubes for scaffolding and for structural and general engineering purposes.
[74] SABS 135	ISO metric bolts, screws and nuts (hexagon and square) (coarse thread free fit series).
[75] SABS 136	ISO metric precision hexagon-head bolts and screws, and hexagon nuts (coarse thread medium fit series).
[76] SABS 1143	Mushroom- and countersunk-head bolts and nuts.
[77] SABS 1149	Flat and taper steel washers
[78] SABS 1282	High-strength bolts, nuts and washers for friction-grip joints.
[79] SABS 094	The use of high-strength friction-grip bolts.
[80] SABS 435	Mild steel rivets.
[81] SABS 455	Covered electrodes for the manual arc welding of carbon and carbon manganese steels.

- [82] BS 5135 Specification for ore welding of carbon and carbon manganese steels
- [83] BS 709 Methods of destructive testing fusion welded joints and weld metal in steel.
- [84] BS 2901 Filler rods and wires for gas-shielded ore welding.
- [85] BS 1473 Specification for wrought aluminium and aluminium alloys for general engineering purposes - rivet, bolt and screw stock.
- [86] BS 3382 Specification for electroplated coatings on threaded components.

7.2.2 Standard specifications included in this contract document

The following standard specifications bound in this document, shall be read in conjunction with this specification:

Standard Specification: General Corrosion Protection

7.3 GENERAL REQUIREMENTS

The design of structural steelwork, where undertaken by the Contractor, shall comply with the requirements of SABS 0162, and shall apply to all structural work made from other metals where relevant.

Welding shall be in accordance with SABS 044.

7.4 MATERIALS

7.4.1 Stainless Steel

a) Material grade

Unless otherwise specified or shown on the drawings, stainless steel shall be grade 304L.

b) Dimensions and properties of structural members

i) Structural sections

All dimensions and properties of stainless steel structural sections shall comply with those published in the latest edition of the Stainless Steel Buyers Guide, issued by the Southern African Stainless Steel Development Association (SASSDA). The Contractor shall obtain his own copy.

ii) Tubes

Stainless steel tubes shall comply with the requirements of SABS 965 for class A tubes.

iii) Bolts, nuts and washers

Stainless steel bolts and nuts shall be those acting in the bearing and shear rather than in the friction-grip mode, and shall comply with the requirements of SASSDA Standard Programme K18-8(A2); which embraces all nuts, bolts and accessories of the most frequently used types and sizes.

iv) Rivets

Stainless steel rivets shall be subject to approval by the Engineer.

v) Welding consumables

- (1) Welding electrodes shall be approved by the Engineer. The handling and storage of all consumables shall be in accordance with BS 5135.

- (2) Welding consumables used shall be appropriate for producing weld metal that will yield all-weld test specimens as specified in BS 709. The minimum yield and minimum tensile strengths of both should not be less than those of the parent metal.
- (3) Welding consumables shall be compatible with the material to be welded.

7.4.2 Proprietary-brand corrosion-resistant steels

a) Material grade

The grades and types of proprietary-brand corrosion-resistant steels selected for structural work will be specified in the detailed specifications. Particular attention shall be paid to the costs and technical aspects of fastenings, welding, bimetallic couplings, etc. because the fastening systems such as bolts, etc. of the same material are often not readily available. Contamination in workshops caused by the use of tools on other metals shall be avoided. All the requirements and recommendations made by material producers shall be adhered to.

b) The dimensions and properties of structural members

The dimensions and properties of structural members shall be subject to approval by the Engineer.

Where the use of 3CR12-steel is approved, the dimensions and properties of structural members shall be in accordance with the publication 3CR12 Cold Formed Structural Sections, issued by Middelburg Steel & Alloys (Pty) Ltd; or by an approved equivalent source. The Contractor shall obtain his own copy.

c) Fastening systems

All fastening systems shall be subject to approval by the Engineer.

Where the use of 3CR12-steel structural sections has been approved by the Engineer, stainless steel fastening systems shall be employed between 3CR12 and other materials such as concrete. Welding or stainless-steel fastening systems shall be employed between 3CR12 parts.

d) Welding consumables

Welding electrodes shall be approved by the Engineer. The handling and storage of all consumables shall be in accordance with BS 5135.

Welding consumables used shall be appropriate for producing weld metal that will yield all-weld test specimens as specified in BS 709. The minimum yield and minimum tensile strengths of both shall not be less than those of the parent metal.

Welding consumables shall be compatible with the material to be welded.

7.4.3 Aluminium

a) Material grade

Unless otherwise specified or shown on the drawings, aluminium shall be Hulett Designation Grade 6082 (Old Hulett Designation Grade B51S); or Hulett Designation Grade 6261 (Old Hulett Designation Grade D65S). The Hulett Designation is equivalent to the designation of the Aluminium Association (AA) as used in the United States of America.

b) Dimensions and properties of structural members

All dimensions and properties of aluminium structural sections shall comply with those published in the Hulett Standard Profile Catalogue issued by Hulett Aluminium Limited, or an approved equivalent. The Contractor shall obtain his own copy.

c) Rivets and bolts

Rivets shall be manufactured from material which complies with the requirements of BS 1473. Where practicable, aluminium bolts, washers, and nuts shall be of the same alloy as the members to be joined. However, where bolts, washers, and nuts of the said alloy are not available, they shall be of:

- i) alloy designation 6261 or 6082 or 5083, as may be applicable, or such other alloy designation as is given in the detailed specifications, and shall comply with the appropriate requirements of BS 1473; or
- ii) electroplated steel.

Electroplated steel bolts, nuts, and washers shall have an electroplated coating of nickel plus chromium that complies with the requirements of SABS 728 for the service conditions stated in the detailed specifications. The threads shall be coated to the thickness required in terms of BS 3382.

Fasteners of other materials shall be used only where shown on the drawings, or required in terms of the detailed specifications, or where their use is specifically approved by the Engineer.

- d) Welding consumables

Welding filler wires shall comply with the relevant requirements of BS 2901.

The handling and storage of all consumables shall be in accordance with BS 5135.

Welding consumables used shall be appropriate for producing weld metal that will yield all-weld test specimens as specified in BS 709. The minimum yield and minimum tensile strengths of both shall not be less than those of the parent metal.

Welding consumables shall be compatible with the material to be welded.

7.4.4 Structural Steel

- a) Material grade

Structural steel shall comply with the requirements of SABS 1431. Unless otherwise specified or shown on the drawings, mild steel shall be grade 300 W and high-tensile steel shall be grade 350 W.

- b) The dimensions and properties of structural members

Rolled-steel sections shall comply with the dimensions and properties given in the structural-steel tables issued by the SA Institute of Steel Construction.

Steel tube shall comply with the requirements of SABS 657: Part 1.

- c) Bolts, nuts and washers

Ordinary bolts and nuts shall be bolts acting in the bearing and shear rather than in the friction-grip mode; and shall comply with the requirements of SABS 135, SABS 136 or SABS 1143.

Washers for ordinary bolts and nuts shall comply with the requirements of SABS 1149.

High-strength friction-grip bolts, nuts and washers shall comply with the requirements of SABS 1282; and shall be capable of being reliably tensioned to the appropriate load recommended in SABS 094.

Other friction-grip fasteners equal to the above may be used subject to the Engineer's approval.

Bolts, nuts and washers shall be of the material shown on the drawings or specified in the detail specifications.

d) Rivets

Mild-steel rivets shall comply with the requirements of SABS 435. High-tensile rivets shall be so manufactured that they can be driven with their heads formed satisfactorily without the physical properties of the steel being impaired.

e) Welding consumables

Welding electrodes shall comply with the requirements of SABS 455. The handling and storage of all consumables shall be in accordance with BS 5135.

Welding consumables used shall be appropriate for producing a weld metal that will yield all-weld test specimens as specified in BS 709. The minimum yield and minimum tensile strengths of both shall not be less than those of the parent metal.

Welding consumables shall be compatible with the material to be welded.

7.5 WORKSHOP DETAILS

Where workshop details are not provided on the drawings, the Contractor shall prepare his own workshop details. On receipt of the design drawings and calculations, the Contractor shall satisfy himself that the design drawings contain all the information required for the preparation of the workshop details, supporting calculations, and any other necessary drawings. The workshop details and other drawings shall be submitted in duplicate to the Engineer for approval at least one month (or such other period as may be stated in the detailed specifications) before the commencement of fabrication.

The Contractor's drawings shall be complete in every respect (including welding details, which shall be fully described) and shall be checked by the Contractor prior to submission. One copy of each drawing will be retained by the Engineer, and within 2 weeks (or such other period as may be stated in the detailed specifications) of the date of receipt by the Engineer, the other copy will be returned to the Contractor with the Engineer's comments or written approval as the case may be.

Before the commencement of fabrication, the Contractor shall obtain the Engineer's approval in writing of the workshop details. The approval given by the Engineer does not absolve the Contractor from the responsibility for dimensional accuracy and structural adequacy.

7.6 FABRICATION AND ASSEMBLY

7.6.1 Tolerances

Both before and after fabrication, all structural steel shall be within the tolerances specified in the relevant clause; and shall be flat, straight (unless required to be formed to another shape) and free from twists.

7.6.2 Identification

At all stages of fabrication, structural metal other than grade 300 W steel, shall be positively identified by grade, and by means of a suitable approved marking system.

7.6.3 Cutting

Cutting may be done by sawing, shearing, cropping or flame cutting, provided that the method used will not adversely affect the material properties.

Edges shall be free from any defects or distortions, and all burrs, notches and similar defects shall be removed.

7.6.4 Holes for Fasteners

Holes for fasteners shall not be formed by flame cutting. Holes in light members not thicker than 12 mm or the diameter of the hole, whichever is the smaller, may be punched.

Holes for fasteners up to 25 mm in diameter shall not be more than 2 mm bigger than the fastener diameter, and for larger fasteners, not more than 3 mm bigger than the fastener diameter.

Holes for friction-grip fasteners shall be in accordance with SABS 094.

All burrs shall be removed from holes before assembly.

7.6.5 Joints in Compression

The abutting surfaces of joints which depend on contact for the transmission of load, shall be accurately prepared so that the full area intended for bearing is in contact.

7.6.6 Hollow Sections

Unless protection against corrosion is provided by other means approved by the Engineer, the interior of any hollow section shall be sealed to prevent the ingress of water into the interior of the member. Vent holes for galvanising shall be sealed by means of a plastic plug after galvanising has been completed.

7.6.7 Alignment of Holes

All matching holes for fasteners or pins shall be accurately aligned so that the fasteners can be inserted freely through the assembled members in a direction at right angles to the faces in contact. Drifting to align the holes shall not distort the metal or enlarge the holes.

7.6.8 Welding

All welding shall comply with the appropriate international standards such as BS 1856 (General Specification) and BS 709 (Methods of Testing).

The welding shall be executed in accordance with modern accepted practice for welding and shall be sound, full strength and free from undercut and slag inclusions. Crater effects at the ends of weld runs shall be eliminated.

Intermittent welding and incomplete penetration butt-welding shall not be used.

All fabricated items shall be stress relieved after welding.

The supplier shall, well in advance of the commencement of fabrication, submit for approval details of proposed welding procedures.

Welding techniques shall be such as to avoid undue distortion and minimise shrinkage stresses.

All slag shall be removed.

Where specified in the detailed specifications in respect of certain work, the welders for welding in the workshop, or on the site, shall have passed the tests for a grade 1 welder as laid down in SABS 044: Part IV.

7.6.9 Bolting

The parts to be joined shall be firmly drawn together. Where necessary, washers shall be tapered to give the bolt heads and nuts a full bearing. Where bolt holes have clearances greater than those specified and are acceptable to the Engineer, washers shall be used under the bolt heads and nuts.

The length of each bolt shall be such, that after tightening, at least one full thread but not more than five, will project beyond the outer face of the nut. At least one full thread (in addition to the thread run-out) will remain clear between the nut and the unthreaded shank.

7.6.10 Friction-Grip Fastening

The use of friction-grip bolts shall be in accordance with SABS 094. Where use is made of other types of friction-grip fasteners, they shall be assembled and tightened to not less than the load at permanent set as specified in SABS 094.

7.6.11 Riveting

Wherever possible, riveting shall be done with pneumatic equipment.

Riveted members shall have all parts firmly drawn together and aligned before riveting is done. Every rivet shall, when driven, completely fill the hole and have a well-formed head, or if countersunk, shall completely fill the countersink.

All loose, eccentric-headed, badly formed, burnt or otherwise defective rivets, shall be cut out and replaced at the Contractor's expense.

7.6.12 Staircases

Staircases shall be provided in accordance with the details and positions as shown on the drawings and in accordance with the requirements of this section.

The staircases shall be fabricated from the materials specified in the detail specifications, shall be of an approved design, and shall comply with all the requirements of the Machinery and Occupational Safety Act, Act No 6 of 1983.

All mild steel staircases shall be galvanised in accordance with the requirements of the specification on general corrosion protection. The galvanising shall be of the heavy-duty class. Under no circumstances shall any cutting, drilling, welding, etc. on parts be allowed after galvanising.

Each staircase shall be fastened with at least four bolts at its top, to a structure, wall or beam. The bottom of each staircase shall be founded on a concrete base to which it shall be fastened with at least four bolts.

The width of all staircases measured between the handrails shall, unless otherwise shown on the drawings, not be less than 900 mm.

7.6.13 Handrailing

Handrailing shall be provided on the sides of all staircases and edges of walkways as required by the Machinery and Occupational Safety Act, Act no 6 of 1983.

All handrailing shall be of the material specified in the detailed specifications, and shall be manufactured and positioned in accordance with the details shown on the drawings and in accordance with the detailed specifications.

Galvanising shall be applied to all mild steel handrailing, shall be of the heavy-duty class in accordance with the requirements of the standard specification on general corrosion protection. Under no circumstances shall any cutting, drilling, welding, etc. on any part be allowed after galvanising.

All handrailing shall be erected strictly in accordance with the manufacturer's requirements and shall be standard Wecrolok or approved equivalent types.

The painting of handrailing shall mean the application of a final coat of paint, as specified in the standard specification on general corrosion protection.

The Contractor shall obtain from the Engineer in writing, the colour of the final coat. Unless otherwise specified or instructed by the engineer, all stanchions shall be black and all stringers chrome yellow.

7.6.14 Open-Grid Flooring

Open-grid flooring shall be provided in accordance with the details and positions as shown on the drawings and in accordance with the requirements of this section.

All open-grid flooring shall be of panels fabricated from the materials specified in the detailed specifications. Each individual panel shall be loose, removable and banded. Galvanising on mild steel panels shall be of the heavy-duty class in accordance with the standard specification on general corrosion protection. Openings and holes for valve spindles, pump brackets, etc. shall be cut and banded to the approval of the Engineer prior to galvanising.

Fibreglass open-grid flooring may, on approval, be supplied in corrosive areas, or in high voltage areas.

The sliding or see-sawing of panels when walked on is unacceptable. Each panel shall remain flat in position and its top shall be on the same level as and form a uniform plane with the tops of all adjacent panels or concrete edges. Where a panel adjoins concrete, it shall rest on an angle-profiled ledge embedded in and anchored to the concrete with approved anchor hooks as shown on the drawings. The angle-profiled ledge shall be of the same material and have the same corrosion protection as the open-grid flooring panel (except for fibreglass panels).

Kick plates and handrailing shall be provided along all flooring edges where sheer drops occur or where instructed by the Engineer.

Nosing edges shall be provided at all front edges of step treads.

All nosing edges, kick plates, grids, accessories, etc. shall be standard proprietary brand types, and be approved by the Engineer.

7.7 ERECTION

7.7.1 Methods

Where required in the detailed specifications, details of the method of erection shall be submitted to the Engineer for approval. All structural metal shall be so stored, transported, handled and erected that it will not be subjected to undue stress nor be damaged.

7.7.2 Safety During Erection

During erection of a structure, the metalwork shall be bolted, braced or otherwise secured so as to make adequate provision for all erection loads.

The Contractor shall use appropriate slings, crane loading, barriers, notices, clothes and other precautions to ensure the safety of the public, staff and operators.

7.7.3 Alignment

Each part of a structure shall be aligned as soon as possible after erection. Members shall not be permanently connected until a sufficient part of the structure has been aligned, levelled, plumbed and temporarily connected. This ensures that it will not be displaced during the erection or alignment of the remainder of the structure.

7.7.4 Corrections

Drift pins, jacking equipment and the like, shall not be used for bringing improperly fabricated members into place. A moderate degree of cutting and reaming may be employed for correcting minor misfits; but only if in the opinion of the Engineer, it will not adversely affect the appearance, corrosion protection or strength of the structure. The burning of holes will not be permitted without the approval of the Engineer.

7.8 CORROSION PROTECTION

Corrosion protection of all materials, fasteners and consumables shall conform to the requirements of the standard specification on general corrosion protection.

7.9 TESTING

7.9.1 Testing by the Engineer

The Engineer may nominate a testing authority to inspect the works and to conduct such tests as he may consider necessary, for testing compliance with the specifications. Where required, test samples of welds shall be prepared by the Contractor, free of charge.

The Contractor shall, where required and specified in the detailed specification, pay for the cost of testing.

7.9.2 Process control

Welds shall be regularly inspected and tested by the Contractor. This shall include the visual inspection of welds to ensure that there is no undercutting, no uneven lengths, no porosity or no evidence of cracking, and that the full fusion has been achieved. If required by the Engineer, cores containing weld and adjacent parent material shall be cut out in doubtful areas. The cores shall be polished and examined and the hole re-instated.

7.10 TOLERANCES

Fabrication and assembly tolerances for structural metal shall be as follows:

7.10.1 Default Tolerance

Unless otherwise specified herein, or in the detailed specifications, or on the drawings, fabrication and assembly tolerances applicable to the dimensions of structural metal shall be ± 2 mm. Holes for connections shall be drilled or punched, and aligned within the tolerances specified in clause.

7.10.2 Cross-section

The tolerances on cross-sectional dimensions of rolled sections shall be as specified in the Structural Steel Tables published by the SA Institute of Steel Construction.

7.10.3 Straightness

A structural member, before erection, shall not deviate from straightness (or the specified shape) by more than the following:

- a) For compression members and beams (other than purlins and sheeting rails): 1/1000 of the length between points which are laterally restrained.
- b) For other members: 1/500 of the overall length, but not more than 25 mm.

7.10.4 Length

The length of a member shall not deviate from its specified length by more than the following:

- a) For compression members faced at both ends for bearing purposes: ± 1 mm.
- b) For other members: + 0 - 4 mm.
- c) For composite members such as trusses and lattice girders, the above tolerances shall apply to the members as a whole.
- d) The length of component parts shall be such that the member can be properly assembled with the required accuracy.

7.10.5 Bearing surfaces

The maximum clearance between two steel-bearing surfaces shall not exceed 1 mm when the members are aligned, and the surfaces are in contact.

7.10.6 Accuracy of erection

Steelwork shall not be out of plumb over any vertical distance by more than 5 mm or 1/1000 of the distance, whichever is the greater.

Handrails shall, in the opinion of the Engineer, be visually straight and of the specified shape.

7.11 MEASUREMENT AND PAYMENT

Note:

Payment for structural metalwork related to equipment which is specified in other sections of these specifications (such as open-grid flooring and handrailing for settling-tank bridges, access stairways, platforms over blower pipes, and specifically mounting frames for pumps and compressors, etc.) shall be deemed to be included in the rates tendered for such equipment under the appropriate sections.

Structural metalwork not related to equipment specified in other sections of these specifications (such as open-grid flooring fixed over and stairways fixed against concrete channels, etc.) shall be measured and paid for under this section of the schedule of quantities.

For items measured by mass, no reductions in mass shall be made for punching, borings, sheared edges, milling, planing and cut-outs; and no additions in mass shall be made for rivets, bolts, nuts, washers, welding fillets or temporary bracing. Tolerances and other permissible deviations shall be ignored.

The tendered supply and delivery rates below shall include full compensation for preparing workshop details where they have not been provided in the drawings; the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading. They shall also include full compensation for all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and temporary bracing, and transportation.

Separate items will be scheduled in the schedule of quantities for different types and sizes of items manufactured from metal.

Item	Description	Unit
7.11.1	Supply and delivery of metal items by mass	tonne (t)

The unit of measurement shall be a tonne (1 000 kg) of structural metal contained in the structural item to be erected as specified.

Item	Description	Unit

7.11.2	Supply and delivery of metal items by length	linear metre (m)

The unit of measurement shall be a metre of completed item to be installed as specified.

Item	Description	Unit

7.11.3	Supply and delivery of metal items by area	square metre (m ²)

The unit of measurement shall be a square metre of completed item to be installed as specified.

Item	Description	Unit

7.11.4	Supply and delivery of metal items by number	No

The unit of measurement shall be the number of units of each item to be supplied and delivered as specified.

The tendered installation rates below shall include full compensation for the installation, the making good of all damaged corrosion-protection areas, testing, commissioning and maintenance of the structural metal items, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal shall be included on the tendered rates if required for installation.

Item	Description	Unit

7.11.5	Installation, testing and commissioning of metal items by mass	tonne (t)

The unit of measurement shall be a tonne (1 000 kg) of structural metal contained in the structural item to be erected as specified.

Item	Description	Unit

7.11.6	Installation, testing and commissioning of metal items by length	linear metre (m)

The unit of measurement shall be a metre of completed item to be installed as specified.

Item	Description	Unit

7.11.7	Installation, testing and commissioning of metal items by area	square metre (m ²)

The unit of measurement shall be a square metre of completed item to be installed as specified.

Item	Description	Unit

7.11.8	Installation, testing and commissioning of metal items by number	No

The unit of measurement shall be the number of units of each item to be installed, tested and commissioned as specified.

SECTION 8: PIPEWORK

DOCUMENT NO.: STD-LRM-MM-0016

CONTENTS

8.1	SCOPE	546
8.2	STANDARDS.....	546
8.3	DEFINITIONS	547
8.4	ABBREVIATIONS	548
8.5	PIPES, FITTINGS AND SPECIALS.....	548
8.6	CORROSION PROTECTION	550
8.7	ACCESSORIES AND APPURTENANT MATERIALS	550
8.8	HANDLING AND STORAGE	552
8.9	EXCAVATION.....	552
8.10	PIPE BEDDING	552
8.11	DESIGN OF PIPELINES	553
8.12	LAYING OF PIPES	553
8.13	THE JOINTING OF PIPES	555
8.14	ENCASING OF PIPES	556
8.15	THRUST BLOCKS.....	557
8.16	VALVE CHAMBERS	557
8.17	BACKFILLING	557
8.18	ROUTE MARKERS	558
8.19	CONNECTION TO EXISTING NETWORK OR PIPELINE.....	558
8.20	FLUSHING AND STERILIZATION OF PIPELINES FOR POTABLE WATER	558
8.21	FLUSHING OF PIPELINES OTHER THAN THOSE FOR POTABLE WATER.....	558
8.22	TOLERANCES	559
8.23	PIPEWORK TESTING.....	560
8.24	COMMISSIONING OF PIPEWORK	562
8.25	MEASUREMENT AND PAYMENT	562

8.1 SCOPE

This specification covers the requirements for the manufacturing, supply, delivery, installation, erection, testing, commissioning, handing over and the payment item descriptions for the construction of fluid, gas or air pipelines and reticulation systems as well as service connections operating under pressure.

8.2 STANDARDS

8.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[87]SANS 1223

Fibre cement pressure pipes and couplings

[88] SANS 455	Covered electrodes for the manual ore welding of carbon and carbon manganese steels
[89] SANS 546	Cast iron fittings for asbestos-cement pressure pipes
[90] SANS 533-1	Black polyethylene pipes for the conveyance of liquids
[91] SANS 558	Cast iron surface boxes and manhole and inspection covers and frames
[92] SANS 227	Burnt clay masonry units
[93] SANS 801	Epoxy-tar paints
[94] SANS 966-1	Components of unplasticized polyvinyl chloride (uPVC) pressure pipe systems
[95] SANS 62	Steel pipes
[96] SANS 14	Malleable cast iron fittings threaded to ISO 7-1 (ISO 7 is withdrawn, use DS/EN 10226-1&2 instead)
[97] SANS 719	Electric welded low carbon steel pipes for aqueous fluids (ordinary duties)
[98] SANS 2001-DP2	Construction works Part DP2: Medium pressure pipelines
[99] SANS 1123	Steel pipe flanges
[100] SANS 1700-2-1	Fasteners Part 2: Screw threads Section 1: ISO general purpose screw threads - Basic profile - Metric screw threads
[101] BSI BS EN 512	Fibre-Cement Products - Pressure Pipes and Joints
[102] BS EN 13101	Steps for manhole entry chambers
[103] API 1104	Welding of pipelines and related facilities
[104] BS EN 10226-1 to 3	Pipe thread where pressure tight joints are made on the thread
[105] BS 1710	Specification for identification of pipelines and services
[106] SANS 10044-3	Welding Part 3: The fusion welding of steel (including stainless steel): Tests for the approval of welding procedures and production welds
[107] SANS 10044-4	Welding Part 4: The fusion welding of steel (including stainless steel): Tests for the approval of welders working to approved welding procedures
[108] BS EN 10311	Joints for the connection of steel tubes and fittings for the conveyance of water and other aqueous liquids.
[109] BS EN 13101	Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity

8.2.2 Standard Specifications

The following standard specification shall be read in conjunction with this specification and shall be deemed to form part thereof:

[110] STD-LRM-GN-0006	Corrosion protection

8.3 DEFINITIONS

For the purposes of this standard specification, the following definitions shall apply:

8.3.1 Fittings

Standard accessories available, ex stock, such as bends, crosses, tees, plugs, flanges, sockets, adaptors, reducers, couplings, elbows, saddles, reflux valves, air valves, etc.

8.3.2 Specials

Any of the accessories mentioned in 8.3.1 above, which are purpose-made for a specific project or for use in conjunction with pipes.

8.4 ABBREVIATIONS

For the purposes of this specification, the following abbreviations shall apply:

CI	:	Cast iron
CID	:	Constant inner diameter
COD	:	Constant outer diameter
FRC	:	Fibre-reinforced cement
GMS	:	Galvanised mild steel
HDPE	:	High-density polyethylene
uPVC	:	Un-plasticised polyvinylchloride
SS	:	Stainless steel
PTFE	:	Polytetrafluoro-ethylene

8.5 PIPES, FITTINGS AND SPECIALS

8.5.1 General

- a) All pipes and fittings shall be marked with the manufacturer's name, its grade, type or class, the SANS standardisation mark where applicable, and any other markings that may be required in terms of this specification. Pipework shall be colour coded in accordance with the process application as per BS 1710 [105].
- b) Pipes shall be supplied in standard lengths unless otherwise specified in the schedule of quantities. Each standard length shall be deemed to include one pipe coupling for coupling to another standard length. For flanged pipes this includes the flange at either end of the pipe, and the required nuts, bolts, washers, a gasket and any other items required for the correct coupling of one end of the pipe. Nuts and bolts shall conform to the metric system, and unless stated otherwise, lock clockwise.
- c) Specials shall be fabricated to the details shown on the drawings, using where applicable, the same materials, welding procedures and protective linings and coatings, as are specified for the corresponding straight pipes.
- d) Fittings and specials shall be hydraulically tested to the pressures specified for the corresponding straight pipes.
- e) Satisfactory temporary end-covers shall be provided for the protection of threads, flanges, the prepared ends of pipes, fittings and specials, and for the prevention of damage to linings and coatings during transportation, and during storage and handling on the site.

8.5.2 FRC Pipes and Fittings

- a) FRC pipes shall be of the class specified and shall comply with the requirements of SANS 1223546 [87]
- b) FRC pipes shall be jointed by means of FRC three-ring sleeve-type couplings which comply with the relevant requirements of BSI BS EN 512 [101]; or with approved CI short-collar couplings where the pipe ends have been cut. When jointing FRC pipes to plain-ended steel pipes, FRC triplex adaptors shall be used. FRC bends shall not be used.
- c) CI fittings for use with FRC pipes shall comply with the requirements of SANS 546 [89].

8.5.3 HDPE pipes and fittings.

HDPE pipes shall comply with the relevant requirements of SANS 533-1 [90] type IV for a working pressure of 1 200 kPa. Pipe fittings and couplings for HDPE pipes shall be Plasson or approved equivalent compression fittings, and shall be manufactured and tested for a working pressure of 1 600 kPa.

8.5.4 uPVC Pipes and Fittings

- a) uPVC pipes shall comply with the requirements of SANS 966-1 [94] for class 12 pressure pipes and shall be fitted with spigot-and-socket Z-joints with rubber sealing rings. Except for bends, which shall be of uPVC with a factory-applied Z-joint at one end, all fittings for use with uPVC pipes shall be of cast iron, with wall thicknesses in accordance with SANS 546 [89], and socket dimensions in accordance with SANS 966-1 [94].
- b) All uPVC pipes and fittings, shall prior to delivery, be factory tested to 4,2 times the specified working pressure, and a certificate to this effect shall accompany all deliveries. uPVC products shall be stored away from sunlight and shall be backfilled as soon as practicable after having been installed. Installation must either be in ground trenches, or shall be painted in accordance with the requirement of the standard specification on general corrosion protection for pipework installed above ground level; or in buildings and non-ground backfilled pipe trenches; or in service ducts.

8.5.5 GMS Pipes and Fittings with 150 mm or Smaller Nominal Diameter

- a) GMS pipes shall be solid-drawn, seamless, medium-duty, screwed-and-socketed pipes which comply with the requirements of SANS 62 [95]. Welding will not be permitted on GMS piping.
- b) Screw threads shall be tapered in accordance with BS EN 10226-1 to 3 [104].
- c) Pipe fittings shall be of malleable cast iron and shall comply with the requirements of SANS 14 [96].
- d) Unless otherwise specified in the detailed specifications, pipes and fittings shall be galvanised inside and outside in accordance with the requirements of the standard specification on general corrosion protection.

8.5.6 Steel Pipes, Fittings and Specials of the Nominal Diameter Range from 165 mm to 2 230 mm

- a) General
 - i) All steel pipes with a diameter exceeding 150 mm shall conform to the requirements of SANS 719 [97], and specials shall be manufactured from straight pipes in accordance with the relevant requirements of BS EN 10311 [108]. All welding in pipes and specials shall be electric-fusion welding.
 - ii) The grade of the steel plate or strip to be used in the manufacturing process, the wall thickness, corrosion protection and diameter of the pipes, and whether flanges, welding or couplings will be used for jointing the pipes and specials, shall be as specified in the detailed specifications or as shown on the drawings. Pipelines with a diameter of less than 600 mm shall not be joined by welding in the field.
 - iii) The Contractor shall furnish the Engineer with the manufacturer's certificates which cover the chemical analysis and physical properties of the steel used in the manufacture of pipes and specials. He shall also provide written confirmation that the welding has been carried out by coded welders.
 - iv) All production welding of pipes and specials shall be done by welders who are competent in terms of the procedure-approval tests set out in SANS 10044-3 [106] [106], or an acceptable equivalent standard. All welding, whether by hand or otherwise, shall be so carried out that the height of inner-weld reinforcement and of upset metal on the inner surface, shall not exceed 1 mm. Field welding for pipes with a diameter of more than 600 mm shall comply with the relevant requirements of API 1104 [103].
 - v) The ends of pipes and specials shall be bevelled for the field welding of butt-welded joints, and shall be plain-ended for use with slip-on couplings, all in accordance with the relevant requirements of BS EN 10311 [108].
- b) Flexible couplings

- i) All flexible couplings for plain-ended steel pipes and fittings shall be of the slip-on type without centre register, such as Viking Johnson or an approved equal and similar coupling; and shall comply with the relevant requirements of BS EN 13101 [109]. Flexible couplings shall be thoroughly cleaned and painted as specified in the detailed specifications.
- ii) Flexible couplings installed on pump discharge lines, long gravity pipelines and pipelines exposed to water hammer shall be constrained by means of anchor bolts.
- c) Pipe record

The Contractor shall maintain a record, in an approved form, showing the pipe serial and delivery numbers, the steel cast number for the plate used in each pipe section, the date of fabrication and hydrostatic testing, together with the actual test pressure and details of defects and subsequent repairs. Each record shall be signed by the Contractor, and copies shall be handed over to the Engineer before the commencement of the maintenance period.

8.5.7 Electrical-Continuity Bonds

- a) Steel pipes of similar materials other than those with welded joints shall be double bonded by two separate copper connecting wires of 16 mm, and two copper-strand green PVC-covered wire, being installed across all flanged joints and flexible couplings, to provide electrical continuity over the entire pipeline.
- b) Connections on the pipe on either side of the coupling and on the coupling-barrel shall be made by Thermite welds and shall be done only when the pipeline is full of water (i.e. during pressure tests, etc.), to prevent possible damage to the internal lining of the pipe.
- c) The costs of repairing the external coating at the welds shall be included in the price of the pipes.

8.6 CORROSION PROTECTION

- a) The requirements for corrosion protection of all pipelines shall be as specified in the standard specification on general corrosion protection.
- b) Fully insulated flanges shall be installed where dissimilar metals are flanged together as described below.

8.7 ACCESSORIES AND APPURTENANT MATERIALS

8.7.1 Flanges

- a) Unless otherwise specified, the flanges of flanged pipes and fittings shall be drilled in accordance with SANS 1123 [99], Table 16, for pipes and fittings with a diameter of 150 mm and smaller; and in accordance with Table 10 for diameters exceeding 150 mm, of flanges for air-valves and matching tees, where the drilling shall conform to the drilling of the valve supplied.
- b) Loose flanges for galvanised steel pipes shall be threaded to fit the threaded pipe, and loose flanges for welding onto steel pipes shall be manufactured from the same steel as is specified for the pipes; and shall be either flat-faced or raised in accordance with SANS 1123 [99].
- c) Any item that is found to have flanges that are incorrectly drilled will be rejected, and the reaming of bolt holes to oversize dimensions to make a particular piece fit will not be permitted.
- d) All flanged items shall be supplied with one set of bolts and nuts and one suitable gasket with the appropriate diameter and shall be made from a material that is suitable for the maximum test pressure.
- e) Refer to the relevant clause in the section dealing with installation and testing of pipework for requirements with regard to insulated flanges for the flanged connection of dissimilar steel pipework.

8.7.2 Bolts and Nuts

- a) Bolts and nuts shall be of mild steel unless otherwise specified in the detailed specifications or shown on the drawings, and shall comply with the relevant requirements of SANS 1700-2-1 [100]. High tension bolts shall be used for high pressure applications.
- b) The bolt thread protrusion through the nut shall be a minimum of 1,5 threads but not more than 5 threads.
- c) A flat washer shall be installed under each nut unless a spring washer is used as a locking device.

- d) All bolts shall point in the direction of flow for horizontal pipelines, and shall point downwards for vertical pipelines unless the construction of the joint prevents the use of this convention.

8.7.3 Step Irons

Step irons shall be of malleable cast iron, and shall comply with the appropriate requirements of BS EN 13101 [109] Figure 1, or shall be of the type shown on the drawings or specified in the detailed specifications. The length of step irons shall be suitable for being fixed in brick or in-situ concrete.

8.7.4 Surface Boxes and Valve-Chamber Covers and Frames

- a) All surface boxes, and the covers and frames of valve chambers, shall be of CI and shall comply with the requirements of SANS 558 [91]. All covers shall be embossed with letter groups as specified in the detailed specifications.
- b) All surfaces which will not be in contact with concrete shall be painted with two coats of epoxy-tar paint prior to installation.
- c) The types of boxes, covers and frames shall be as follows:
 - i) Surface boxes for valves shall be in accordance with the details shown on the drawings.
 - ii) The surface box mentioned shall be installed with the longer side parallel to the water main served by the valve.
 - iii) Valve chambers
 - (1) In roadways: Type 2A - SANS 558 [91]
 - (2) On sidewalks: Type 9D - SANS 558 [91]
 - (3) Air-valve chambers: Type 9D - SANS 558 [91], with ventilation openings.
 - iv) The Contractor shall be at liberty to precast the surface box into its concrete surround by using a mould made of 2 mm steel plate. The concrete shall be class 1:2:4/19, and light reinforcing shall be used as shown on the drawings.

8.7.5 Reflux Valves, Air Valves and Pressure Relief Valves

- a) The Contractor shall ensure that the necessary reflux (non-return or one-way) valves and air valves, are fitted in order to attain an efficient and trouble free pipework system, with the minimum maintenance requirements.
- b) Reflux valves shall be installed where required to protect pumps or compressors, or to ensure correct process flow.
- c) All compressors, blowers and positive displacement pumps shall have pressure relief valves installed on their delivery pipework, as close as possible to the delivery flange. The valves shall preferably be calibrated to between 1.3 times the operational pressure and 0,8 times the maximum safe operating pressure of the compressing or pumping equipment. Two copies of the calibration certificates shall be submitted to the Engineer.
- d) Reflux, air and pressure relief valves shall be included in the tendered rates for pipework, unless special requirements are specified, in which case separate pay items will be scheduled.

8.7.6 Appurtenant materials

- a) Bricks

Bricks shall be obtained from an approved manufacturer and shall be either general-purpose (special) or engineering-grade bricks, which comply with the appropriate requirements of SANS 227 [92]. The Contractor shall furnish the Engineer with samples of the bricks which he intends to use, for approval.

- b) Mortar

Mortar for brickwork shall consist of 1 part of cement and 4 parts of building sand.

All mortar shall be prepared using ordinary Portland cement, unless otherwise specified.

c) Concrete

Concrete shall conform to the requirements of the detailed specification.

d) Marker blocks and markers

Marker blocks and markers indicating the position of house connections shall be constructed and positioned in accordance with the detailed specification.

e) Epoxy-tar paint

Epoxy-tar paint used for protecting metal surfaces where specified, shall conform to the requirements of SANS 801 [93] Type III, and shall be applied in two coats with a dry-film thickness of 0,230 mm each.

f) Welding electrodes

Welding electrodes shall comply with SANS 455 [88], and the type of electrode shall be compatible with the welding operation to be performed. Also refer to the standard specification dealing with corrosion protection and structural metalwork in this regard.

8.8 HANDLING AND STORAGE

- a) The method of handling pipes and other items will depend on the material from which the item has been made or with which the item has been coated. Light-sensitive items and items prone to weathering shall be stored under cover. The manufacturer's instructions regarding the handling and storage of his products shall where applicable, be strictly adhered to, and copies of such instructions shall be supplied to the Engineer before any such item is despatched to the site. Concrete pipes however, shall irrespective of the manufacturer, be handled and stored as set out in the latest issue of the Concrete Pipe Handbook as issued by the Concrete Society of Southern Africa, unless otherwise directed by the Engineer. The Contractor shall obtain his own copy.
- b) Should the Engineer consider that any pipes or components are being handled, stacked, stored or transported in such a way that damage, deterioration or contamination may occur, he may instruct the Contractor to adapt the method used, or to take specific precautions, without the Contractor being entitled to any additional payment. Unless otherwise specified, no separate payment shall be made for taking delivery of, or for handling, storing, stacking, transporting, protecting, etc. pipes and components or materials. Allowance must be made (in the rates tendered for pipe-laying) for all labour, plant and equipment required for such work during the validity of the contract.

8.9 EXCAVATION

- a) The excavation of trenches, the preparation of trench bottoms, and the additional excavation for valve chambers and joint holes shall be carried out if required by the detailed specifications; and shall be approved by the Engineer before any pipe bedding and pipe-laying may be carried out.
- b) The minimum trench widths shall be as specified in the detailed specifications or as determined by the Engineer on the site.
- c) Variations in the authorised widths may be effected only with the written approval of the Engineer.
- d) The Engineer reserves to himself the right to limit the length of an excavation preceding the pipe-laying activities.
- e) Excavations for valve chambers and other brickwork structures shall be 200 mm wider than the outer dimensions of the structures, i.e. 100 mm measured from each outer face.
- f) Excavations for reinforced-concrete chambers which require the use of formwork, shall be such that a working space of 600 mm will be available around the outer perimeter of the structure.

8.10 PIPE BEDDING

- a) Where founding conditions are unsuitable, the trench bottom shall be excavated deeper than instructed by the Engineer, and backfilled to the original level as specified in the detailed specification.

- b) Only material placed alongside the pipes and to a height of 300 mm above the top of the pipe barrels, will be regarded as the pipe bedding, payment for which shall be made under this section.
- c) Bedding material shall be free from stones exceeding 10 mm and from organic matter and lumps of clay. It shall contain sufficient fine material to ensure a densely graded, well-compacted bedding. Bedding material shall be compacted in layers not exceeding 100 mm of compacted thickness.

8.11 DESIGN OF PIPELINES

- a) All piping shall be routed and configured by the Contractor using suitable diameters, wall thicknesses, corrosion protection and materials as required in the detailed specification. The design of pipework reticulation systems shall be submitted to the Engineer for approval. The Contractor shall make allowance for all costs involved in the design of the pipework. No additional payments shall be made for the design. The design shall include adequate scour and drainage valves for the complete emptying of each pipeline, and air valves removing entrapped air.
- b) Pipelines shall be designed such that adequate compensation is made for the thermal expansion and contraction of the pipe system. Equipment such as pumps and compressors shall have negligible thermally-induced loads from the pipe system imposed on them. No excessive loads shall be present at thrust blocks due to thermal expansion or contraction.
- c) Pipes, fittings, joints, support brackets, etc. shall be selected such that all parts are either electrolytically compatible, or are effectively insulated from each other.
- d) The Contractor shall ensure that all pipe systems are effectively earthed in conjunction with the required electrical continuity bonds across flanges, etc.
- e) All pipelines shall be designed and constructed such that all air valves, water traps, flame arresters and other similar fittings can be isolated by means of valves, and that these components can be removed without damage to the pipeline. Pipelines utilised for the conveyance of gasses shall be routed at suitable gradients to allow condensate removal. Refer to the standard specification dealing with the compressing plant.
- f) All air and scour valves shall be located at the highest and lowest points respectively in the pipelines, and in locations accessible for maintenance.

8.12 LAYING OF PIPES

8.12.1 General

- a) Pipework shall be installed along routes as shown on the drawings and in conformance with building and structure conditions. No deviations from the drawings may be made without the written approval of the Engineer having been obtained. Exposed piping shall be parallel, or at right angles to the walls of structures. Provision shall be made so that expansion and contraction will not cause undue stress in the piping systems. Pipework shall be supported adjacent to valves, to the satisfaction of the Engineer.
- b) All pipes, fittings, specials and valves shall be thoroughly cleaned and carefully examined for damage and defects before they are laid. The onus of detecting damage and defects before installation shall be on the Contractor. Should any damaged or defective pipe, fitting, special or valve be found after laying or installation, it shall be removed and replaced at the Contractor's expense.
- c) Each pipe shall be laid with the identification marks visible on the crown of the pipe. Where markings are no longer visible once the pipes have been laid, the Contractor shall at his expense, remark the pipes in a manner approved by the Engineer. Control of laying shall be by means of boning rods and sight rails, or by other approved methods.
- d) Precautions shall be taken to prevent the entry of foreign matter and unwanted water into the pipes; and if laid in trenches, to prevent the flotation of the pipes caused by water and mud. At the close of each day's work, or at any time when work is suspended for a significant period, the last laid section of each pipe shall be plugged, capped or otherwise tightly closed until laying is recommenced.
- e) An approved cleaning device such as a badger shall be drawn through all pipes smaller than 600 mm in diameter as they are being laid and jointed. Pipes with a 600 mm diameter and larger shall be kept clean internally, by the pipes being carefully swept by hand as laying progresses.

8.12.2 Underground Pipelines

Pipes shall be laid in the centre of the trench, and except where it is specified that they should be supported on precast pedestals, they shall be laid in such a manner that the full lengths of their barrels will bear uniformly on the prepared trench bottom, except at joint holes. Valves shall be placed with spindles in the upright position unless otherwise specified or shown on the drawings. All valves, specials and fittings shall be set, supported and placed in their correct positions as the work proceeds, with their positions not being governed by the standard lengths of pipe.

8.12.3 Above-ground pipelines

- a) uPVC, galvanised mild steel or stainless-steel piping is generally preferred on account of their resistance to corrosion. If exposed to sunlight, steel piping is generally preferred due to UV-decay (ultraviolet-decay) of uPVC piping. If uPVC pipework is required in outdoor applications, the pipework shall be adequately coated with a UV resistant paint as approved by the Engineer.
- b) Pipe supports for vertical and horizontal uPVC pipes shall be provided at the following minimum centres (in metres):

Table 12: Pipe supports - Minimum centres

Nominal size of pipe	Classes 6 and 9	Classes 12 and 16
16 mm	-	0,70
20 mm	-	0,90
25 mm	-	1,00
32 mm	-	1,00
40 mm	-	1,20
50 mm	-	1,20
63 mm	1,00	1,40
75 mm	1,20	1,50
90 mm	1,40	1,60
110 mm	1,50	1,80
125 mm	1,70	2,00
160 mm	2,00	2,20
200 mm	2,40	2,70

- c) Supports for uPVC pipes shall be pre-fabricated and shall be specifically designed for the relevant pipes.
- d) Stainless-steel pipes of less than 50 mm in diameter shall be fixed to walls with galvanised malleable cast-iron school-board-pattern brackets. Pipes of more than 50 mm in diameter shall be fixed with stainless steel hinged holderbats and fastened with stainless steel pins or bolts. The brackets or holderbats shall be fixed to walls or floors with cement mortar. Pipes fixed to timbers shall be secured with approved stainless steel pipe clips, screwed to the woodwork.
- e) Supports for steel pipes shall be provided at the following minimum distances:

Table 13: Pipe Supports for steel pipes

Pipe size	Horizontal	Vertical
15 mm to 20 mm	1 200 mm	1 800 mm
25 mm to 40 mm	1 800 mm	2 500 mm
50 mm to 100 mm	2 500 mm	3 050 mm
More than 100 mm	4 600 mm	4 600 mm

- f) Before any one of the supports listed above is installed, samples thereof shall be supplied to the Engineer, whose written approval shall first be obtained. Where items are too large for samples to be submitted, full documentary descriptions of the item shall be supplied to the Engineer for approval.

8.13 THE JOINTING OF PIPES

Subject to approval of the methods to be used, and the observance of the necessary precautions, only steel pipelines with welded joints and HDPE pipes may be jointed outside their trenches prior to being laid. In all other cases pipes shall be joined in their final positions.

8.13.1 FRC Pipes

- a) FRC pipes and their fittings shall be jointed in accordance with the manufacturer's instructions.
- b) After cutting an FRC pipe to suit the position of a valve or fitting, the Contractor shall use an approved field-turning apparatus to turn the cut ends to suit the coupling sleeve. The reason for this is that filling of the ends of an FRC pipe is not permitted.
- c) Where CI detachable couplings are used, a gap of 10 mm central to the coupling, shall be left between the pipe ends, to allow for expansion when the pipes are filled and have absorbed moisture.

8.13.2 HDPE Pipes

HDPE pipes and their fittings shall be jointed in accordance with the manufacturer's instructions, and special care shall be taken not to over-tighten the couplings.

8.13.3 uPVC Pipes

uPVC pipes and their fittings shall be jointed strictly in accordance with the manufacturer's instructions, and except for the joint, shall be backfilled as soon as possible after laying.

8.13.4 GMS Pipes

- a) Before connections are made, all external and internal threads of GMS pipes and fittings shall be thoroughly cleaned, and external threads shall be covered with a small quantity of yarn and a thin layer of approved jointing compound. The external threads of pipes and fittings smaller than 25 mm may be wrapped with an approved PTFE tape in lieu of the yarn and compound.
- b) Care shall be taken to avoid tool damage to the surfaces of pipes and fittings during installation. All joints shall be screwed up tightly.

8.13.5 Steel Pipes

- a) Flanged joints
 - i) In the jointing of steel pipes with flanges, special care shall be taken to align and level the pipes, specials, fittings and valves, to avoid straining of the flanges. To facilitate the alignment process, all flanged pipes and the larger fittings, specials and valves shall be supported on precast, pre-positioned concrete pedestals, all in accordance with the drawings.
 - ii) The mating face of each flange shall be thoroughly cleaned immediately before jointing. Gaskets shall be placed so that no portion of the gasket will project inside the bore of the pipe.
 - iii) Nuts shall be tightened up evenly in opposite pairs to ensure a uniform bearing on the gasket, but shall not be fully tightened until all bolts have been inserted, and the flanges accurately aligned relative to each other.
 - iv) The Contractor shall repair all damage to corrosion protection layers due to the installation activities at his own cost. All repair work shall be to the satisfaction of the Engineer.
 - v) Wherever loose flanges are welded onto pipes, the Contractor shall make sure that the linings and coatings are repaired, and are soundly jointed to existing linings and coatings.
- b) Fully insulated joints
 - i) To prevent galvanic corrosion at joints between pipes of dissimilar metals, (e.g. stainless or mild steel) fully insulated flanged joints shall be used. Fully insulated flanged joints shall comply with the following minimum requirements:
 - (1) The flange bolt shanks shall be insulated from flanges by means of GRP sleeves with a thickness of 1 mm.

- (2) The flange bolts and nuts shall be suitably downsized for the application. The Contractor shall ensure that the performance and strength requirements, and specifications, are met in this regard.
- (3) Bolt heads and nuts shall bear on the standard required steel washers for the downsized bolts.
- (4) The steel washers shall be insulated from the flanges by means of insulating washers with a diameter 10 mm larger than the specified diameter of the steel washers.
- (5) An insulating gasket shall be installed between the flanges. The central 3 mm thick fabric reinforced phenolic full-face resin gasket shall be installed with one full face neoprene gasket.
- (6) Lightning and surge protection shall be provided across insulated flanges which shall consist of a suitable spark gap across the insulating flange and bolted directly to the steel flange face on either side. The spark gap shall be subject to the approval of the Engineer.
- (7) Insulating flanges not continuity bonded shall be identified as follows:
- (8) The entire insulating flange shall be wrapped circumferentially with a white plastic backed polymer modified bituminous tape, with a red strip in the centre. A metal tag shall be attached through a pre-drilled 2 mm hole in the most overt insulating flange stud via a 1 mm stainless steel locking wire. On the metal tag shall be stamped the words:

OPERATING INSULATING FLANGE

NO ATTACHMENTS TO PIPEWORK PERMITTED

CHAMBER TO BE KEPT DRY

c) Slip-on type couplings

Slip-on type of couplings shall be installed strictly in accordance with the manufacturer's recommendations, and the angular deflection allowed by the couplings shall not be exceeded. Before commencing with the installation of slip-on-type couplings, the allowable deflection or misalignment as specified by the coupling manufacturer, shall be submitted to the Engineer.

d) Welded joints

- i) All field welding of butt-welded joints shall be carried out by welders who are competent in terms of the procedure-approval tests of SANS 10044-3 [106].
- ii) While welding is done inside pipes, these pipes shall be ventilated to the approval of the Engineer.

8.14 ENCASING OF PIPES

- a) Where specified or ordered by the Engineer, pipes shall be fully encased in accordance with the drawings. During concreting, pipes shall be supported near their ends on suitable pedestals and shall be suitably anchored where necessary to prevent uplift. All spaces under and around the pipes shall be properly filled with concrete.
- b) No part of the concrete casing shall be closer than 150 mm to any flexible joint, and concreting between joints shall be carried out in one continuous operation. The concrete shall be raised equally on both sides of the pipe.
- c) Where shown on the drawings or ordered by the Engineer, soilcrete shall be used to encase the pipes fully and shall be placed in the same manner as concrete casing.
- d) Care shall be taken to prevent concrete or soilcrete from entering flexible joints.
- e) Encasing the pipes shall only be carried out after the pipeline has been tested and passed, and while the pipeline is still full of water. Formwork shall be used where necessary to ensure that flexible joints remain uncased. Payment for such formwork shall be deemed to be included in the rates tendered for the encasing of the pipe.

- f) Where puddle pipes are encased in civil structures, the Contractor shall ensure that sufficient precautions have been taken for corrosion protection. Unless otherwise specified in the detailed specification, all puddle pipes with a diameter less than 200 mm that terminates inside a liquid containing sump or container, shall be manufactured from 304 L stainless steel, with the necessary insulated flanges installed where required. Other puddles shall be suitably coated and/or wrapped in accordance with the standard specification on general corrosion protection and/or the detailed specification.

8.15 THRUST BLOCKS

- a) Thrust blocks shall be constructed in accordance with the drawings and/or the Contractor's pipeline design at tees, bends, terminal valves and end caps, and where otherwise directed by the Engineer. All flexible couplings shall be supported in the thrust directions by means of thrust blocks.
- b) The sides and bottoms of excavations against which thrust blocks are cast shall be sound and undisturbed, and all loose material shall be removed. Excess excavations shall be filled with concrete simultaneously with the concreting of the thrust block, and shall not be paid for unless the excess excavations have been authorised.
- c) Care shall be taken to leave all pipe joints accessible, and no pipeline shall be tested unless the concrete has attained its full strength. Formwork shall be used to ensure the accessibility of joints.
- d) Unless otherwise directed, no thrust blocks shall be constructed where steel pipes with flanged or welded joints are used.

8.16 VALVE CHAMBERS

- a) After a section of pipeline or reticulation has been completed and successfully tested as specified below, valve chambers shall be constructed where required by the detailed specification to the details as shown on the drawings.
- b) Brickwork for chambers shall be supported on a concrete foundation, on compacted backfill material, or on a concrete slab, as shown on the drawings. The top of the chamber cover or surface box shall be at the level of the sidewalk or street, or at a height of 40 mm above ground level in the case of unsurfaced areas.
- c) Chambers for flanged gate valves with a nominal bore not exceeding 200 mm and for air valves, shall be constructed after the backfilling has been thoroughly compacted around the valve and above the pipe, to serve as a firm base for the brickwork. Chambers for flanged gate valves with a nominal bore exceeding 200 mm shall be constructed on a class 15/19 concrete slab.
- d) Where pipes with diameters exceeding 200 mm pass through the brick walls of chambers, relieving arches shall be built neatly over the upper halves of the pipes. In all other cases, the bricks shall be carefully cut to fit not closer than 10 mm from the pipes to allow for possible differential settlement.
- e) If required, step irons shall be built into one wall of the chamber at 300 mm intervals staggered left and right in vertical rows.
- f) CI valve chamber covers and frames, surface boxes and surface boxes precast into their surroundings, shall be fitted on top of the chambers as shown on the drawings.

8.17 BACKFILLING

- a) No backfilling shall be carried out before authorisation is given by the Engineer to do so.
- b) Before pipelines are hydraulically tested, the bedding shall be completed; also at joints, valves, specials and fittings to a height of 300 mm above the top of the pipe barrels, with the use of the materials in the manner required by this section; and with great care being taken not to damage protective materials with which pipes, specials, etc. may be coated. All joint holes shall be carefully backfilled with the same material as that on which the pipe has been laid.
- c) Should suitable material for bedding not be available from the excavation of the trench which is backfilled, the Contractor shall obtain suitable material from other authorised excavations on the site. In the event of suitable material not being available on the site, the Contractor shall screen the excavated material using a sieve with 10 mm clear openings, but if the latter method is impracticable, the Engineer may order the Contractor to import suitable material.

- d) After the beddings have been completed and approved, the balance of the trench shall be backfilled as described in the section dealing with civil Engineering work, except above the bedding at joints, valves, specials and fittings.
- e) The pipeline shall now be tested as specified in this standard specification.
- f) When the tests have been successfully completed and the pipeline approved, the balance of the trench shall be backfilled at joints, and at all other positions where no chambers have to be constructed.
- g) At valves, the bedding shall be completed to a level as shown on the drawings, or as may be applicable, a concrete slab shall be constructed, followed by the construction of the valve chambers. Backfilling around valve chambers shall be carried out with the use of selected material compacted by hand in 100 mm layers or with soilcrete, where insufficient space is available. The cost of backfilling shall be included in the rates tendered for valve chambers.

8.18 ROUTE MARKERS

For underground pipelines, marker blocks shall be installed, if required by the detailed specification, after the trimming of the surrounding area has been completed so as to mark the pipe routes.

The marker blocks will be detailed in the detailed specifications.

8.19 CONNECTION TO EXISTING NETWORK OR PIPELINE

Wherever a new reticulation system or pipeline joins up with an existing network or pipeline, the Contractor shall notify the Engineer in good time as to when the connection will be required. The work will be carried out by the Contractor who shall supply all nuts, bolts, gaskets and labour to perform the coupling.

8.20 FLUSHING AND STERILIZATION OF PIPELINES FOR POTABLE WATER

- a) After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter has been removed.
- b) The pipeline shall then be filled with water containing 0,015 grams per litre of chloride of lime. The solution shall be allowed to flow slowly into the pipeline until it fills it completely, and shall be left there for at least 24 hours.
- c) The pipeline shall then be thoroughly and repeatedly flushed with clean water until the water, which is flushed from the pipeline, complies with the requirements of the Employer.

8.21 FLUSHING OF PIPELINES OTHER THAN THOSE FOR POTABLE WATER

8.21.1 Pipelines for the Dosing of Liquid Chemicals

- a) After each pipeline has been tested, it shall be thoroughly flushed out until all sediment and other foreign matter has been removed. Water shall be used for flushing-out purposes, provided that the water is suitable as a dilutant for the chemical which the pipeline is ultimately intended to convey. If water is not suitable as a dilutant, the undiluted chemical shall be used for flushing purposes. If it is practicable to dilute the chemical with a dilutant which is non-detrimental to the materials of the pipeline, the Contractor may do so. However, the dilution percentage shall be subject to approval by the Engineer.
- b) During flushing, the pipeline shall not be subject to pressures exceeding 1,5 times the maximum design working pressure of the pipeline.
- c) Upon completion of the flushing operation, the Contractor shall empty the flushing liquid from the pipeline and shall then clean it and leave it ready for the Employer to feed the correctly diluted chemical into the pipeline for commissioning.
- d) The Contractor shall ensure that no spillages whatsoever occur during flushing and cleaning, and he shall clean up any such spillages in a manner approved by the Engineer. The Contractor will be held responsible for all damages caused by spillages and he shall enforce all safety precautions in the handling of hazardous chemicals.
- e) Commissioning shall commence only after the Contractor has received written notice from the Engineer that the chemical solution has been delivered and that commissioning can proceed.

8.21.2 Pipelines for Liquids Containing Raw or Treated Sewage

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter have been removed.

8.21.3 Pipelines for Gaseous Media

a) Pipelines for the conveyance of gaseous media such as air-blower pipelines, methane-gas pipelines, chlorine-gas pipelines, etc. shall be blown clean with compressed air, or flushed with water, or a non-reactive chemical solution, after having been successfully tested. Clearing of the pipelines shall be as follows:

i) Pipelines up to 150 mm in diameter

(1) These pipelines shall be directly connected to a contaminant-free compressed-air supply, capable of maintaining a linear air-flow velocity of not less than 5ms-1 through the pipeline section with the largest nominal bore. All fittings which reduce the nominal bore, such as restrictions, orifices, nozzles, etc. or form recesses in the pipe invert like check valves, etc. shall be removed. These shall immediately be reinstalled after the air-flushing operation, and after they have been blown clean with compressed air.

(2) During the air-flushing operation, all in-line valves on the particular section being flushed shall be fully open. The air flow shall be maintained until all foreign objects or particles trapped inside the pipeline have been blown out at the open end. If drainage or scour valves are installed on the particular section being flushed, these valves shall be opened and closed in succession to promote the removal of dirt and foreign material as quickly as possible.

ii) Pipelines larger than 150 mm and up to 600 mm in diameter

These pipelines shall be treated as pipelines for liquids containing raw or treated sewage as specified above, and shall afterwards be ventilated with compressed air until the entire pipeline is internally dry.

iii) Pipelines larger than 600 mm in diameter

These pipelines shall be manually cleaned by brushing and the use of compressed air. Adequate ventilation shall be provided by using compressed air to ensure the removal of suspended dust particles and to ensure compliance with safety requirements. Cleaning operations shall progress in the same direction as the flow of the ventilation currents.

8.22 TOLERANCES

Where pipework or pipework reticulation systems have been detailed in drawings the permissible tolerance limits for the positioning of the pipework shall be as follows:

8.22.1 Valves, Fittings and Specials

a) Lateral deviation: ± 100 mm, except where pipelines are to be laid at a designated distance from a fence, kerb or boundary. In these cases, the permissible deviation shall be ± 25 mm.

b) Vertical deviation: ± 100 mm.

8.22.2 Pipelines

Permissible horizontal deviation from straight-line joining valves, fittings and specials shall be ± 100 mm with a permissible deviation per pipe length of ± 20 mm. The permissible vertical deviation from straight line joining valves, fittings and specials shall be ± 50 mm.

8.22.3 Valve chambers

a) Lateral deviation: As for valves, provided that access to bolts, nuts, etc, is maintained.

b) Vertical deviation: To suit the valve.

8.23 PIPEWORK TESTING

8.23.1 General

- a) All tests shall be conducted in the presence of the Engineer or his representative. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.
- b) Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.
- c) All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

8.23.2 Testing of Welds

a) Shop welds

- i) In order to prove the procedures, a radiographic examination shall be made on 100% of the welded seams of the first pipe of each type. If unsatisfactory results are obtained, the successive pipes shall be radiographically examined until the procedures are found to be acceptable. Thereafter one pipe from each lot of 50 pipes shall be radiographically examined.
- ii) Irrespective of the above, each and every coil-joining butt weld for helically formed pipes, a 400 mm length from each end of every longitudinal weld seam of every pipe, and all welded seams of all specials, shall be tested radiographically.

b) Field welds

The Contractor shall supply all equipment and materials on the site, and also personnel to conduct the radiographic examination, in accordance with the requirements of API 1104 [103] in respect of the full length of 10% of the circumferential welds made by hand welding, and 2.5% of the circumferential welds made in accordance with an approved automatic process during the installation of pipes and specials.

c) Defects

Cracks, a lack of complete penetration, or a lack of complete fusion, shall be considered as being injurious defects, and defective field welds shall be repaired in accordance with API 1104 [103]. The full length of all repairs shall be radiographically tested.

8.23.3 Testing of Linings and Coatings

a) Epoxy linings and coatings

In accordance with requirements of the standard specification on general corrosion protection, a low-voltage pinhole detector with a wet-sponge probe, which is operated at a voltage between 80V and 100V, shall be used for the detection of pinholes in linings and coatings with a thickness of less than 0,50 mm. A high-voltage holiday detector operated at a voltage between 12 kV and 15 kV, shall be used to detect pinholes and holidays in linings and coatings exceeding 0,50 mm in thickness.

b) Repairs

- i) Repairs to and the making good of damaged areas and areas that have failed, shall be carried out strictly in accordance with the manufacturer's instructions and the section dealing with corrosion protection in these specifications.
- ii) If an area exceeding 0,5% of the coated or lined area needs repairing, the entire coating or lining shall be removed and the pipe recoated.
- iii) Where linings and coatings have been cut back to facilitate the jointing of pipes, the uncoated section shall where applicable, be reinstated in an approved manner to a standard and quality not inferior to the original protection. Protective linings and coatings shall be reinstated strictly in accordance with the manufacturer's instructions.

c) Other tests

Any other tests, as may be considered by the Engineer to be necessary, to be conducted on pipe linings and coatings, shall be as set out in the detailed specifications.

8.23.4 Hydrostatic Testing of Steel Pipes

- a) Prior to the application of protective coatings and linings, each pipe shall be subjected to an approved hydrostatic test at a test pressure determined as follows:

$$P = 2\,000 \frac{t \times f}{D}$$

where

P is the test pressure in kPa;

f is 85% of the guaranteed minimum yield strength in MPa for the steel plate;

t is the wall thickness in mm; and

D is the outer diameter of the pipe in mm.

- b) Hydrostatic testing shall not be done until all aspects of fabrication have been completed.
- c) The pressure shall be applied steadily by an approved method, and shall be maintained without variation, for a period of time as agreed by the Engineer, to allow for proofing and inspection.
- d) Should water sweat or ooze from any part, or any defect of any other nature be discovered, the pipe shall be emptied and the defect made good. The pipe shall then be retested. Should a pipe, after repair, fail to pass the second hydraulic test, the Engineer may order its rejection.

8.23.5 Hydraulic or Pneumatic Field-Testing of Pressure Pipes

a) General

- i) Hydraulic or pneumatic testing shall commence only after the permanent thrust blocks have attained their specified strength. The Contractor shall provide all the necessary testing equipment, including pressure-testing domes, blank flanges, the pump or compressor, meters, temporary valves, etc. for the conducting of the tests on the various pipes. Water for testing purposes will be provided free of charge by the Employer.
- ii) After the trench has been partly backfilled, and before the trench is filled in at the pipe joints and the fittings, the pipelines shall be tested in sections between isolating valves, end caps, blank flanges, or other isolating devices, at a pressure of 1,5 times the design maximum working pressure.
- iii) In the case of fibre-cement pipelines, each section shall be filled with water 24 hours before the pressure is applied.
- iv) In the case of water pipes, care shall be taken to ensure that all the air is expelled from the line to be tested after it has been filled, and before the test commences.

b) Visible or audible leaks

- i) The test pressure shall be maintained for a period of at least 3 hours (or such longer period as may be necessary for the inspection of the pipeline) by means of a suitable pump or compressor, during which period, all pipes, specials, joints and fittings shall be carefully inspected for leaks. All visible or audible leaks shall be made good, and any pipe, special or fitting found to be defective shall be removed and replaced at the expense of the Contractor. Such replacement material shall be tested at the expense of the Contractor after having been installed.
- ii) In the case of pipes with a nominal diameter of less than 400 mm, the test period may be reduced proportionally to the nominal diameter of the pipe, provided that the test period shall not be less than 1 hour.

c) Permissible leakage rates

The test pressure shall be maintained for a further period of 1 hour after the completion of the test period, during which time the volume of water required to be pumped into the pipeline for maintaining the pressure shall be measured. No additional water shall be required in the case of continuously welded steel pipes, and in other cases the volume shall not exceed the value, in litres, calculated from the appropriate formula below:

$$V = F \times d \times l \times \sqrt{P}$$

with:

V : maximum volume in litres that may be added to maintain pressure

F : multiplication factor:

= 0,075 for fibre cement pipes

= 0,01 for jointed pipes in steel, uPVC and HDPE

= 0 for all other pipes

d : diameter of pipe in millimetres

l : length of test section in kilometres

P : test pressure in MPa

8.23.6 Field-Testing of Electrical Continuity Bonds, Earthing and Insulated Flanges

Electrical continuity and earthing of pipework and insulated flanges shall be tested, if required, as specified in the detailed specification.

8.24 COMMISSIONING OF PIPEWORK

Complete pipework or reticulation systems forming one process unit, shall be commissioned together with the pumping and/or compressing equipment. The costs involved shall be deemed to be included in the tendered rates for commissioning for the relevant pumping and/or compressing equipment.

8.25 MEASUREMENT AND PAYMENT

Item	Description	Unit
8.25.1	Supply and delivery of pipework, fittings and specials	Lump Sum

The unit of measurement shall be the lump sum for the pipework or pipework reticulation between two or more points as specified in the detailed specifications.

The tendered lump sum shall include full compensation for the design, manufacture, procurement, corrosion protection, patent rights, pre-delivery tests, storage, transport for delivery to site and off-loading including all handling of the complete section of pipework or pipework reticulation specified, which shall include the pipes, fittings, fixing equipment, reflux valves, drainage valves, manual isolation valves, pressure reducers, flanges and appurtenances to ensure a complete operational system.

Separate items will be scheduled in the schedule of quantities for different types, sizes and locations of pipework.

Item	Description	Unit
8.25.2	Supply and delivery of pipework	m

The unit of measurement shall be metres of running pipe length supplied and delivered.

The tendered lump sum shall include full compensation for the design, manufacture, procurement, corrosion protection, patent rights, pre-delivery tests, storage, transport for delivery to site and off-loading including all handling of the pipework which shall include the pipes and flanges.

Separate items will be scheduled in the schedule of quantities for different types, sizes and locations of pipework.

Item	Description	Unit
8.25.3	Supply and delivery of pipework, fittings and specials	No

The unit of measurement shall be the number of described units supplied and delivered.

The tendered lump sum shall include full compensation for the design, manufacture, procurement, corrosion protection, patent rights, pre-delivery tests, storage, transport for delivery to site and off-loading including all handling of the components as specified.

Separate items will be scheduled in the schedule of quantities for different types, sizes and locations of pipework.

Item	Description	Unit
8.25.4	Installation, field testing and commissioning of pipework, fittings and specials	Lump Sum

The unit of measurement shall be the pipework or reticulation system between two or more points as specified in the detailed specification.

The tendered lump sum shall include full compensation for the installation and flushing of the pipework to provide a complete working system as detailed in the standard and detailed specifications. The cost for handling of equipment, fixing of pipework, coupling of flanges and all installation materials and labour shall be included in the tendered rates.

The tendered sum or rate shall include full compensation for all field testing, including re-testing where required and the Contractor shall provide all instrumentation, tools, equipment and labour at no extra cost to perform the following:

- a) Testing of welds
- b) Testing of linings and coatings
- c) Hydraulic or pneumatic field-testing
- d) Field testing of electrical continuity bonds, earthing and insulated flanges, where required by the detailed specifications.

The pipework system shall be tested as a whole together with the appurtenant pumps, compressors, blowers, boilers, etc.

Separate items will be scheduled in the schedule of quantities for different types, sizes or locations of pipework.

Item	Description	Unit
8.25.5	Installation, field testing and commissioning of pipework, fittings and specials	m

The unit of measurement shall be the number of running metres of pipework installed and tested.

The tendered rate shall include full compensation for the installation and flushing of the pipework to provide a complete working system detailed in the standard and detailed specifications. The cost for handling of equipment, fixing of pipework, coupling of flanges and all installation materials and labour shall be included in the tendered rates.

The tendered sum or rate shall include full compensation for all field testing, including re-testing where required and the Contractor shall provide all instrumentation, tools, equipment and labour at no extra cost to perform the following:

- a) Testing of welds
- b) Testing of linings and coatings
- c) Hydraulic or pneumatic field-testing
- d) Field testing of electrical continuity bonds, earthing and insulated flanges, where required by the detailed specifications.

The pipework system shall be tested as a whole together with the appurtenant pumps, compressors, blowers, boilers, etc.

Separate items will be scheduled in the schedule of quantities for different types, sizes or locations of pipework.

Item	Description	Unit
8.25.6	Installation, field testing and commissioning of pipework, fittings and specials	No

The unit of measurement shall be the number of described units installed and tested.

The tendered rate shall include full compensation for the installation and flushing of the pipework to provide a complete working system as detailed in the standard and detailed specifications. The cost for handling of equipment, fixing of pipework, coupling of flanges and all installation materials and labour shall be included in the tendered rates.

The tendered sum or rate shall include full compensation for all field testing, including re-testing where required and the Contractor shall provide all instrumentation, tools, equipment and labour at no extra cost to perform the following:

- a) Testing of welds
- b) Testing of linings and coatings
- c) Hydraulic or pneumatic field-testing
- d) Field testing of electrical continuity bonds, earthing and insulated flanges, where required by the detailed specifications.

The pipework system shall be tested as a whole together with the appurtenant pumps, compressors, blowers, boilers, etc.

Separate items will be scheduled in the schedule of quantities for different types, sizes or locations of fittings and specials.

Separate items will be scheduled in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the relevant equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the Engineer.

SECTION 9: FLOW CONTROL VALVES AND SLUICE GATES

DOCUMENT NO.: STD-LRM- MM-0017

CONTENTS

9.1	SCOPE	566
9.2	STANDARDS.....	566
9.3	INSTALLATION AND HANDWHEELS	566
9.4	MECHANICALLY PINCHED RUBBER-SLEEVE VALVES	567
9.5	GATE VALVES	567
9.6	BUTTERFLY VALVES.....	568
9.7	SLUICE GATES.....	568
9.8	BALL FLOAT VALVES	569
9.9	ELECTRICALLY DRIVEN ACTUATORS	569
9.10	CORROSION PROTECTION	570
9.11	MEASUREMENT AND PAYMENT	570

9.1 SCOPE

This section covers the supply, delivery, installation, testing and commissioning of manually and electrically actuated control valves, sluice gates, and ball float valves.

The Contractor shall take note that valves associated with certain plant, equipment or installations as specified in the detailed specification will be measured together with the applicable equipment.

9.2 STANDARDS

9.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[111]	SANS 1123	Steel pipe flanges
[112]	SANS 664	Cast iron gate valves for water works
[113]	BS EN 593	Industrial valves. Metallic butterfly valves

9.2.2 Standard Specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[114]	STD-LRM-GN-0006	Corrosion protection

9.3 INSTALLATION AND HANDWHEELS

- Valves shall be installed in positions as shown on the relevant drawings and process flow diagrams, and as specified in the detailed specifications.
- Where applicable, the spindles or wheels of valves shall clearly indicate the direction of closure, which shall be clockwise when viewing the valve from and along the valve spindle axis.

9.4 MECHANICALLY PINCHED RUBBER-SLEEVE VALVES

Each mechanically-pinched rubber-sleeve valve shall comply with the following specifications:

- a) The valve shall be of the full metal-body mechanical-pinch type with flanged joint buds on both the body and the rubber sleeve.
- b) Flanges shall be drilled in accordance with SANS 1123 [111].
- c) Port areas shall be 100% of the full pipe area throughout the entire length.
- d) All internal valve metal parts shall be completely protected by a flexible elastomer pinch-tube. The elastomer pinch-tube shall be of single-piece construction with integral flanges drilled to the same flange drilling as the rest of the pipeline. Should the flanges be drilled to another standard, which is incompatible with the specified SANS standard, suitable adaptors shall be included with the valve to ensure its satisfactory operation.
- e) All materials shall be resistant to the corrosive environment in which it has to operate.
- f) The pinch-tube shall be nylon reinforced with an exterior wrapping of 3mm thick neoprene.
- g) The closing mechanism shall be double-acting and shall pinch the sleeve equally from two opposing sides.
- h) The stem shall be non-rising, and mounted to the driving mechanism through the stem by direct coupling.
- i) No cast parts shall occur in the operating mechanisms of the valve.

9.5 GATE VALVES

- a) Gate valves shall have non-rising spindles.
- b) Each gate valve shall comply with the following specifications:
 - i) Each valve shall be a resilient seal gate valve in accordance with SANS 664 [112].
 - ii) Each valve shall be designed to facilitate maintenance without the body of the valve having to be removed from the line.
 - iii) Each valve shall be double flanged, with the flange drilling being in accordance with SANS 1123 [111].
 - iv) Each valve shall be resistant to the corrosive environment in which it has to operate.
 - v) The following materials shall be used in the manufacture of each valve in pipelines, for the conveyance of water and sewage, with diameters in excess of 100 mm:

Component	Material
Body	Cast iron
Bonnet	Cast iron
Gate	Cast iron
Bridge	Carbon steel
Gland	Carbon steel
Spindle	Stainless steel 304
Gate seals	Neoprene
Gate studs	Stainless steel 304
Gate nuts	Stainless steel 304
Gland packing	Polytetrafluoroethylene (PTFE)
Gaskets	Rubber

9.6 BUTTERFLY VALVES

- a) Butterfly valves shall comply with the requirements of BS EN 593 [113], and shall be of the double-flanged, lugged or wafer types, as may be specified. They shall be designed to fit between flanges drilled in accordance with SANS 1123 [111].
- b) Butterfly valves may be controlled by weather-proof actuators fitted with hand wheels, as specified in the detailed specifications. Safety devices such as shear pins shall be built into the actuators to prevent damage from being done to the valve, should excessive force be applied to the hand wheel in the fully open or closed positions. If so specified, valves with a 200mm diameter and smaller, shall be controlled by direct-mounted ratchet handles.
- c) Closure of valves shall be by the clockwise movement of the hand wheel or ratchet handle, and the fully open and fully closed positions shall be indicated by a positive stop. Handwheels shall be clearly marked to show opening and closing directions.
- d) Valve discs shall be of a single casting, have a stream-lined shape, and shall also have smooth surfaces.
- e) Where resilient seats are specified, they shall be moulded to the shape of the valve body, but shall not be bonded to the body, so that they can be easily replaced.
- f) Butterfly valves of class 16 and higher, or with a 350mm diameter and larger, shall be fitted with self-lubricating two-way adjustable thrust bearings, to permit precise disc-to-seat positioning at all times.
- g) Valve shafts shall preferably be continuous, but if stub shafts are provided, they shall each extend into the disc hub for a distance of at least 1,5 times the shaft diameter.

9.7 SLUICE GATES

- a) The frames, spindles, spindle braces and gates of all sluice gates shall be manufactured from stainless steel 304, unless otherwise specified.
- b) All gates shall be guided by rigid guide rails. The gates shall be held uniformly against the side facings of the frames by the action of adjustable wedges, and shall provide drop-tight closure under the specified conditions.
- c) All channel sluice gates shall be of the level invert-type fitted with renewable seals of a non-biodegradable material on the invert.
- d) All hand-operated sluice gates shall be supplied with clockwise closing handwheels. If rising spindles are to be used, the rising spindles shall be protected by suitable sleeves which provide convenient visual inspection and greasing facilities.
- e) Handwheels shall be of cast iron with diameters to suit operating either directly on the head frame or on a stainless steel (grade 304) tubular pedestal to suit the installation depth. Where necessitated by the mass of the gate and/or the pressure against the gate, suitable gearing shall be provided so as to facilitate the operation.
- f) All parts shall be designed with a minimum factor of safety against structural failure of not less than 3,0, based on the working stresses of the material. In the design, due consideration shall be given to the thickness of materials, with regard to corrosion and operating conditions.
- g) The sluice gates shall be designed with suitable stiffeners to prevent the gates from deforming or buckling, on the account of unbalanced pressures acting on the sluice gates.
- h) All channel sluice gates shall be designed for an unbalanced water pressure caused by a water column of twice the height of the gate.
- i) The maximum force required at a handwheel or crank to raise a gate or open a valve shall not exceed 100N.
- j) The Contractor shall supply the Engineer with all information regarding cavities to be left in the channel floors and walls, and all the details concerning holding-down bolts, or any other information relating to details of installation in civil structures to be constructed.
- k) The Contractor shall be responsible for all handling, installation and grouting of the sluice gates, and shall carry out all necessary adjustments to ensure proper and smooth operation.

9.8 BALL FLOAT VALVES

- a) Ball float valves shall be used where storage tanks, make-up tanks and/or other containers will have their liquid level automatically maintained at the full level (as set by the ball float mechanism).
- b) The Contractor shall take special care with regard to corrosion protection, as ball float valves are frequently used in chemical dosing plants (make-up tanks).
- c) Unless otherwise specified, the ball float valve shall effectively and completely seal off against a pressure of 8 bar.
- d) It shall be possible to adjust the height at which the valve closes completely, by means of a convenient mechanism.

9.9 ELECTRICALLY DRIVEN ACTUATORS

- a) Each electrically driven actuator shall be supplied by a reputable supplier as standard equipment, and shall comply with the following specifications:
- b) The actuators shall be compatible with the relevant valves or sluice gates on which they have to operate.
- c) The actuators shall operate from a 400/230 V 50 Hz power supply.
- d) Standards for the various components on the actuator shall be equal to or exceed that set by actuators from Rotork or approved equivalents.
- e) The actuators shall be adequately sealed and insulated to guarantee satisfactory operation under a submergence of 10,0 m of water.
- f) The various actuators shall either be equipped with a mechanism by which either an analogue 4 -20 mA signal is generated in proportion to the status of the valve; or a sluice gate setting to facilitate proportional control; or the actuators shall be actuated by a digital signal which causes them to open fully or close fully. Distinction between these will be made in the detailed specifications.
- g) The two types of electric actuator shall have the following control or signal facilities (type A = open/close, type B = modulating):
 - i) Type A: Open/close valve
 - (1) Open coil - 230 VAC - Facilities to open the valve by means of a potential free contact.
 - (2) Close coil - 230 VAC - Facilities to close the valve by means of a potential free contact.
 - (3) Potential free contact to signal that the valve is open.
 - (4) Potential free contact to signal that the valve is closed.
 - (5) Potential free change over contact to signal local "Local/Remote" selection.
 - ii) Type B: Modulating valve
 - (1) Position signal : 4 - 20 mA.
 - (2) Position feedback : 4 - 20 mA.
 - (3) Potential free changeover contact to signal local "Local/Remote" selection.
- h) Each actuator shall be designed for modulating operation (S4). The equipment shall be designed to tolerate 10 changes in the setting of a valve or sluice gate per hour on a continuous basis.
- i) The ambient temperature at which the actuators shall operate is expected to be between -5 °C and 45 °C.
- j) Each actuator shall be provided with a local/remote-control selection switch, and a handwheel by which the setting of the valve or sluice gate can be manually adjusted when the local/remote-control selection switch is in the local-control position. The directions for closing and opening shall be indicated on the wheels. The local/remote-control selection switch shall be designed with a locking device to inhibit unauthorised adjustments being made to the valve settings.
- k) Each actuator shall be designed to facilitate maintenance. The coupling between the actuator and the valve or sluice gate shall be easily accessible. It shall be possible to do maintenance work on the actuator whilst the valve or sluice gate is in operation under local control.

9.9.2 The Design Requirements for Electrical Actuators are Summarized as Follows:

- a) Double-sealed housings are preferred.
- b) Only direct, gear-driven units will be accepted.
- c) Open/close limits on the valve or sluice shall have adjustable set-points.
- d) The valve or sluice position on modulating units shall be infinitely variable, so that any position can be selected.
- e) Control of valves shall be by means of non-rising spindles, unless otherwise specified.
- f) The gear case shall be isolated from valve or sluice thrust.
- g) The actuator shall be capable of operating effectively at any angle.
- h) No plastic on nylon gears will be accepted.
- i) Oil-bath lubrication is preferred for the gearbox.
- j) Permanently sealed bearings are preferred.
- k) The actuator shall be protected by means of a torque switch, an instantaneous reversal protection circuit, and a jammed valve motor protection circuit.
- l) For high speed applications, torque limiting brakes shall be supplied to prevent excessive valve seat loading.
- m) Indications for response times (fully closed to fully open) are given in the detailed specifications.

9.10 CORROSION PROTECTION

Corrosion protection shall be in accordance with the section dealing with corrosion protection, and the Contractor shall ensure that the unit is fit for operation in the relevant environment as per STD-LRM-GN-0006 [114].

9.11 MEASUREMENT AND PAYMENT

Item	Description	Unit
9.11.1	Supply and delivery of manually or electrically actuated flow-control valves and sluice gates	No

The unit of measurement shall be the number of manually or electrically actuated valves or sluice gates supplied.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage or on the site, etc, as well as all royalties, patent rights, etc. for the flow-control valves or sluice gates, complete with electric motor, gearbox, motor control, headstock, seals, guide rails, frame, etc, as specified.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

Item	Description	Unit
9.11.2	Installation, testing and commissioning of manually or electrically actuated flow-control valves or sluice gates	No

The unit of measurement shall be the number of manually or electrically actuated flow-control valves or sluice gates installed.

The tendered rates shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, calibration, commissioning and maintenance of the flow-control valves or sluice gates, and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the relevant equipment, unless the required operation and maintenance manuals have been supplied and have been accepted by the Engineer.

SECTION 10: POWER TRANSMISSION COUPLINGS

DOCUMENT NO.: STD-LRM- MM-0020

CONTENTS

10.1	SCOPE	572
10.2	STANDARDS	572
10.3	DIRECT DRIVES AND COUPLINGS	572
10.4	BELT DRIVES	573
10.5	CHAIN DRIVES	573
10.6	TESTING AND COMMISSIONING	574
10.7	MEASUREMENT AND PAYMENT	574

10.1 SCOPE

This specification covers the minimum requirements with regard to the selection, supply, installation, testing, commissioning and the payment item descriptions for of power transmission couplings.

10.2 STANDARDS

10.2.1 National and International standards

The latest edition, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[115]	BS 46 Part 1	Keys and keyways and taper pins. Specification. Keys and keyways
[116]	BS 4235 Part 1 & 2	Part 2 -Specification for metric keys and keyways. Woodruff keys and keyways
[117]	BS 436	Specification for machine cut gears. A. Helical and straight spur

10.2.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[118]	STD-LRM-MM-0010	Dry-well pumping equipment
[119]	STD-LRM-MM-0011	Submersible pumping equipment
[120]	STD-LRM-MM-0001	Compressors and blowers
[121]	STD-LRM-MM-0021	Gearboxes
[122]	STD-LRM-MM-0024	Surface mounted mixers and aerators

10.3 DIRECT DRIVES AND COUPLINGS

- To reduce noise and vibration levels, all direct drives shall be of the flexible type, which allow for misalignment unless otherwise specified.
- The coupling shall be selected such that it can safely transfer 150% of the design starting torque, and can safely operate up to a rotational speed of 150% of the nominal duty speed.

- c) The motor or engine and driven equipment, shall be aligned and installed such that misalignment and stagger is within 60% of the safe allowable limits, as specified by the supplier of the driving and/or driven equipment.
- d) The driven equipment and electric motor shall be aligned to within 0,05 mm for equipment rated in excess of 100 kW, and to within 0,25 mm for equipment rated below 100 kW, both radially and axially, to avoid vibration.
- e) Care shall be taken to ensure that the axial clearance between coupling flanges is well within the range specified by the supplier. The clearance shall lie not closer than 25% of the allowable range from either the lower or higher limits. No thrust shall be transferred from the motor to the driven equipment or vice versa.
- f) All couplings shall be covered with a sturdy guard that covers but does not touch moving parts. The guard shall be bolted in position and shall be easily removable.
- g) Direct, flexible couplings shall be maintenance-free.
- h) Rigid couplings shall only be used if specified in the detailed specifications or if prior approval is obtained from the Engineer.

10.4 BELT DRIVES

- a) Belt drives shall only be used with the permission of the Engineer, or as specified in the detailed specifications. The use of belt drives shall be fully motivated in a covering letter if the Contractor has specific reasons for using them.
- b) This clause only deals with V-belts, but full details of alternatives may be submitted to the Engineer for approval.
- c) The Contractor shall install at least two belts per coupling if belt drives are approved.
- d) The coupling (the belts, pulleys, shafts and keys) shall be selected such that it can safely transfer 200% of the design starting torque, and can safely operate up to a rotational speed of 150% of the nominal duty speed.
- e) The motor or engine and driven equipment, shall be aligned and installed such that misalignment and stagger is within 60% of the safe allowable limits, as specified by the supplier of the driving and/or driven equipment. Radial runout on pulleys shall not be more than 1% of the pulley diameter.
- f) Keys and keyways for load transfer to and from shafts, shall comply with BS 46 Part 1 and BS 4235 Part 1 and Part 2.
- g) Suitable and accessible methods for adjusting the tension of the belts shall be provided.
- h) The driving and driven pulleys and belts shall be enclosed in a single sturdy guard, which allows for visual inspection of the belt condition with the guard fitted. The guard shall be easily removable for belt maintenance.
- i) Pulley sizes and ratios shall be selected such that operational belt speeds never exceed 25 m/s, and are never less than 10 m/s.
- j) The arc of contact on the small pulley shall be more than 120°. The pulley ratio shall not be less than 1,25:1, unless prior approval is obtained from the Engineer.
- k) Belts shall be easily removed and installed for maintenance purposes, and shall be to the approval of the Engineer.

10.5 CHAIN DRIVES

- a) Roller chain drives shall only be used when approved by the Engineer, or as specified in the detailed specifications. The use of chain drives shall be fully motivated in a covering letter, if the Contractor has specific reasons for using them.
- b) The coupling (the chain, sprockets, shafts and keys) shall be capable of safely transferring 200% of the design starting torque, and can safely operate up to a rotational speed of 150% of the nominal duty speed.
- c) The motor or engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60% of the safe allowable limits, as specified by the supplier of the driving and/or driven equipment.
- d) Sprockets shall be precision machined with hardened teeth in accordance with BS 436.

- e) Keys and keyways for load transfer to and from shafts, shall be in accordance with BS 46 part 1 and BS 4235 part 1 and part 2.
- f) Suitable and accessible methods for adjusting the tension of the chain(s) shall be provided.
- g) The driving and driven sprockets and chain(s) shall be enclosed in a sturdy guard which allows visual inspection of the chain condition with the guard in place. The guard shall be easily removable for chain and sprocket maintenance.
- h) For low speed applications, sprockets shall not have less than 11 teeth, and for moderate to high speed applications, not less than 17 teeth.
- i) Drip feed or shallow bath lubrication is preferred. The application of heavy oils or greases shall only be considered for very low speed applications for which the prior approval of the Engineer shall be obtained. In the case of grease lubrication pre-lubricated chains with O – ring seals are preferred.
- j) Chains shall be easily removed and installed for maintenance purposes.

10.6 TESTING AND COMMISSIONING

Testing and commissioning of all power transmission couplings shall be included in the tests of the relevant motors or engines and driven equipment.

10.7 MEASUREMENT AND PAYMENT

Measurement and payment for all power transmission couplings shall be deemed to be included in the rates tendered for motors or engines and driven equipment.

SECTION 11: GEARBOXES

DOCUMENT NO.: STD-LRM- MM-0021

CONTENTS

11.1	SCOPE	575
11.2	GENERAL	575
11.3	DESIGN AND MANUFACTURE	575
11.4	RATINGS AND CALCULATIONS	576
11.5	TEMPERATURE AND LUBRICANTS	576
11.6	PAINTING/COATING/CORROSION PROTECTION	576
11.7	PROTECTION DEVICES	577
11.8	SHOP TESTING	577
11.9	SHAFT COUPLINGS AND ALIGNMENT	577
11.10	MARKING AND RECORDS	577
11.11	TESTING AND COMMISSIONING	578
11.12	MEASUREMENT AND PAYMENT	578

11.1 SCOPE

This section covers gearboxes that may be incorporated in any of the items of equipment to be supplied under the contract.

11.2 GENERAL

Only well proven gearboxes of high quality will be accepted, such as Hansens or an approved equivalent in all respects.

11.3 DESIGN AND MANUFACTURE

- a) The gearbox shall be a unit specially selected for the specified application and shall employ standardised components. The helical and spur gears shall be manufactured from alloy steel, and shall be thoroughly hardened prior to grinding. No worm-gears will be accepted. Gears that are cut from special alloys, shall not cause galvanic or chemical reactions between the gears and the gearbox shafts.
- b) The housings shall be made of grey cast iron and shall be equipped with a breather, drain and oil refilling plugs, which shall be accessible above the mounting frame. Oil level indication shall be provided either by means of a window or a dipstick.
- c) The gearbox shall have lifting lugs for lifting purposes, if its mass is more than 25 kg.
- d) The bearings shall have a minimum L10h, basic life rating of 60 000 hours at full torque rating unless specified to the contrary in the detailed specification. Bearing ratings shall be to AGMA standards, as specified in the clause on ratings and calculations of this specification.
- e) The design of shafts and bearings shall be carefully calculated to allow for the adequate stiffness, life, and the required overhung load capability for the unit. The shaft seatings for bearings, gear wheels and oil seals shall all be ground. The shaft shall preferably run at well below the first critical speed.
- f) Special care shall be taken to account for large bending moments, thrusts and other forces due to large overhangs, where applicable.
- g) Gearbox housings shall be of suitable rigid construction, but with provision for ease of maintenance.

- h) The Contractor shall ensure that bore and keyway sizes and tolerances for high speed and low speed shaft coupling halves, are compatible with the gearbox shaft extensions.
- i) Proof of experience in the particular application shall be given by way of a reference list. If no adequate reference list exists, then a five year guarantee shall be required.

11.3.2 Manufacturing Quality

Gear teeth shall be manufactured to the following standards:

Class 12 to AGMA 390.02

or

Class 7 to ISO 1328

Shafts, housings, etc. shall be designed so that anticipated deflections under load, together with tolerance on manufacture, do not exceed the allowable deviations in the helix angle provided for in the above standards.

Proof from the SANS that the tenderers systems conform to SANS ISO 9000 will be favoured.

11.4 RATINGS AND CALCULATIONS

- a) For purposes of selection, the power transmission rating of the gearbox shall be calculated in accordance with the method laid down by the American Gear Manufacturers Association for indefinite operation with a reliability of 99%. Strength and durability calculations may be required from the successful tenderer in accordance with AGMA 2001. Gear calculations shall indicate the reference specification used and all factors used in the calculation.
- b) The service factor, chosen in accordance with AGMA 6010-E88 and based on the installed motor power, shall not be less than the factor specified for each application in these specifications (refer to the relevant sections). However, if no service factor is specified for particular equipment, the lower limit for this factor shall be taken as 2,0. The service factor calculation shall be based on a maximum motor torque of twice full-load running torque. The tenderer, shall on request, submit to the Engineer the full-service factor calculation in accordance with AGMA 6010-E88, complete with full substantiation of all factors used. The Contractor shall ensure that the service life and lubrication of all bearings are not adversely affected due to the specified service factor. Where required, additional precautions shall be taken to ensure adequate operation and lubrication of all bearings. The Contractor shall submit fully detailed calculations on request, to substantiate his compliance with these requirements. A copy of the bearing life calculations shall be submitted and a 23 or similar factor used, must be shown clearly.

11.5 TEMPERATURE AND LUBRICANTS

- a) The normal maximum operating temperature of the gearbox under full load shall not exceed 90 C in a maximum ambient temperature of 40°C.
- b) Unless the gearbox is totally full of oil, the space above oil level shall be protected from corrosion by a vapour corrosion inhibitor, added as a 10 % addition thoroughly mixed into the manufacturer's recommended oil. VCI 329 from Cortec (Pty) Ltd or another approved inhibitor may be used. The corrosion inhibitors added by the oil manufacturer do not protect the surfaces above the oil level.
- c) Mineral oils with extreme pressure additives shall be used, and a list of suitable lubricants shall be supplied by the Contractor in his Operations and Maintenance Manuals.
- d) The Contractor shall ensure that no joints, seals, gaskets and external oil fittings (where applicable) leak oil, and shall tighten all pipe fittings and unions after installation.

11.6 PAINTING/COATING/CORROSION PROTECTION

- a) All housings shall be abrasive blast-cleaned with new, non-recycled iron, copper or platinum slag abrasives designed for blast cleaning. The abrasive used for cast iron shall not be recycled. Cast iron shall be blast cleaned until all sand particles, burnt on sand and casting skin have been removed. The cleanliness shall not be less than SA 2,5 of ISO 8501-1 (formally SIS 05 5900).

Omegas shall be opened up to their full diameter and filled, together with blowholes, with a solvent-free epoxy filler or putty, and finished level and smooth with the surrounding surface. After curing, the surface shall be blast cleaned, dust and debris removed by vacuum cleaner (preferred) or by means of a clean dry brush to achieve a residual dust and debris level not greater than 0,5 % (SANS Method 769). Within 4 hours of blast cleaning (or less if relative humidity exceeds 70 %) apply a suitable primer which shall be suitable for overcoating with two pack epoxy material on external surfaces. If the primer is a two-pack material, each pigmented component shall be thoroughly mixed, after which the two components shall be mixed together for not less than five minutes. The whole of the two-pack shall be mixed and the use of split packs without accurate measurement is not permitted.

- b) Priming shall be allowed to cure for a minimum of 24 hours before machining.
- c) The exterior paint finishing system shall be subject to approval by the Engineer. In severe corrosive conditions, special protection may be specified.
- d) Paint finishing shall be done after final shop test running. The tenderer shall submit on request his standard finish paint specification for approval.
- e) Also refer to the clause on temperature and lubricants above, with regard to corrosion inhibitors added to oil.

11.7 PROTECTION DEVICES

Gearboxes rated at more than 75 kW installed power, shall have oil pressure indicators and oil low pressure limit switches fitted for protection purposes.

11.8 SHOP TESTING

- a) Each gearbox shall after assembly, be test-run for approximately 24 hours but no less than 12 hours under no load at the speed and in position it will operate in service. It shall be checked for oil tightness, proper lubrication of bearing and gears, meshing of gears and correct clearances of bearings. Access must be allowed to inspectors to witness the testing procedure.
- b) Housings and covers will show no visible leaks. During testing, the indication of the operating oil level shall be checked, and in case of a dipstick which can be removed, the serial number shall be stamped on the dipstick.
- c) A test certificate shall be supplied by the Contractor to the Engineer.

11.9 SHAFT COUPLINGS AND ALIGNMENT

- a) The motor shall be mounted to the gearbox via an accurately located lantern housing, unless otherwise specified. A precision high speed flexible coupling, incorporating rubber buffers, shall transmit power from the motor to the gearbox.
- b) All couplings of shafts on the gearbox output side, shall be flexible flanged couplings, except where fixed or rigid couplings have been specified. Fixed or rigid couplings shall not be utilised unless specifically authorised by the Engineer.
- c) Flexible couplings shall make provision for minor misalignment of shafts only, and shall tolerate minor relative axial movement between shafts. Flexible couplings shall dampen the effect of shock loadings and cyclic fluctuating loads. Energy dissipation in the flexible elements of the flexible couplings shall contribute to the dampening of torsion vibrations.
- d) Flexible couplings shall be installed and adjusted strictly according to the supplier's instructions. Clearances between coupling flanges shall be carefully set to in all planes and axes.
- e) Where rigid output couplings have specifically been indicated in either solid or hollow shaft gearboxes, they shall be implemented as specified in the detailed specification.
- f) The Contractor shall refer to the section dealing with power transmission couplings for additional specifications.

11.10 MARKING AND RECORDS

- a) Each gearbox will be fitted with a nameplate showing at least the following information:
 - i) Gearbox type or model number
 - ii) Serial number

- iii) AGMA rating
- iv) Nominal ration
- v) Approximate oil quantity required
- b) The successful tenderer shall keep suitable records accessible from the serial number which will contain at least:
 - i) Date of manufacture
 - ii) Details of test runs
 - iii) List of part number used in the assembly.

11.11 TESTING AND COMMISSIONING

Gearboxes shall be tested together with the driving motors and driven equipment, as required in the standard specification on testing and commissioning.

11.12 MEASUREMENT AND PAYMENT

A gearbox shall be supplied and installed as a complete integrated unit with its driving and driven equipment, and shall therefore be included in the tendered rates for the driven equipment as specified in the relevant section.

SECTION 12: EQUIPMENT FOR THE MEASUREMENT OF FLUID/FLOW PROPERTIES

DOCUMENT NO.: STD-LRM-MM-0006

CONTENTS

12.1	SCOPE	579
12.2	STANDARDS.....	579
12.3	MECHANICAL PRESSURE GAUGES	579
12.4	TESTING AND COMMISSIONING.....	580
12.5	MEASUREMENT AND PAYMENT	580

12.1 SCOPE

This specification covers requirements for various equipment and instruments used to determine the properties of fluids or the flow as present in the process during operation of the relevant plant.

12.2 STANDARDS

12.2.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[123]	BS EN 10226-1 to 3	Pipe threads pressure-tight joints are made on the threads .
[124]	BS EN 10255	Non-alloy steel tubes suitable for welding and threading.
[125]	BS EN ISO 9906	Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1 and 2
[126]	BS EN 837-1	Pressure Gauges Part 1: Bourdon Tube Pressure Gauges - Dimensions, Metrology, Requirements and Testing.

12.2.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[127]	STD-LRM-GN-0005	Testing and commissioning

12.3 MECHANICAL PRESSURE GAUGES

Analogue mechanical or bourdon tube pressure gauges shall be of the bottom entry type and shall have a face of at least 60 mm in diameter with clear, readable markings and indicators. The screw-in fitting shall be compatible with the pipe fitting, which shall be the metric equivalent of a 2 inch BSP internal thread unless otherwise specified in the detail specifications. Threads shall be in accordance with BS EN 10226-1 to 3 [123] for jointing threads or BS EN 10255 [124] for long screw threads. Details in this regard shall be supplied by the contractor in the operation and maintenance manuals.

The indicated range on the gauge shall span 120% of the operational pressure range specified for the relevant equipment. Accuracy shall be within 3% of the full scale deflection value. An adjustable indicator shall be set to indicate the maximum operational system pressure clearly.

It shall be possible to isolate the pressure gauge from the pipe pressure by means of a valve or a gauge cock, which shall be supplied and installed by the contractor and shall be included in the tendered rate for the equipment.

A gauge protector shall be fitted where a gauge has to indicate pressures in corrosive media or liquids that could easily clog the pressure ports. It is a requirement that gauge protectors be fitted where sludge is the working medium.

Pressure gauges fitted to hydraulic pipe lines shall be glycerine-filled for damping purposes, and gauges fitted to pneumatic or gas pipelines shall be vacuum damped.

The circumferential positioning of pressure gauges on water and sewage pipes shall be in accordance with BS EN ISO 9906 [125] and the static head tapplings shall also comply with these standards.

Bourdon type pressure gauges shall comply with BS EN 837-1 [126].

12.4 TESTING AND COMMISSIONING

The equipment shall be tested and commissioned together with the relevant pipework and other equipment such as pumps or compressors in accordance with STD-LRM-GN-0005 [127].

12.5 MEASUREMENT AND PAYMENT

Pressure gauges will be deemed to be included in the tendered rates for the relevant equipment to which they are fitted.

SECTION 13: DRY-WELL PUMPING

DOCUMENT NO.: STD-LRM- MM-0010

CONTENTS

13.1	SCOPE	581
13.2	STANDARDS.....	581
13.3	TECHNICAL REQUIREMENTS APPLICABLE TO ALL PUMP TYPES.....	582
13.4	CENTRIFUGAL PUMPS.....	585
13.5	PROGRESSING CAVITY PUMPS	585
13.6	DIAPHRAGM PUMPS	586
13.7	PERISTALTIC PUMPS.....	586
13.8	SPECIAL REQUIREMENTS IN RESPECT OF CHEMICAL DOSING PUMPS	586
13.9	TESTING AND COMMISSIONING.....	587
13.10	CORROSION PROTECTION	587
13.11	MEASUREMENT AND PAYMENT	588

13.1 SCOPE

This specification covers the supply, delivery, installation, testing, commissioning and payment item descriptions for dry-well pumping equipment. Dry-well pumping equipment shall mean pumping equipment, of which the motors may or may not be submersible, but which operate in a non-submersible mode.

13.2 STANDARDS

13.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[128]	BS 5316, Part 1	Acceptance tests for centrifugal, mixed flow and axial pumps
[129]	ISO 281/1	Rolling bearings – Dynamic load ratings and rating life
[130]	BS EN ISO 9906	Rotodynamic pumps. Hydraulic performance acceptance tests.
[131]	BS 5315	Hose clamps (worm drive type) for general purpose use (metric series)

13.2.2 Standard Specifications Included in this Contract Document

The following standard specifications shall be read in conjunction with this specification, and shall be deemed to form part thereof:

[132]	STD-LRM-GN-0004	General Design
[133]	STD-LRM-MM-0008	Electric motors
[134]	STD-LRM-MM-0020	Power transmission couplings
[135]	STD-LRM-MM-0006	Equipment for the Measurement of Fluid/Flow Properties
[136]	STD-LRM-GN-0006	Corrosion protection
[137]	STD-LRM-GN-0005	Testing and Commissioning

13.3 TECHNICAL REQUIREMENTS APPLICABLE TO ALL PUMP TYPES

13.3.1 Pump Layout

Together with their tenders, tenderers shall provide full details and drawings of the proposed pump layout, including all pipework to facilitate coupling with existing pipes, which shall be subject to the approval of the Engineer before acceptance of the tender. The design of all pipework, if required by the detailed specification, and the layout, shall be included in the tendered rates. The tenderer shall submit details with regard to the required plinth sizes and civil requirements in order to install the equipment.

13.3.2 Material

The Contractor shall take cognisance of the operating environment, and the properties of the pumped liquid, when selecting the materials of manufacture for the pump components. Full specifications in this respect shall accompany the tender and the tenderer's advice will be considered.

13.3.3 Condition Monitoring

- a) Pumps fitted with motors rated in excess of 110 kW shall be designed to accept transducers for the monitoring of:
 - i) the vibration levels in three mutually perpendicular directions; and
 - ii) the lubricant temperature of the bearings.
- b) Adequate access around the bearing housing shall be available for the positioning of transducers.
- c) The system analyser to be used to interface with the transducers, will be detailed in the detailed specifications, and the Contractor shall ensure that his fittings on the pumps are compatible with suitable transducers. Accelerometer type transducers are preferred for vibration monitoring.

13.3.4 Pump Casings

Pump casings shall be manufactured from high-grade cast steel or grey iron No 30, rigidly secured to a bed plate or base, and shall be finished off smoothly before a high-quality corrosion protection system is applied. The casing shall be selected for a minimum of 1 000 kPa or 1,5 times the actual discharge pressure, whichever is the greater. The removing of parts may in no way interfere with the pipework.

13.3.5 Pump Shaft

- a) The shaft shall be manufactured of high-tensile steel. Where the shaft passes through stuffing boxes, it shall be fitted with renewable sleeves of high-quality, wear-resistant alloy.
- b) The shaft shall be so designed that the running speed is well below the first critical speed, and the complete rotor shall be accurately balanced after assembly.

13.3.6 Pump Impeller

The impeller shall be bored and keyed. All parts inaccessible to machining shall have a smooth finish. The impeller shall be hydraulically, statically and dynamically balanced.

13.3.7 Bearings

- a) Only ball or roller bearings shall be installed, and bearings shall have a minimum L10h basic life rating of 50 000 hours at the rated load and speed for the application, unless specified to the contrary in the detailed specification.
- b) Special bearings shall be provided to absorb any axial thrust that may be caused by the characteristic of the impeller, or by the type of coupling selected between the pump and the motor.
- c) Pump shaft bearings shall be carried outside of the main casing and glands on extensions to the main casing. Bearings shall be positively sealed against water penetration.
- d) Bearing numbers shall be given for all bearings in the pumps to facilitate replacement.

13.3.8 Wearing Rings

Wearing rings shall be easily replaceable.

13.3.9 Shaft Seals

- a) Clean-water pumps
 - i) Pumps shall be fitted with stuffing boxes and shall have packings of adequate depths unless otherwise specified in the detailed specification. A lantern or water seal shall be housed between the inner and outer packing rings, and shall be connected by copper tubing to the discharge volute.
 - ii) The packing shall be designed to permit high speed rotation without the possibility of seizing and charring the packing material or shaft. An automatic water seal shall be provided to prevent the entry of air into the pump.
 - iii) Drains from the pump seals shall be provided. These shall discharge visibly into funnel-shaped receivers before discharging to a suitable drainage point. Drainage pipework shall be included in the tendered rates for the pump.
- b) Sewage pumps
 - i) The pumps shall be fitted with stuffing boxes as described above, but a separate clean water supply shall be provided to the glands. This will either be done by means of pumps supplied by the Contractor, or as specified in the detailed specification.
 - ii) A mechanical seal arrangement as described below for sludge pumps, may also be offered as an alternative to glands.
- c) Sludge pumps
 - i) All pumps utilised for the pumping of biological sludges shall be fitted with double-flushed mechanical seals, which shall be included in the cost of the pumps.
 - ii) Pump shafts shall be hardened and accurately ground where the seal bears on the shaft.
 - iii) The mechanical seals shall be supplied by a reputable supplier and shall be of the axial direction, face-type shaft seals. The rotating seal face shall be mounted on a flexible member, the latter also sealing on the shaft. The flexible member shall be manufactured from rubber, PTFE or an equivalent material, suitable for the operating environment.

13.3.10 Coupling between Pump and Motor

- a) The pump and motor shall either be separately mounted on a common base frame, or the motor shall be flange mounted to the pump. The former method is preferred for centrifugal pumps, and the latter for positive displacement pumps.
- b) No V-belt couplings will be accepted, unless required in the detailed specifications or approved by the Engineer. In this case, the bearings shall be suitable for such operation.
- c) The pumps and motors shall be directly coupled with a suitable type of coupling, which will satisfactorily take up minor misalignment or off-setting of the motor and pump shaft.
- d) Refer to the standard specification on power transmission couplings for additional specifications.

13.3.11 Pump Motor

Unless otherwise specified, each pump shall be supplied complete with an electrical motor, which shall comply with the requirements as specified in the standard specification on electric motors.

13.3.12 Base Plate or Frame

- a) The pump and electric motor shall be mounted and levelled on a common base-plate of fabricated steel construction or cast iron. Machined facings shall be provided to receive the pump and motor.
- b) The base-plate shall be bolted down onto a concrete base. The concrete base will be constructed by others. Before fabrication is commenced with, detailed drawings of the base, including its exact position in the building, shall be submitted to the Engineer for approval.
- c) The Contractor shall supply the required holding down or mounting bolts manufactured from galvanised or plated high tensile steel, to be grouted into the plinth pockets by others. The Contractor shall be responsible for the grouting of the base plates or frames.
- d) The pump shall be accurately aligned with the motor and at least two dowel pins shall be installed in the base-plate.

13.3.13 Accessories

- a) The pump shall be fitted with air cocks, drain cocks, and lifting eyes if the mass of the pump is more than 25 kg, and all guards required in terms of the Occupational Health & Safety Act, (Act 85 of 1993).
- b) All pumps supplied shall be fitted with glycerine filled pressure gauges on the suction and delivery sides. The pressure gauges supplied shall have a face diameter of at least 100 mm. The pressure gauge scale shall be sized such that the normal operating pressure shall be at approximately 60% of full scale, but not higher than 80% of full scale. The gauge shall be protected against the deleterious effects of surge-over pressures, up to the pressure rating of the pipe system. Chemical seal gauge protectors shall be installed on all gauge installations, with the exception of gauge installations for potable water. Each gauge installation shall be fitted with a 3-way gauge cock to isolate the pressure gauge when not required.
- c) The pressure gauge installation shall be such as to minimise vibration on the pressure gauge. Pressure gauges installed on separate pedestals are preferred above gauges installed on the pump or pipework.
- d) The location of the pressure gauge fitting shall be as per BS 5315 [131], and shall also be such that the pressure gauge is easily accessible, and can be clearly seen from the emergency stop station for the pump.

13.3.14 Priming of Pumps

- a) Where the pump is connected to a flooded suction manifold, a master gate valve shall be fitted in the manifold, as close as practicable possible to the water retaining wall, as a safety precaution against flooding.
- b) Where the pump is so installed that it is dependent on a foot valve or reflux valve to maintain priming at start-up, it shall be provided with additional priming arrangements such as piping and valves not less than 50 mm in diameter, supplied from a head tank well above the pump. An electrically operated priming pump or a hand-operated diaphragm pump will also be considered. Where an adequate volume of water is available in the discharge line at a low head, priming may be carried out by means of a bypass around the discharge reflux valve.

13.3.15 Lubrication Details

- a) The pump housing shall be fitted with a sight glass or a dipstick facility to monitor oil levels where applicable.
- b) Suitable lubrication arrangements such as accessible grease nipples shall be provided.
- c) Full details on lubrication intervals, oil and/or grease specifications, and acceptable substitutes shall be specified in the operations and maintenance manuals.

13.3.16 Pump Technical Details and Installation

- a) The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, and speed and efficiency for the expected range of operational conditions.
- b) Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.
- c) The flow rate at the break-off point of the curve for the impeller selected, shall be at least 1,5 times that of the maximum flow rate specified.
- d) The head at zero delivery of the curve for the impeller selected, shall be at least 1,2 times the maximum head in the pump's operational range.
- e) The possible percentage variation of data measured on site by the supplied and/or installed instrumentation, when compared with the catalogued performance data, must be submitted.
- f) All calculations for static and dynamic heads are to be based on an atmospheric pressure above sea level, as specified in the detailed specifications.
- g) The Engineer or his representative reserves the right to call for:

- i) test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SANS, and/or site inspection, customer reports or references, and user's interviews; and/or
- ii) full engineering, and/or design and component selection details, in order to check the correctness of the service life claimed.
- h) The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in an "as new" condition until taken over by the Employer.
- i) The required unobstructed space left around the installation for maintenance and servicing of the equipment, shall be in accordance with the manufacturer's instructions, local authority by-laws and with the Occupational Health & Safety Act, Act 85 of 1993.
- j) Pumps shall be statically, dynamically and hydraulically balanced, at the manufacturer's works, to within the design operating range.
- k) If the Contractor is required to be responsible for the pipework by the detailed specification, he shall ensure that overhauling and removal of the pumps is possible without extensive dismantling or any cutting of pipework.
- l) A metal lubrication instruction plate shall be attached to the pump where it is clearly visible. The plate shall indicate the recommended lubricant, points of lubrication and the recommended frequency of lubrication.
- m) Detailed pressure-drop and net positive suction head calculations for the system, shall be included in the operations and maintenance manuals.

13.4 CENTRIFUGAL PUMPS

Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements, regarding all pump types, as well as the following:

- a) Preference will be given to pumps of the self-regulating type, and where the power consumption characteristic is such that with an increase in delivery to beyond a certain limit, the power consumption decreases, thereby ensuring that the motor is not overloaded, in the event of a large reduction in pumping head.
- b) The casing for centrifugal pumps shall be horizontally or vertically split to allow for the removal of parts.
- c) The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.

13.5 PROGRESSING CAVITY PUMPS

Progressing cavity pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, and the following requirements:

- a) The pump shall be of the progressing cavity type with a stator and a rotor, similar to Mono, Orbit or approved equivalent pumps.
- b) The stators of the pumps shall be manufactured from a suitable wear-resistant rubber and shall be formed by moulded-to-metal construction. The rubber shall be resistant to wear and heat caused by the occasional dry running of the pumps, and the maximum permissible time span during which the pumps can run dry, without any damage caused to the pumps. This shall be indicated in the covering letter at the tender stage.
- c) The rotors shall be manufactured from stainless steel 316.
- d) Shaft sealing shall be by packed glands with a flush-fitting lantern ring. The gland surface areas shall be hard chrome plated.
- e) The efficiency of the pumps shall not be less than 75%. The normal operational efficiency of the pumps shall not be less than 3% below the peak efficiency of the pumps.
- f) Each pump shall have a suitably calibrated pressure relief valve fitted in the delivery pipework, immediately downstream of the outlet flange. This valve shall be included in the tendered rates.

13.6 DIAPHRAGM PUMPS

Diaphragm pumps shall comply with the relevant and applicable items under the clause on technical requirements regarding all pump types, and the following:

- a) The Contractor shall take special care to ensure that the materials of construction, in particular the diaphragm material, are resistant to the corrosive actions of the liquid being pumped. The relevant liquids are frequently highly corrosive chemicals such as ferric chloride.
- b) The pump mechanism for diaphragm pumps shall incorporate a positive return of the plunger. Pumps with spring-returns on the plungers are not acceptable. The pumps shall be single units and shall be of a modular, standard design.
- c) Flow dampers shall be installed if required to protect the reflux valve seats incorporated in the pump head.
- d) Each pump shall have a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange. This valve shall be included in the tendered rates.

13.7 PERISTALTIC PUMPS

- a) Peristaltic pumps shall only be supplied if specified in the detailed specification.
- b) The pump shall consist of a pump casing with rotor and pumping tube, with the rotor being driven through a gearbox by a flange mounted electric motor. The motor and gearbox shall comply with the standard specification on electric motors, and the standard specification on gearboxes.
- c) The pumping tube or hose shall be manufactured from a compliant, tough material resistant to cracking. Special care shall be taken to ensure that it is resistant to chemical attack from the pumped liquid. The tenderer shall indicate at tender stage which material he intends to use for the specified application.
- d) The pumping hose shall have an outer diameter to inner diameter ratio of not less than 1,75.
- e) The pumping hose shall be easy to replace, and each pump shall be supplied with a spare replacement hose.
- f) The rotor shall have at least two rollers mounted on roller bearings, and the rotor shaft shall also be supported in roller bearings. All bearings shall be permanently sealed.
- g) It shall be possible to rotate the pump in the reverse direction for cleaning or maintenance purposes.

13.8 SPECIAL REQUIREMENTS IN RESPECT OF CHEMICAL DOSING PUMPS

The Contractor shall refer to the standard specification on chemical dosing plant with regard to special requirements for chemical dosing plant and chemical dosing pumps shall also conform to the following:

- a) Chemical dosing pumps shall either be progressing cavity, diaphragm or peristaltic type pumps unless otherwise specified in the detailed specification.
- b) The Contractor shall select suitable materials of manufacture for all components in order to render the pump resistant to chemical attack from the pumped liquid whilst retaining effective performance from the pump.
- c) The flow rate of diaphragm pumps shall be variable between certain values given in the detailed specifications. A fine-adjustment facility shall be incorporated with positively distinguishable increments as given in the detailed specifications. The stroke length shall be manually adjustable and shall be calibrated as a percentage of the full stroke.
- d) Variable speed drives may be required on all types of pump as specified in the detailed specification. The Contractor shall ensure that the electric motor has sufficient cooling facilities while the motor runs for extended periods at the minimum speed setting, as prescribed by the Contractor. The minimum speed setting shall never be less than 40% of the maximum running speed.
- e) The Contractor shall include in the maintenance manuals of the pump, graphs which show the flow of the liquid chemical (in m³/h) vs the stroking speed (in strokes per minute) for various stroke lengths, varying from 10% to 100% of the full stroke, in steps of 10% of the full stroke.

- f) Gearboxes may be fitted to dosing pumps in accordance with the standard specification on gearboxes, and the AGMA service factor, based on installed power, shall not be less than 1,75. Details on the service factor calculations are supplied in the standard specification on gearboxes.

13.9 TESTING AND COMMISSIONING

13.9.1 Test to be Performed

- a) All pumping equipment shall be subject to the commissioning tests as described in the standard specification on testing and commissioning.
- b) At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow-rate or volumetric flow testing facilities will be supplied by others, unless otherwise specified in the detailed specification.
- c) The operating point of each pump shall be determined.
- d) Efficiency tests will only be performed when specified in the detailed specification.
- e) NPSH tests will only be performed when specified in the detailed specification.

13.9.2 Pump Operating Point

- a) During the day-01 commissioning tests, the pump operating point shall be determined by observing the following:
 - i) pump delivery and suction pressures; and
 - ii) electric motor power consumption.
- b) If no efficiency tests are required in the detailed specification, then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.
- c) The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

13.9.3 Flow Rate (delivery), Efficiency and NPSH Tests

- a) Testing will be done in accordance with BS EN ISO 9906 [130].
- b) Power consumption of electric motors shall be as determined by the three Wattmeter method where efficiency tests are required in the detailed specification.

13.9.4 Test Conditions

- a) All tests will be performed in situ.
- b) The pumped medium or liquid specified as the process liquid in the detailed specifications, shall be utilised during the tests. The Contractor shall obtain from the pump manufacturer, the test point for clean water corresponding to the specified duty point for the pumped liquid; in order to relate the measured performance to the pump suppliers curves which are based on water.

13.9.5 Additional Tests

Additional tests may be specified in the detailed specification.

13.10 CORROSION PROTECTION

All corrosion protection shall be in accordance with the standard specification on corrosion protection.

13.11 MEASUREMENT AND PAYMENT

Item	Description	Unit
13.11.1	Supply and delivery of dry-well pumping equipment	No

The unit of measurement shall be the number of dry-well pumping installations supplied and delivered.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading including all handling of the complete dry-well pump unit which shall include the following:

- a) Pump unit.
- b) Required prime mover (electric motor unless otherwise specified in the detailed specification).
- c) Power transmission coupling.
- d) All safety guards.
- e) Pressure ports and all required bleeding screws and priming valves.
- f) Suction and delivery side pressure gauges.
- g) Pressure relief valves, where required.
- h) Base frame, onto which the above shall be mounted.
- i) All required fasteners holding down bolts and auxiliary materials to render a complete and operational pump unit.
- j) Drainage pipework.

Separate items will be scheduled in the schedule of quantities for different types and sizes of dry-well pumping equipment

Item	Description	Unit
13.11.2	Installation of dry-well pumping equipment	No

The unit of measurement shall be the number of dry-well pumping installations installed.

The tendered rate shall include full compensation for the site handling and positioning of the dry-well pumping equipment including the fastening of the equipment in its designated position, including full compensation for the following:

- a) Alignment of prime mover and pump unit, if the unit was shop assembled the correct alignment shall never the less be proved on site.
- b) Piping of all gland drains to a suitable building drain.
- c) Coupling of all required pipe flanges (suction delivery and if required seal water pipes) including all required gaskets, nuts, bolts and washers.
- d) All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be scheduled in the schedule of quantities for different types and sizes of dry-well pumping equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the pumping equipment unless the required operating and maintenance manuals have been supplied, and have been accepted by the Engineer.

Item	Description	Unit
13.11.3	Testing and commissioning of dry-well pumping equipment	No

The unit of measurement shall be the number of dry-well pumping installations tested and commissioned.

The tendered rates shall include full compensation for all preliminary tests, delivery, NPSH and efficiency tests if required by the detailed specification, and commissioning tests. The commissioning tests shall include the day-01 and day-30 test sessions as well as the 30-day monitoring period as described in the standard specification on testing and commissioning.

Separate items will be scheduled in the schedule of quantities for different types and sizes of dry-well pumping equipment.

SECTION 14: HOISTING EQUIPMENT

DOCUMENT NO.: STD-LRM-MM-0019

CONTENTS

14.1	SCOPE	590
14.2	STANDARDS.....	590
14.3	GENERAL REQUIREMENTS FOR ALL HOISTING EQUIPMENT	591
14.4	HOISTING FRAMES	593
14.5	MANUAL CRAWL AND CHAIN HOISTS.....	594
14.6	ELECTRICALLY DRIVEN CRAWLS AND HOISTS	594
14.7	CORROSION PROTECTION	596
14.8	OPERATING AND MAINTENANCE MANUALS	596
14.9	TESTING AND COMMISSIONING.....	596
14.10	MEASUREMENT AND PAYMENT	597

14.1 SCOPE

This section covers the manufacture, transportation, installation, testing and commissioning of hoisting frames and manual or electrically driven chain hoists and crawls.

14.2 STANDARDS

14.2.1 National and International Standards

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications, and codes of practice shall be read in conjunction with this specification and shall be deemed to be part thereof:

[138]	SANS 2408	Steel wire ropes for general purposes - Characteristics
[139]	ISO 1328-1	Cylindrical Gears - ISO System of Accuracy - Part 1
[140]	SANS 1592	Short-link steel chain (close-tolerance) for lifting appliances
[141]	BS EN 13001-1	Cranes — General design — Part 1: General principles and requirements.
[142]	BS 2853	1957 Specification for the design and testing of steel overhead runway beams
[143]	BS 3037	Part 1 : 1958 : Double flanged parallel-tread tyres
[144]	BS 4235	Specifications for metric keys and keyways
[145]	BS EN 1011-1	Welding — Recommendations for welding of metallic materials Part 1: General guidance for arc welding
[146]	BSI BS 7121-1 to 3	Code of practice for safe use of cranes
[147]	SANS 10044	Welding
[148]	SANS 10094	The use of high-strength friction-grip bolts
[149]	SANS 10142-1	The wiring of premises
[150]	SANS 1411-1	Materials of insulated electric cables and flexible cords Part 1: Conductors
[151]	SANS 1411-2	Materials of insulated electric cables and flexible cords Part 2: Polyvinyl chloride (PVC)

[152]	SANS 1804-2	Induction motors Part 2: Low-voltage three-phase standard motors
[153]	SANS 60529 (IEC 60529)	Enclosures for electrical equipment
[154]	BS 466	Specification for power driven overhead travelling cranes, semi-goliath and goliath cranes for general use
[155]	BS 436-2	Spur and helical gears. Basic rack form, modules and accuracy (1 to 50 metric module)

14.2.2 Proprietary Branded Items

Where an item is a standard proprietary brand item, the Contractor shall ensure that the latest edition, including all amendments up to date of tender, of the manufacturer's written specifications, operating and maintenance documentation, written guarantees, and all applicable national and international standards, publications and codes of practice applicable to the item, shall be read in conjunction with this specification, and shall be deemed to form part thereof. Such specification, operating and maintenance documentation and a written guarantee of the manufacturer shall form part of the operating and maintenance manuals to be supplied by the Contractor. Prior to ordering a standard proprietary brand item, the Contractor shall obtain the approval of the Engineer. The use of a proprietary brand item for which no written manufacturer specifications, no operating and maintenance documentation and no written guarantee exists, shall not be permitted without the approval of the Engineer.

14.2.3 Standard Specifications Included in this Contract Document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[156]	STD-LRM-GN-0004	General design
[157]	STD-LRM-GN-0006	Corrosion protection
[158]	STD-LRM-GN-0007	Structural metalwork
[159]	STD-LRM-MM-0018	Installation, erection and fixing of equipment to concrete structures
[160]	STD-LRM-MM-0020	Power transmission couplings
[161]	STD-LRM-MM-0021	Gearboxes
[162]	STD-LRM-MM-0008	Electric motors

14.3 GENERAL REQUIREMENTS FOR ALL HOISTING EQUIPMENT

14.3.1 Introduction

Apart from the general requirements for all hoisting equipment specified in this sub-clause, hoisting equipment shall also comply with the additional requirements as specified under other sub-clauses in this section, depending on the type of hoisting equipment.

14.3.2 Structural Steelwork

- All structural steelwork and profiles shall be of the highest quality and shall conform to BS 436-2 [155].
- All bolted connections shall comply with the requirements of SANS 10094 [148], and all welded joints shall comply with the requirements of SANS 10044 [147].
- Welding shall only be permitted in workshops or on flat surfaces on the site. All in situ joints and connections of structural steel profiles to be done on the site, shall be bolted. All site welding shall be approved by the Engineer. If welding is done to any steel member or plate cast into concrete, care shall be taken to prevent damage to the concrete by the heat of the welding operation.

14.3.3 Welding

- a) All welding shall be carried out under the supervision of a qualified person, who shall lay down the welding procedure and the order in which the welding shall be done.
- b) All welding shall conform to the Code of Practice for Welding: SANS 10044 [147] Parts I to VII.
- c) All welds shall be thoroughly cleaned.

14.3.4 Fixing of Structural Steel to a Concrete Wall

- a) Structural steel, or any part of the hoisting equipment, to be fixed to the building, shall only be fixed to a structural concrete member of the building specifically designed for such fixtures.
- b) Suitable anchorages shall be cast into the concrete by the Civil Contractor for the fixing of any structural steel members to the building. Details of such fixings shall be supplied by the Mechanical Contractor before the concrete is cast. Should any other fixing be required for which no anchorage has been cast into the concrete, the method of fixing such structural steel to the concrete shall be in accordance with the standard specification on installation, erection and fixing of equipment to concrete structures and subject to approval by the Engineer.
- c) No structural steel member shall be fixed to brick walls.
- d) The corrosion protection of structural steel work shall comply with the standard specification on corrosion protection and shall be suitable for the operating environment.

14.3.5 Lifting Cable/Rope

- a) Cable/rope used for lifting purposes shall comply with SANS 2408 [138] and shall be manufactured from materials suitable for the operating conditions of the lifting equipment.
- b) The cable shall be of sufficient length to reach any one of the lifting or hoisting eyes, lugs or handles of the equipment with the hoisting device in its intended working position.
- c) The cable shall be sized for the specified safe working load plus a factor of safety of not less than four.
- d) The cable drums, pulleys and sheaves shall be dimensioned to ensure long rope life and to minimise rope wear.
- e) Cables used shall be non-spin cables where only one lifting cable is used.

14.3.6 Chains

- a) Lifting chains shall comply with SANS 1592 [140] and shall be manufactured from suitable materials and shall be corrosion protected to suite the operating environment of the hoist. The chain shall be selected for the specified safe working load and shall include a factor of safety of not less than four.
- b) The design of the chain wheels and pulleys shall minimise wear and stresses on the chain.

14.3.7 Safety Hook

A safety hook shall be supplied on the free end of each cable. The hook shall have a safety factor of 6, and shall be supplied complete with a spring-loaded safety clip or hinged plate closing the opening of the hook and preventing the unhooking of slings when slack. The hook shall furthermore be provided with a device allowing free rotation.

14.3.8 Design Calculations

The design calculations of the hoisting equipment shall be made available for perusal by the Engineer on request of the Engineer.

14.3.9 Bearing Requirements

All bearings shall be ball or roller bearings and shall be of the medium or heavy-duty type. The bearings shall be designed for a minimum L10h, basic life rating of 20 000 hours of operation. The bearings shall be precision aligned to ensure vibration-free operation of the shafts. Permanently lubricated bearings shall be used wherever such application is feasible. All other bearings shall be lubricated by means of

a standard lubrication system by which adequate lubrication is provided during the operation of the bearings.

14.4 HOISTING FRAMES

- a) Apart from complying with the general requirements on hoisting equipment as specified above all hoisting frames shall comply with the additional requirements specified in this sub-clause and in the standard specification on structural metalwork and corrosion protection.
- b) The hoisting frame shall not restrict access to the equipment to be serviced and shall not clash with or damage the equipment. All hoisting frames shall be visibly marked with a SWL sign and shall be supplied with a test certificate.

14.4.2 A-Frames

- a) The A-frame shall have a horizontal lifting I-beam on which a manual or electric crawl hoist shall operate. The lifting beam shall have a span equal to the maximum distance between the service point and an accessible point where the load can be safely off-loaded. This distance shall be specified in the detail specification or be detailed on the drawings. The lifting beam shall be fitted with end stops at both ends of which at least one shall be removable.
- b) A-frames shall have not less than two A-shaped support legs with additional support legs installed should the total length of the lifting beam necessitates mid-span supports.
- c) The A-frame shall be either a mobile or fixed installation as specified in the detail specification.
- d) A mobile hoisting frame shall have at least four retractable wheel assemblies, one on each corner. Each wheel assembly shall be of the castor-action type and all wheels shall be at least 200mm in diameter to facilitate easy travelling across all standard types of open-grid flooring. Each of the wheel assemblies shall consist of a twin set of polyurethane tyres, each of 76 mm tread width, bonded to cast-iron hubs or an approved equivalent type. The load capacity of each wheel shall be double the distributed wheel load of a fully loaded hoist including the weight of the frame and hoist. The wheels shall be in a retracted position during hoisting operations. Retraction and extension of the wheels shall be effected by jack-screwing the vertical castor shaft by hand with a suitable removable handle.
- e) The wheels shall be non-retractable should the specified safe working load be low enough not to overload the wheels under maximum wheel load conditions and all the wheels shall be fitted with foot brakes.
- f) The Contractor shall submit detailed drawings of the A-frame for approval by the Engineer.
- g) A-frames shall be supplied with a hoist and carriage that shall operate on the lifting beam of the frame.
- h) The hoist used on the lifting beam shall be manually or electrically driven and shall be fixed on a manually or electrically driven crawl. Details of the hoist and carriage shall be supplied in the detail specification and shall comply with the section in this document regarding manual and electric crawls and hoists.
- i) Permanent A-frames shall be fixed to concrete structures with stainless steel anchors in accordance with the standard specification on the installation and fixing of equipment to concrete structures.
- j) All hoisting frames shall be supplied with a test certificate in accordance with the section regarding testing and commissioning of hoisting equipment.

14.4.3 Lifting Davits and Jib Cranes

- a) Lifting Davits
 - i) Apart from compliance with the general requirements for all hoisting equipment, all lifting davits shall comply with the additional requirements specified in this sub-clause.
 - ii) Unless otherwise specified or shown on the drawings, lifting davit shall be portable and shall operate on a rotating davit-principle. The davit shall be inserted in a socket cast into concrete or fixed otherwise. The vertical mast of the davit shall rotate by means of a horizontal handle.
 - iii) A cable winch shall be fixed to the mast. The cable shall be rigged from a winch through a pulley at the tip of a horizontal beam fixed to the top of the mast, unless otherwise shown on the drawings.

- iv) The winch shall be designed to allow one person to operate it unaided to lift or lower the load specified in the detail specification. The winch shall have a factor of safety of not less than 6 and shall be of a worm gear construction that will not allow the winch to rotate freely under maximum load conditions without additional work input on the handle by the operator. The Contractor may submit details of alternative winch systems for approval.
- v) The Contractor shall submit a detailed drawing of the proposed lifting davit for approval by the Engineer.
- b) Jib Cranes
 - i) Wall mounted jib-cranes shall comply with the standard requirements for all hoisting equipment specified in this section and with the additional requirements specified in this sub-clause.
 - ii) The jib crane shall have a lifting hook onto which a manual or electric chain hoist can be fitted. The jib crane shall rotate out of the working area when not in use and shall be stored against the wall. The Contractor shall submit detailed drawings of the jib crane to the Engineer for approval.
 - iii) Wall mounted jib cranes shall be fixed to concrete structures in accordance with the standard specification on installation and fixing of equipment to concrete structures. The position and method of fixing of the jib crane shall be subject to the Engineer's approval.

14.5 MANUAL CRAWL AND CHAIN HOISTS

- a) Apart from compliance with the general requirements for hoisting equipment specified in this section, manual crawl and hoist units shall comply with the additional requirements specified in this sub-clause.
- b) Manual crawls shall be installed on single lifting I-beams and shall be chain driven unless stated otherwise in the Detail Specification. The I-beam shall be supplied by others unless stated otherwise in the Detail Specification.
- c) The crawl carriage shall be fitted with not less than four steel wheels that shall be sized for the safe working load of the specified lifting beam.
- d) Two of the carriage wheels shall be chain driven through a gear ratio that shall ensure that the operator does not have to exceed more than 20 kg of downward force on the drive chain during operation. The carriage shall have a minimum displacement along beam of 200 mm for every downward chain stroke of 500 mm.
- e) The crawl carriage shall have an attachment point onto which the hoist shall hook.
- f) The hoist shall use crane chain to lift the load unless steel wire rope is specified in the detail specification.
- g) The maximum downward force required at the lifting chain shall not exceed 40 kg when the maximum load is hoisted.
- h) The hoist shall be a standard catalogued, proprietary brand product with spare parts readily available in the country of installation.
- i) Hoist and crawl drive chains shall be long enough to enable the operation of the hoist and crawl from the lowest operator working level. Details of the maximum lift, lowest operator level and safe working load shall be specified in the detail specification or indicated on the drawings.
- j) Full technical details of the proposed equipment shall be submitted with the tender.

14.6 ELECTRICALLY DRIVEN CRAWLS AND HOISTS

Apart from compliance with the general requirements for hoisting equipment and manual crawl and hoists specified in this section, electrically driven crawls and hoisting units shall comply with the additional requirements specified in this sub-clause.

14.6.1 Electric Motors

- a) AC motors

AC electric motors shall be of standard design and shall comply with the requirements of the standard specification on electric motors. All motors shall comply with the following minimum requirements:

Enclosure ingress protection rating	:	IP55 as per SANS 60529 [153]
Insulation	:	Class F rated for Class B temperature rise
Power supply	:	380/220 V; 50Hz
Service factor	:	S3

b) DC motors

Direct current (DC) motors shall, if used, comply with the following general specifications:

- i) Enclosure ingress protection rating: IP55 as per SANS 60529 [153]
- ii) DC motors with thyristor control shall be specifically designed for such a control system.
- iii) The total magnetic circuit of the motors shall be of the laminated steel plate type.
- iv) Time delayed reaction to sudden changes in the load shall be limited to the absolute minimum.
- v) Communication shall not be influenced by harmonic currents.
- vi) The insulation of the motors shall be class F according to SANS 1804-2 [152].
- vii) The motors shall be equipped with constant-pressure springs at the brushes.

14.6.2 Electrical Supply Cables and Conductors

- a) All wiring shall comply with the latest edition of the Code of Practice for the wiring of premises, SANS 10142-1 [149].
- b) All cables and conductors shall comply with the requirements of SANS 1411-1 [150] and the insulation of such conductors shall comply with the requirements of SANS 1411-2 [151].
- c) All connections to control boards, consoles and motors shall be by means of terminal boxes specially provided for this purpose and the cores of the cables shall be fitted with suitable cable lugs.
- d) All cables shall be suitable for the purpose for which they are intended to be used. The rating of cables with a supply voltage of between 50 volts and 600 volts shall be 600/1000 volt.
- e) Flexible cables shall be insulated with neoprene or rubber and the cores of such cables shall be insulated in a similar fashion as the cable. The copper strands of the individual wires shall have a diameter of $\pm 0,2\text{mm}$.
- f) All power supply to the crawl and hoist shall be by means of flexible cables. Should the Contractor wish to propose, as an alternative, a system by which the power supply to the crane is done by means of a busbar system, he shall give full details of such a system to the Engineer for approval.
- g) All flexible cables shall be supported by means of a standard support system, which shall ensure that the cables are not stretched, twisted or damaged due to excessive tension created by the movement of the crawl or hoist.
- h) Where both the crawl and hoist are electrically driven the power supply to both units shall be by means of a single multi-core electric cable. Both the crawl and hoisting unit shall also be controlled from a single control console.
- i) The electric motor supply cable for both the hoist and crawl motors shall be supported on a cable festoon system that shall ensure the smooth operation of the hoist and that the cables are not stretched or damaged during operation.
- j) The supply, delivery, installation, testing and commissioning of the electrical equipment and cable festoon system from the supply point to the hoisting equipment shall fall under the scope of the hoist supplier and shall form part of this contract. A local isolator shall be supplied by others and the hoist supplier shall be responsible for the termination at the local isolator.

- k) The payment for the electrical equipment, supply cables, cable festoon system and terminations shall be deemed included in the rates for the supply, delivery, installation, testing and commissioning of the hoisting equipment unless a separate item is scheduled in the Schedule of Quantities or it's specifically excluded in the detail specification.
- l) The hoist and crawl motors shall both be single speed drives unless otherwise specified in the detail specification.
- m) The hoist and crawl motors shall be pendant controlled with the pendant suspended from the hoist on two stainless steel cables.
- n) The crawl shall be installed on a monorail crawl beam and shall have not less than four wheels of which two shall be electrically driven through a suitable gearbox.
- o) The hoist shall be bolted onto the electric trolley with a locked connection.
- p) The hoist shall be complete with a chain storage bag fitted to the hoisting unit suitably sized for the chain length.

14.7 CORROSION PROTECTION

- a) Corrosion protection of hoisting equipment shall be in accordance with STD-LRM-GN-0006 [157] and shall take into consideration the operating environment of the equipment.
- b) Special requirements regarding corrosion protection shall be detailed in the Detail Specification.
- c) If the manufacturers' standard corrosion protection is offered, the details of this corrosion protection shall be submitted to the Engineer for approval.

14.8 OPERATING AND MAINTENANCE MANUALS

Operating and Maintenance manuals shall be supplied in accordance with the requirements for Operating and Maintenance manuals as specified in Section 1 of the Standard Specifications.

14.9 TESTING AND COMMISSIONING

14.9.1 Factory Testing

- a) The hoist shall be supplied with factory test certificate where the hoist was tested with a test weight of 1.25 times of the specified safe working load.
- b) The tests shall be carried out according to test procedures specified in BS 466 [154] and the calibration certificates of the test equipment shall be attached to the test certificate.

14.9.2 Testing on Site

- a) After the hoist has been installed on site but before the equipment is taken over by the Engineer, the Contractor shall perform an additional operating test on the hoist that shall be to the approval of and shall be witnessed by the Engineer.
- b) The hoist shall be required to lift an load of 1.1 times its maximum lifting capacity as part of the commissioning tests. The hoist shall be required to perform all hoisting, and long travel actions under this load condition and the operation of the hoist shall be to the approval of the Engineer.
- c) The Contractor shall supply all test loads required for this test and the costs involved for the supply of the test loads shall be included in the tendered rates for testing and commissioning. The Electrical power requirements of the hoist shall be measured during this test by the Contractor and the results shall be to the approval of the Engineer.

14.9.3 Testing of Hoisting Frames

- a) Steel hoisting frames shall be tested on site in accordance with BS EN 13001-1 [141] and deflections shall be measured while under a load of 1.1 times the safe working load.
- b) The hoisting frame shall be supplied with a test certificate and the test results shall be to the approval of the Engineer.
- c) The Contractor shall supply the test weights for this deflection test and shall supply the calibrated measuring equipment.

14.10 MEASUREMENT AND PAYMENT

Item	Description	Unit

14.10.1	Supply and delivery of hoisting frame	No

The unit of measurement shall be the number of hoisting frames supplied and delivered as specified.

The tendered rates shall include full compensation for preparing workshop details where they have not been provided in the drawings, the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading, all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and temporary bracing, transportation and loading and off-loading to render a complete and operating system.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

Item	Description	Unit

14.10.2	Supply and delivery of chain hoist with crawl	No

The unit of measurement shall be the number of chain hoists supplied and delivered as specified.

The tendered rates shall include full compensation for preparing workshop details where they have not been provided in the drawings, the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading, all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and temporary bracing, transportation and loading and off-loading to render a complete and operating system.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

Item	Description	Unit

14.10.3	Installation, testing and commissioning of hoisting frame	No

The unit of measurement shall be the number of hoisting frames installed, tested and commissioned as specified.

The tendered rate shall include full compensation for the installation, the making good of all damaged corrosion protection areas, testing, commissioning and maintenance of the hoisting equipment, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal shall be included on the tendered rates if required for installation.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

Item	Description	Unit

14.10.4	Installation, testing and commissioning of chain hoists with crawl	No

The unit of measurement shall be the number of chain hoists with crawl installed, tested and commissioned as specified.

The tendered rate shall include full compensation for the installation, the making good of all damaged corrosion protection areas, testing, commissioning and maintenance of the hoisting equipment, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems.

The erection of scaffolding and its subsequent removal shall be included on the tendered rates if required for installation.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

SECTION 15: SUBMERSIBLE PUMPING EQUIPMENT

DOCUMENT NO.: STD-LRM- MM-0011

CONTENTS

15.1	SCOPE	599
15.2	STANDARDS.....	599
15.3	PUMP DESIGN AND REQUIREMENTS	599
15.4	CIVIL AND PIPEWORK REQUIREMENTS	600
15.5	HOISTING FACILITIES	601
15.6	PROTECTION AND CONTROL DEVICES	601
15.7	CORROSION PROTECTION	601
15.8	TESTING AND COMMISSIONING.....	601
15.9	MEASUREMENT AND PAYMENT	602

15.1 SCOPE

This section covers the supply, delivery, installation, testing and commissioning of submersible pumping equipment.

15.2 STANDARDS

15.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[163]	BS EN ISO 9906	Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1 and 2

15.2.2 Standard Specifications Included in this Document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[164]	STD-LRM-MM-0008	Electric motors
[165]	STD-LRM-GN-0006	Corrosion protection
[166]	STD-LRM-GN-0005	Testing and commissioning
[167]	STD-LRM-MM-0019	Hoisting equipment
[168]	STD-LRM-GN-0007	Structural metalwork

15.3 PUMP DESIGN AND REQUIREMENTS

Submersible pumps shall be designed to be suitable for submersion in water up to a depth of 10 m.

The pump shaft shall be manufactured from stainless steel, and shall be sealed where it enters the casing with double mechanical face seals.

The impeller shall be manufactured from stainless steel or in the case of other materials, it shall be coated with an approved material resistant to abrasion and corrosion, due to the environment specified.

Full details shall be submitted at tender stage. For pumps rated below 2 kW, non-metallic impellers may be utilised.

The impeller shall be statically, dynamically and hydraulically balanced. No holes may be drilled in the impeller to balance it with regard to mass distribution.

Only permanently sealed ball or roller bearings shall be installed.

Bearings shall have a minimum L10h, basic life rating of 25 000 hours at rated load and speed, unless specified to the contrary in the detailed specification.

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, and speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test, carried out in an approved laboratory. Certified detailed selection shown on these performance curves or tables shall be submitted.

The flow rate at the break-off point of the curve for the impeller selected, shall be at least 1,5 times that of the maximum flow rate specified.

The head at zero delivery of the curve for the impeller selected, shall be at least 1,2 times the maximum head in the pump's operational range.

Each submersible pump and mixer shall be clearly labelled. The label shall be a 0,5 mm thick stainless steel plate of dimensions 100 mm x 50 mm. The label shall be affixed to the pump exterior with an approved adhesive or other method, over its full back surface after the completion of corrosion protection on the pump. It may follow the shape of the pump exterior over areas suited for the bending of flat surfaces, excluding sharp folds. Under no circumstances shall the label plate influence, damage or otherwise have other detrimental effects on the corrosion protection system.

Prior to being fixed onto the pump, the following information shall be punched onto the label:

Client name: (e.g. CITY COUNCIL OF JOHANNESBURG).

Treatment works name: (e.g. OLIFANTSVLEI SEWAGE PURIFICATION WORKS).

Contract No.: (THE NUMBER OF THIS CONTRACT).

Client serial No.: (TO BE PROVIDED BY THE EMPLOYER).

All submersible pumps shall be supplied together with a length of power cable to suit the installation shown in the drawings, but shall not be less than 10 m in length. The unterminated end of the cable shall be properly sealed prior to installation, and final termination to prevent the ingress of water into the cable and electric motor.

Electric motors shall comply with the section dealing with electric motors.

15.4 CIVIL AND PIPEWORK REQUIREMENTS

The Contractor shall refer to the relevant drawings for the required installation, and shall detail any special requirements with regard to openings in civil structures, in order to fit the submersible pump.

If the installation so requires, the Contractor shall supply and install the necessary seating frames, duck-foot bends, guide rails and hoisting facilities as detailed below. The costs thereof shall be included in the tendered rates. Requirements in this regard will be indicated in the drawings and/or the detailed specification.

15.5 HOISTING FACILITIES

All submersible pumps shall have a lifting lug situated such that it hangs upright while being lifted by means of a cable. This applies equally to configurations fitted with outlets for duck-foot bends.

Hoisting facilities shall be supplied and installed in accordance with the standard specification on hoisting equipment where required by the detailed specifications. The hoisting facilities shall be included in the tendered rates and shall consist of the following:

All stainless steel holding down bolts, to be grouted into position by others.

Guide rails from stainless steel or galvanised mild steel where specified in the detailed specification.

A fixed or mobile hoist frame manufactured from galvanised mild steel.

The hoisting cable or chain.

A hand operated winch whereby the pump is lifted from the relevant sump, or a chain hoist fitted to a bogey, as specified in the detailed specification.

The Tenderer shall refer to the drawings for details on the hoist frame and guide rail dimensions.

The guide rails shall be included in the tendered rates for the submersible pumping equipment, together with its fastening devices.

The hoisting frame shall either be a fixed, single point hoisting facility, or shall have a crawl beam installed with a hoist bogey to serve more than one pump. Details will be supplied in the drawings and the detailed specifications. The frame shall comply with the section dealing with structural steelwork.

15.6 PROTECTION AND CONTROL DEVICES

Float switches for the purposes of control and low liquid level protection of the pump will be provided by others, except for drainage pumps rated lower than 0,75 kW. These drainage pumps shall have float switches or equivalent switches attached to switch the pump on and off.

All pumps with installed power of more than 2 kW shall be equipped with di-electrodes for monitoring the seal condition. The di-electrodes shall cause the pump to trip when the seal condition has deteriorated to an unacceptable level. Seal monitor relays shall be supplied by the Contractor and the cost shall be included in the tendered rates.

15.7 CORROSION PROTECTION

The Tenderer shall take note of the environment the pumps will operate in, and the liquid to be pumped. In the case of raw sewage, special care shall be taken to ensure that components of the pump are resistant to the corrosive action of the pumped medium. Corrosion protection shall be in accordance with the standard specification dealing with general corrosion protection.

15.8 TESTING AND COMMISSIONING

15.8.1 Test to be Performed

All pumping equipment shall be subject to the commissioning tests as described in the relevant section.

At least one of each type or size of pump supplied, shall be subject to a delivery flow rate test. Flow rate or columetric flow testing facilities will be supplied by others, unless otherwise specified in the detailed specification.

Efficiency tests will only be performed when specified in the detailed specification.

NPSH tests will only be performed when specified in the detailed specification.

15.8.2 Flow Rate (delivery), Efficiency and NPSH Tests

Testing will be done in accordance with BS EN ISO 9906 [163], where required by the detailed specification.

Power consumption of electric motors shall be as determined by the three Watt meter method.

15.8.3 Test Conditions

All tests will be performed in situ.

Tests will be performed with clean water unless otherwise specified. The Contractor shall obtain from the pump manufacturer, the test point for clean water corresponding to the specified duty point for the pumped liquid.

15.8.4 Additional Tests

Additional tests will be specified in the detailed specification.

15.9 MEASUREMENT AND PAYMENT

Item	Description	Unit
15.9.1	Supply and delivery of submersible pumping equipment	No

The unit of measurement shall be the number of submersible pumps supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading including all handling of the equipment. The equipment shall include the following:

1. The pump and motor as an integrated unit.
2. Electrical power cable.
3. Duck-foot bend, seating frame, guide rails, guide rail spacers and related fixing devices if required by the drawings or the detailed specification.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

Item	Description	Unit
15.9.2	Installation of submersible pumping equipment	No

The unit of measurement shall be the number of submersible pumps installed.

The tendered rates shall include full compensation for the site handling and positioning of the submersible pumping equipment including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

1. Installation of the guide rails and sealing frame.
2. Coupling of all required pipe flanges, including all required gaskets, nuts, bolts and washers.
3. Routing and fastening of the power cable up to the isolator box.
4. All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the relevant equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the engineer.

Item	Description	Unit
15.9.3	Testing and commissioning of submersible pumping equipment	No
	The unit of measurement shall be the number of submersible pumping installations tested and commissioned.	

The tendered rates shall include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

SECTION 16: MECHANICAL FRONT-RAKED SCREEN

DOCUMENT NO.: STD-LRM- MM-0026

CONTENTS

16.1	SCOPE	604
16.2	STANDARDS.....	604
16.3	GENERAL REQUIREMENTS.....	605
16.4	MATERIAL.....	606
16.5	FRAME	606
16.6	ACCESS	606
16.7	SCREEN BARS	606
16.8	SOLE PLATE.....	607
16.9	RAKING MECHANISM	607
16.10	CLEANING MECHANISM	608
16.11	DISCHARGE CHUTE	608
16.12	DRIVE UNIT	608
16.13	CORROSION PROTECTION	608
16.14	INSTALLATION	609
16.15	MAINTENANCE, SPARES AND REFURBISHMENT	609
16.16	SPARE PARTS.....	609
16.17	ELECTRICAL CONTROL	609
16.18	MEASUREMENT AND PAYMENT	610

16.1 SCOPE

This specification covers the design, performance, manufacturing, supply and delivery to site; and the installation, testing, adjustment and commissioning of the mechanically front raked screens to be supplied under the contract.

The screening equipment shall remove from the influent debris materials found in raw sewage and recycled sludge, in order to minimise the subsequent damage to equipment or that may result in unsatisfactory operation of downstream unit processes.

16.2 STANDARDS

16.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[169]	SANS 10400	National Building Regulations
[170]	BS PD 5304	Guidance on safe use of machinery
[171]	SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
[172]	SANS 10104	Hand railing and balustrading (safety aspects)
[173]	SANS 10064	The preparation of steel surfaces for coating

[174]	SANS 10104	Hand railing and balustrading (safety aspects)
[175]	SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs
[176]	SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
[177]	SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress

16.2.2 Standard Specifications Included in this Contract Document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[178]	STD- LRM-GN-0005	Testing and commissioning
[179]	STD- LRM-GN-0006	Corrosion protection

16.3 GENERAL REQUIREMENTS

Screens shall be designed with due consideration of the following requirements:

To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,

Ensure safe and satisfactory operation for an acceptable life expectation of 12 years, under the ambient conditions prevailing at the site,

Prevent undue stresses being produced by expansion due to temperature changes.

Keep maintenance costs to a minimum,

To comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,

To satisfy any specific requirement contained in the statutory codes and legislation, and

Suitable for operation 365 days per year, 24 hours per day under specified design conditions.

The design loads of the screenings for the head of works screens, shall be based on the influent sewage characteristics at the particular wastewater treatment works. The peak screening load shall be equal to five times that of the average daily load. The average daily screening loading is specified in the project specification.

The inflow channel shall not be divided into more than two channels at any division of a channel, so as to maintain the minimum required inlet flow velocity. No fewer than two screens shall be in parallel.

The straight length of channel ahead of the screens shall not be less than five times the width of the approach channel, unless site constraints prevent this arrangement.

The screen field-bars shall be accurately set and secured to give the maximum clearance between bars, as specified in the detailed specification. The screen bars shall be manufactured from bars that have a tapered cross-section.

The maximum velocity through the screen opening shall be 1,2 m/s.

The minimum approach velocity shall be 0,6 m/s

All screen operating mechanisms and frame superstructures above the concrete level shall be completely clad in 3CR12 cladding. Sufficient wind deflection shielding shall be provided to prevent light screening (e.g. paper and plastic) from being blown off the screen. Removable panels shall be provided wherever access is required for routine maintenance and/or repairs.

16.4 MATERIAL

The screen shall be manufactured using 304 L stainless steel or as specified in the project specification.

16.5 FRAME

The rectangular frame shall be formed entirely from stainless steel plate with a minimum thickness of 4,5mm, and shall be recessed to accommodate the chain guides and idler sprockets.

The housing shall be manufactured from 304L stainless steel, with a minimum thickness of 4,5mm, and shall be recessed to accommodate the scraping mechanism, chain guides and idler sprockets, in order to maintain the screening of the full channel width and depth. The screen housing shall be fitted with a rubber skirt and stainless steel diversion plates, to ensure and accommodate the total channel width detailed.

The screen shall be set in the concrete channel at approximately 15 - 20° from the vertical.

The frame shall be grouted into position in recesses in the channel walls and invert; or for screens of the removable variety, either braced at coping level on a spindle bar permitting the unit to be swivelled; or rested against brace-plates affixed to the channel walls, permitting the unit to be hoisted from above.

The frame shall be fully welded to the sole plate, the debris plate, and the discharge chute. At the upstream face of the unit, box-section cross-members shall be securely welded to the side members of the frame at regular intervals, between a point above the maximum water level and the head of the screen. These cross-members shall form the supports for removable stainless steel grade 304L cover panels.

16.6 ACCESS

The screens shall be provided with suitably designed 3CR12 hand railings and deck gratings, which shall provide access to the screens for repair and maintenance.

16.7 SCREEN BARS

The screen field shall be constructed with edged tapered bars that are accurately set and secured to give the clearance between the bars, as specified in the detailed specification.

The bars shall be approximately 40mm deep of a tapered profile, with the thickness of the bars at the upstream edge approximately 6mm, and the downstream edge approximately 3mm.

The individual bars shall be clamped into position and shall extend from the sole plate, to which each bar shall be individually clamped in position, to at least 200mm above the maximum flow depth within the channel, as indicated on the drawings.

To brace the bars, the bars shall be fitted with intermediate laser-cut spacer-plates perpendicular to the bars, installed downstream of the screenfield, that shall allow for easy removal in the event of damage to the screen field.

To brace the bars, the bars shall be fitted with intermediate laser-cut stiffening supports perpendicular to the bars, installed downstream of the screen-field.

The supports shall be welded to the screen bars for strengthening as necessary, and each screen bar shall be individually welded to the stiffening support.

The design and mounting of the screen-field shall be such that it is simple and easy to remove and replace in the case of damage.

16.8 SOLE PLATE

The screening field shall be provided with a sole plate.

The design of the sole plate shall be profiled to divert the accumulation of debris material in the lower level of the flow to the lower portion of the screen, for effective removal.

The leading edge of the sole plate shall be installed at the invert level of the receiving channel.

16.9 RAKING MECHANISM

16.9.1 Rakes and Tines

The raking mechanism shall consist of multiple screen field rakes, designed to form a single continuous meshing into the screen field. This clears the waste caught up in the screen field. The travel speed of the rakes shall be between 8 and 10 meters per minute

The rakes and tines shall be formed from single continuous bars of sufficient depth, to ensure complete stiffness across the full width of the bar. The rake shall have a minimum thickness of 10mm, and shall have tines of appropriate profile to suit the screen bar spacing, and shall be laser, or plasma-cut on the leading edge. The tines shall have an angle of 5° to the plane of the screenfield when engaged. The ends of the tines need to trail the remainder of the raking mechanism.

The raking bars shall be attached to the drive chains within the side members of the screen frame utilising suitably fabricated links. The raking bars shall be bolted to the main rake frames for quick and simple removal when necessary. The raking bars shall be accurately aligned to ensure that for the full width of each bar, the tines penetrate the screen bars to the necessary amount, for the full extent of travel of the tines whilst engaged within the screen bars.

The rake will penetrate to within 1mm of the root of the screen field.

The raking mechanism shall consist of multiple raking bars which shall restrict the headloss to a maximum of 250mm at peak flow.

16.9.2 Chains, Guides and Sprockets

The chain design shall be of pin and bush design, hereby allowing the chain inner link assembly's bushes to pivot about the chain pins. No chain pins will be accepted that pivot on the chain links.

The side-plates shall be of stainless steel grade 304L, the bush shall be manufactured from grade 304L stainless steel (to prevent adhesion of similar materials), and the bushes and rollers made of heat-treated stainless steel grade 316.

The chain pins shall be manufactured from 400 series stainless steel and shall be hardened to a min of 36 Rockwell C.

The chains links shall have a minimum length of 100mm.

The chain links material shall be minimum 6mm thick.

The chain guides shall be securely fixed to the side members of the screen frame for the full length of travel of the chains.

Sprockets shall be suitably sized to the chain used, in order to provide a 0,2mm clearance between the roller and the seating curve of the sprocket. Sprockets shall be removable to allow for easy replacement when necessary.

Idler sprockets shall be located at the lower end of each side member of the screen frame, and shall have a minimum thickness of 20mm. A bush housing shall be continuously welded on both faces to the sprocket. The sprocket shall be mounted on stub axles utilising self-lubricating bush-bearings. The sprockets shall be retained on their stub axles by a suitable, easily removable mechanism, to ensure ease of replacement of the bearing should this be necessary.

A mechanism shall be incorporated within the drive mechanism to enable the drive chains to be correctly tensioned, and the rake to be accurately positioned across the screen field face. This adjustment shall be possible without the dismantling of any part of the screen frame, and without the necessity for any special tools.

16.10 CLEANING MECHANISM

The cleaning mechanism shall comprise a single bar or plate, which shall engage each raking bar as it raises above the upper edge of the screening retention plate.

The scraper bar shall be fabricated and mounted so that it efficiently cleans the full width of each raking bar. The bearing for the scraper bar shall be self-lubricating.

16.11 DISCHARGE CHUTE

The discharge chute shall be set to guide all the screenings removed by the screen as efficiently as possible onto the screenings handling system.

The chute shall form an integral part of the screen. The discharge point of the screenings outlet shall be at least 1,5m above the top of the platform of the structure housing the screen, to allow for a screenings conveying system to be installed on the platform next to the screen.

16.12 DRIVE UNIT

The drive unit will be a helical-gearred hollow shaft-type, shaft-mounted gearbox to accommodate the drive shaft. A torque arm will be attached to the drive unit to accommodate vertical adjustment, and shall be fitted with an mechanical adjustable torque limiting switch.

The gearbox shall be selected for continuous operation 24 hours per day. The gearbox shall have an AGMA service factor of at least 2 on installed power and shall comply with the requirements of the gearbox standard specification. Thermal power ratings shall be based on an ambient temperature of 40°C.

The drive motor shall comply with the requirements of the motors standard specification and shall have a minimum IE3 or better efficiency rating.

Each drive unit shall be fitted with a name plate showing at least the following information:

- a) Gearbox type or model number.
- b) Serial number.
- c) AGMA rating.
- d) Nominal reduction ratio.
- e) Approximate oil quantity required.
- f) The electrical motor shall have a name plate conforming with the requirements as set out in the motors standard specification.

16.13 CORROSION PROTECTION

Corrosion protection must be carried out strictly in accordance with the requirements of the corrosion protection standard specification.

16.14 INSTALLATION

Holding-down bolts which are to be built into concrete work for securing the plant, shall be grade 316 stainless steel, and shall be supplied and installed under this section of the contract. Grouting up of these bolts will be done by a suitable Sub-Contractor appointed by the Contractor, after completion of setting up of the plant by the Contractor under this contract.

16.15 MAINTENANCE, SPARES AND REFURBISHMENT

The screening equipment shall be fully capable of being maintained by a local (South African) company, that has experience in manufacturing and maintaining of screening equipment.

The design and assembling methods employed during manufacturing of the screen shall be such that refurbishment can be performed timeously, without the necessity of replacing the major structural components of the unit.

16.16 SPARE PARTS

The following spare parts shall be included and supplied together with the equipment:

- 2 off set of rake plates
- 4 off set of drive chains
- 4 off master links
- 1 off scraper blade

16.17 ELECTRICAL CONTROL

Unless specified to the contrary, the electrical control equipment required for the screen shall be incorporated in the plant Motor Control Centre (MCC) for the plant area, and shall be supplied as part of the MCC.

The screen supplier shall provide the Engineer with his detailed requirements for the control to be incorporated in the MCC, within 14 days after the tender has been awarded.

The screen shall be provided with an electrical interface panel to which all electrical connections shall be terminated on a suitable terminal rail. A clear interface document shall be provided to the electrical contractor detailing the connection required.

The control of the screen shall contain the following minimum requirements:

- a) A current sensing overload device with a built-in intelligent control facility shall be incorporated within the screen starter compartment in the motor control centre. The device shall have the facility to be able to reverse the direction of travel of the scraping mechanism, should a blockage occur on the screen, and cause the overload device to trip the normal operation of the screen.
- b) The device shall have the additional facility to enable this reversing action to be affected twice for any one occurrence, before tripping the alarm. Furthermore, the device shall either be re-set automatically, if the blockage causing the initial overload conditions is cleared; or should the blockage remain upon the completion of the second attempt at automatic clearance, an alarm shall be generated.
- c) The control of the screen shall provide for time switches (adjustable anywhere from zero and 60 minutes for the selection of frequency cycles, and adjustable between zero and 30 minutes for the selection of duration of operation per cycle); a water differential control equipment starter with overload and single phasing protection of three phase motors; and stop/start push buttons for manual operation as an alternative to automatic operation.
- d) The screen, conveyor, and press system shall be interlocked by the field mounted switch panel. The screen must be provided with an interlock overriding mechanism, to ensure that the screen continues to operate during failure of the press, screenings conveyor, and associated equipment.

16.18 MEASUREMENT AND PAYMENT

Item	Description	Unit
16.18.1	Supply and delivery of mechanical raked screens	No

The unit of measurement shall be the number of identical mechanically raked screens supplied and delivered as specified or shown on the drawings.

Separate items shall be scheduled for different screen sizes and aperture openings.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each mechanically raked screen as specified with all appurtenances.

Item	Description	Unit
16.18.2	Installation, testing and commissioning of Mechanical raked screens	No

The unit of measurement shall be the number of identical mechanically raked screens installed, tested and commissioned as specified or shown on the drawings.

Separate items shall be scheduled for different screen sizes and aperture openings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete mechanically raked screen; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

SECTION 17: MANUALLY CLEANED SCREENS

DOCUMENT NO.: STD-LRM- MM-0025

CONTENTS

17.1	SCOPE	611
17.2	STANDARDS.....	611
17.3	SCREEN.....	612
17.4	HAND-RAKE.....	613
17.5	CORROSION PROTECTION	613
17.6	TESTING	613
17.7	TOLERANCES	613
17.8	MEASUREMENT AND PAYMENT	613

17.1 SCOPE

This particular specification covers the manufacture, delivery and installation of a screen consisting of parallel bars, which is installed in an open waterway and which is manually cleaned with hand-rakes or other tools.

17.2 STANDARDS

17.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to the date of tender of the following particular national and international specifications, publications, and codes of practice, shall be read in conjunction with this specification and shall be deemed to form part thereof:

[180]	SANS 455	Covered electrodes for the manual arc welding of carbon and carbon manganese steels
[181]	SANS 657, Part I	Steel tubes for scaffolding and for structural and general engineering purposes
[182]	SANS 965	Welded joints, stainless steel, austentic steels, pipes
[183]	EN 10025	Weldable structural steels
[184]	BS 709	Methods of destructive testing fusion welded joints and weld metal in steel
[185]	BS 5135	Specification for arc welding of carbon and carbon manganese steels

The design of structural steelwork, where undertaken by the Contractor, shall comply with the requirements of SANS 10162, and shall apply to all structural work made from other metals where relevant.

Welding shall be in accordance with SANS 10044.

17.2.2 Standard Specifications Included in this Contract Document

The following standard specifications bound in this document, shall be read in conjunction with these specifications:

[186]	STD-LRM-GN-0007	Structural metalwork

[187]	STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
[188]	STD-LRM-GN-0006	Corrosion protection

17.3 SCREEN

17.3.1 General

Each screen shall be manufactured to the dimensions shown on the drawings, and to the details stipulated in this specification, and in the detailed specification.

17.3.2 Fixing

If no particulars relating to the fixing of a screen are stipulated on the drawings, or in the detailed specification, the screen shall be permanently fixed to the internal sides and bottom of the waterway or other structural support, by means of suitable fixing brackets with holding-down bolts anchored in concrete.

At least four fixture points shall be used for each individual screen panel with an area of one square meter or less. Thereafter, two more fixture points shall be added per additional 0,5 m² of screen panel or part thereof. For a rectangular screen panel, one fixture point shall be located in close proximity of each corner. The rest of the fixture points for a rectangular screen panel shall be evenly spaced along the top and bottom edges of the screen. All fixture points for a screen panel of non-rectangular, semicircular or other irregular shape, shall be regularly or evenly spaced along the total perimeter of all edges of the panel in contact with the side or bottom of the waterway, or any other structural support. Using an adjoining screen panel as a structural support shall not be permitted.

Brackets, supports, bolts and other components used for fixing, shall provide for sufficient clearance to allow the rake to pass unhindered along the entire length of the screen, at any position along the width of the screen.

17.3.3 Multiple-Panel Screen

If a screen is made up of more than one panel, all panels shall be installed in a frame and in one plane, unless stipulated otherwise on the drawings or in the detailed specification. The spacing of panels shall be such that the width of the gap between the side most bar of one panel and the adjacent side most bar of the next panel, shall be the same as the width of the gap between bars for the rest of either panel, so as to allow proper operation of the rake over and along the joint edges of the panels.

17.3.4 Orientation

Each non-vertical screen shall be installed with the lower end on an upstream side, and the higher end on a downstream side of the waterway. Bars shall span vertically between the lower and upper ends of the screen and not horizontally, unless otherwise stipulated on the drawings or in the detailed specification.

17.3.5 Screen Bars

The screen bars shall be parallel and evenly spaced, and the distance between bars shall not deviate with more than 5mm over the entire length of the screen. The screen shall only be accepted if the cleaning operation with the rake is trouble free, and to the approval of the Engineer.

17.3.6 Particulars Concerning the Screen

The detailed specification stipulates particulars relating to material of manufacture, waterway cross-sectional dimensions, the angle of inclination, gap between bars, bar size, number of screens of the same dimensions, number of screen panels per screen, and the number of hand-rakes required for each screen. If the number of screen panels is not indicated in the detailed specification, the entire screen shall consist of a single panel.

17.4 HAND-RAKE

Two hand-rakes shall be supplied per screen.

The rake shall be of lightweight and durable construction and the total weight of the rake shall not exceed 5kg.

The hand-rakes shall be dimensioned according to the screen dimensions, and the length of the handle shall be long enough to reach to the toe of the screen, with the handle's end 1m above the operator's platform. Details of the screen installation as shown in the civil drawings shall be used to design the rake.

The rake handle shall be constructed from 40 mm $\varnothing$ thin walled high strength tubing and shall be sealed at both ends. The toothed blade shall be manufactured from the same material as the screen, and shall be at least 4,5 mm thick and 300 mm wide.

The blade height shall be equal to the teeth length + 100mm. The tooth length shall be 5 mm shorter than the unobstructed screen bar depth, and straight teeth with rounded ends shall be used.

The teeth width shall be a maximum of 5mm less than the screen bar spacing, as specified in the detailed specification.

The handle bar shall be welded to the toothed blade, and gussets shall be welded in-between the blade and handle, to ensure that the rake is sufficiently reinforced.

The Contractor shall submit drawings of the hand-rake and screen to the Engineer for approval

17.5 CORROSION PROTECTION

Corrosion protection of all materials, fasteners and consumables shall comply with the requirements of the standard specification on corrosion protection. Special precautions shall be provided to avoid bimetallic corrosion. Where no corrosion protection is stipulated, the following shall apply *mutatis mutandis* as specified:

- a) Pickling and passivating on 3CR12 and stainless steel.
- b) Two-pack chemically cured or solvent-free epoxy on cast iron.
- c) Galvanising, vinyl, two-pack chemically cured or solvent-free epoxy, or epoxy with aliphatic or elastomeric polyurethane topcoat on mild steel.

17.6 TESTING

Testing, as specified for structural metalwork shall apply. In addition, the Contractor shall formally arrange with the Engineer for in-situ testing, to illustrate that the screen is properly installed and that the rakes pass freely through the entire screen.

17.7 TOLERANCES

Fabrication and assembly tolerances as specified in this specification and in the standard specification for structural metalwork shall apply.

17.8 MEASUREMENT AND PAYMENT

Note:

Each rate tendered for supply and delivery shall include full compensation for preparing the workshop; details where they have not been provided in the drawings; the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off -loading; and patent rights, royalties, etc. if applicable. They shall also include full compensation for all rakes, nuts, bolts, rivets, washers, holding-down bolts, and anchors.

The rates tendered for installation, testing and commissioning shall include full compensation for the installation, the making good of all damaged corrosion-protection areas, testing, commissioning and maintenance of the structural metal items, and for all other costs, and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal, if required for installation, shall be included in the tendered rates.

Item	Description	Unit
17.8.1	Supply and delivery of manually cleaned screen	No

The unit of measurement shall be the number of manually cleaned screens supplied and delivered as specified.

The tendered rate shall include full compensation for the manufacture, supply and delivery of the complete manually cleaned screen including all panels, the frame, all rakes, and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the manufacture, supply and delivery of a complete screen.

Separate payment items for individual manually cleaned screens will be listed in the schedule of quantities.

Item	Description	Unit
17.8.2	Installation, testing and commissioning of manually cleaned screen	No

The unit of measurement shall be the number of manually cleaned screens installed, tested and commissioned.

Separate items shall be scheduled for different screen sizes and aperture openings.

The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.

Separate payment items for individual manually cleaned screens will be listed in the schedule of quantities.

SECTION 18: SURFACE MOUNTED MECHANICAL MIXERS AND AERATORS

DOCUMENT NO.: STD-LRM- MM-0024

CONTENTS

18.1	SCOPE	615
18.2	STANDARDS.....	615
18.3	CONFIGURATION OF THE INSTALLATION.....	615
18.4	ELECTRICAL MOTOR	616
18.5	GEARBOX	616
18.6	IMPELLER AND DRIVE SHAFT.....	616
18.7	PERFORMANCE.....	617
18.8	INSTALLATION	617
18.9	CORROSION PROTECTION	618
18.10	TESTING AND COMMISSIONING.....	618
18.11	MASUREMENT AND PAYMENT	618

18.1 SCOPE

This standard specification covers the supply, delivery, installation, testing and commissioning of surface mounted mechanical mixers (including chemical mixers) and aerators.

18.2 STANDARDS

18.2.1 Standard Specifications Included in this Contract Document

The following standard specifications bound in this document shall be read in conjunction with this specification:

[189]	STD-LRM-MM-0008	Electric motors
[190]	STD-LRM-MM-0021	Gearboxes
[191]	STD-LRM-GN-0006	Corrosion protection
[192]	STD-LRM-MM-0020	Power transmission couplings
[193]	STD-LRM-GN-0007	Structural metalwork
[194]	STD-LRM-GN-0005	Testing and commissioning

18.3 CONFIGURATION OF THE INSTALLATION

- The mixer or aerator shall consist of a vertical flange-mounted motor, a parallel or in-line shaft gearbox, and a vertical shaft coupled to an impeller.
- Aerators shall be configured to allow vertical height adjustment of the complete unit as described below.
- Chemical mixers may be installed at an incline, and shall unless otherwise specified, have slotted guides in its support frame to adjust the angle of incline.
- The motor shaft shall be coupled to the gearbox input shaft with a direct, flexible coupling.
- The impeller shall be coupled to the gearbox output shaft with a direct, rigid coupling.

18.4 ELECTRICAL MOTOR

- a) The electrical motor shall comply with the standard specification on electric motors and shall be specifically rated for vertical operation.
- b) The motor shall be flange-mounted to the gearbox.
- c) Motors installed outdoors shall be fitted with weather hoods to prevent the ingress of rain water into the motor.
- d) The method of starting will be specified in the detailed specification. The Tenderer shall confirm with the Engineer at tender stage as to which starting methods are to be employed.
- e) The motor, shall unless otherwise specified, be a fixed speed motor.

18.5 GEARBOX

- a) The gearbox shall comply with the standard specification on gearboxes.
- b) The service factor, rated in accordance with AGMA, as described in the standard specification on gearboxes, shall not be less than 2,5.
- c) Each gearbox (excluding those for chemical mixers) shall have flat reference surfaces, in order to check their installation levels in two directions (at 90° to each other) by means of a spirit level.

18.6 IMPELLER AND DRIVE SHAFT

18.6.1 Mixers

- a) The mixer impeller shall, depending on the application, be of the following types:
 - i) Curved, backswept blades: Mixers in biological reactors, balancing tanks and sumps.
 - ii) Axial flow, propeller blades: Mixers in chemical make-up tanks.
- b) Alternative impeller designs may be submitted in a covering letter at the tender stage.
- c) The drive shaft shall be a large diameter solid shaft, and shall be locked to the impeller by means of a central bolt and a key. The shaft shall be connected to the gearbox shaft via a heavy-duty, rigid coupling, rated to at least 150% of the maximum torque to be transmitted.
- d) The impellers shall be designed to prevent long, fibrous material from snagging on the impellers.
- e) Drive shafts shall be manufactured from stainless steel and be insulated from the impellers and/or gearbox output shafts, to prevent galvanic corrosion where applicable.
- f) Impellers shall be manufactured from either stainless steel or cast iron. Other materials of manufacture shall be subject to the prior approval of the Engineer.
- g) Mixer impellers with minimised oxygen entrainment are preferred.
- h) Mixer impellers and shafts to be used in highly corrosive chemicals such as ferric chloride, shall be coated with natural rubber or other approved coating.
- i) No holes shall be drilled to effect balancing of the impeller.
- j) Mixer impellers and shafts shall be balanced to prevent unnecessary vibration and cyclical rotation.

18.6.2 Aerators

- a) Aerator impellers shall consist of radial blades welded to a central cone.
- b) Floating aerator impeller/shaft combinations will be preferred.
- c) A jig shall be used during manufacture to ensure that the unit is symmetric (concentric) and balanced.
- d) The aerator shaft shall be tubular and shall be flange bolted to both the impeller and the rigid coupling of the gearbox output shaft, the latter being rated for at least 200% of the expected maximum torque.
- e) The impeller shall be fitted with a central flange for coupling to the shaft. The impeller flange shall have a larger diameter than that of the shaft by at least 30 mm, to provide a flat face to use as a reference level during installation. The Tenderer may propose an alternative reference level at the tender stage.

- f) Both the drive shaft and the impeller shall be manufactured from mild steel.
- g) The tip speed of the impeller shall not exceed 5m/s.
- h) The impeller shall be designed such that no cavitation takes place during operation of the plant.
- i) The impeller shall not clog.
- j) The impeller shall be statically and dynamically balanced.

18.7 PERFORMANCE

18.7.1 Mixers

- a) The power input per mixing zone (allocated to each mixer) shall not exceed 10 W/m³.
- b) Mixers with minimised power consumption will be preferred.
- c) The Tenderer/Contractor shall ensure that the rotational directions of the mixers conform to that indicated on the drawings, or as specified in the detailed specification.
- d) No visible sludge build-up shall be present in any zone.
- e) Minimal vortex formation or air entrainment shall be present.
- f) Mixing performance tests shall be performed as described below.

18.7.2 Aerators

- a) Aerators with minimised power consumption will be preferred.
- b) The required oxygenation rate will be specified in the detailed specifications.
- c) The Tenderer shall submit performance and efficiency graphs for the impellers offered by him at the tender stage and shall guarantee the specified duty point or range.

18.8 INSTALLATION

18.8.1 Mixers

- a) The mixer gearbox/motor combination shall be mounted on a rigid base-plate, and bolted to the concrete platform.
- b) The unit shall be levelled by means of shims, and the Contractor shall grout the plate into position after completing the installation.
- c) Chemical mixers may be bolted to suitable structures such as walkways or tank walls by means of suitable brackets, subject to the approval of the Engineer.
- d) The Contractor shall supply the required fasteners and shall issue cast-in bolts to others to be grouted into position. The fasteners shall be manufactured from galvanised mild steel.

18.8.2 Aerators

- a) The aerator gearbox/motor combination shall be mounted on a rigid frame or have suitable rigid brackets attached to it, to allow the unit to be supported on four jacking and levelling screws or bolts.
- b) The Contractor shall issue the jacking screws to others to be grouted into position. The screws or bolts may also be bolted into position through the platform. Details shall be provided in a covering letter at tender stage.
- c) Lock and nuts shall be fitted to allow the unit to be locked into position after levelling and/or height adjustment.
- d) It shall be possible to adjust the aerator impeller level at least 100mm lower or higher than the design operating level in the aeration zone, as shown in the drawings. The total level adjustment range shall therefore be at least 200mm.
- e) The jacking bolts or screws and nuts, shall be manufactured from galvanised mild steel.
- f) The base frame or plate shall either be manufactured from galvanised mild steel, or from mild steel coated to the same standard as the gearbox.
- g) Should baffles be required, it shall be indicated in a covering letter at the tender stage, and the costs involved shall be included in the tender amount for the aerator.

- h) The Tenderer shall indicate at the tender stage if his aerators are compatible with the civil structures, and if not, he shall provide full details with regard to his requirements in a covering letter.

18.9 CORROSION PROTECTION

- a) Care shall be taken to ensure that insulation is applied between mating dissimilar metals in order to prevent galvanic corrosion.
- b) Aerator impellers and shafts shall be Copon coated to a thickness of at least 350µm. After installation and levelling of a unit, the Contractor shall similarly coat the flanges, bolt heads and the reference surface where the impeller is coupled to the shaft. All other bolt heads on the impeller shall also be coated.

18.10 TESTING AND COMMISSIONING

18.10.1 Mixers

- a) Six randomly placed samples shall be taken by others in one or more mixing zone and analysed for solids content.
- b) The solids content of any of the above six samples shall not vary by more than 15% from the mean of the six samples.
- c) The above, together with the performance criteria, shall be evaluated during the commissioning period. Should the mixers not comply with the criteria, the Contractor shall modify or add to his installations at his own expense, until the criteria are met.

18.10.2 Aerators

- a) Should any doubt exist regarding the efficiency and capacity of the aerators after installation, the SANS, or an approved laboratory may be instructed by the Engineer to carry out the necessary efficiency tests.
- b) If the oxygenation capacity of the aerators should prove to be less than specified, the Contractor shall be responsible for the costs of the tests, and shall entirely at his own cost, improve the oxygenation capacity to the capacity specified.
- c) If these improvements result in larger aerators with greater electricity demands, the Employer will recover once-only from the Contractor a sum of money which shall be determined by the cost of the additional electricity required by the aerators. The sum will be calculated as a capitalised sum, taking into account the present cost of electricity, inflation, interest rates for state loans and redemption period of the loan. This sum will also include any costs incurred in upgrading the electrical and other installations as may be necessary.

18.10.3 Commissioning

Testing and commissioning of the equipment shall be performed as detailed in the standard specification on testing and commissioning.

18.11 MASUREMENT AND PAYMENT

Item	Description	Unit
18.11.1	Supply and delivery of mixer or aerator installations	No

The unit of measurement shall be the number of mixer or aerator installations supplied and delivered.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading. The rate shall include for the complete mixer or aerator installation which shall include the following:

1. the impeller and drive shaft
2. the gearbox
3. the electric motor

4. all protection devices as specified
5. the mounting frame, plate and/or brackets
6. all required fasteners and/or jacking screws/bolts

Separate items will be scheduled in the schedule of quantities for different types or sizes of mixing or aeration equipment.

Item	Description	Unit

18.11.2	Installation, testing and commissioning of mixer or aerator installations	No

The unit of measurement shall be the number of mixer or aerator installations installed, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the mixing/aeration equipment including the fastening of equipment in its designated position, the required efficiency/performance tests and the commissioning tests. The installation shall include the levelling of the units to the required height. Commissioning shall include the day-01 and day-30 test sessions as well as the 30-day monitoring period as detailed in the standard specification on testing and commissioning.

Separate items will be scheduled in the schedule of quantities for different types or sizes of mixing or aeration equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the mixing/aeration equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the Engineer.

SECTION 19: BAFFLES, WEIRS AND OTHER SPECIALLY FABRICATED DEVICES

DOCUMENT NO.: STD-LRM- MM-0022

CONTENTS

19.1	SCOPE	620
19.2	STANDARDS.....	620
19.3	BAFFLES	620
19.4	WEIRS	621
19.5	SPECIALLY FABRICATED DEVICES.....	621
19.6	CORROSION PROTECTION	621
19.7	TESTING	622
19.8	TOLERANCES	622
19.9	MEASUREMENT AND PAYMENT	622

19.1 SCOPE

This section covers the manufacture, transportation and installation of baffles, weirs and other specially fabricated devices that are usually fabricated from various corrosion-resistant metals.

19.2 STANDARDS

19.2.1 National and International Standards

The applicable national and international standards, publications, and codes of practice, listed under the various sections of the standard specifications included in this contract document shall apply.

19.2.2 Standard Specifications Included in this Contract Document

The following standard specifications bound in this document, shall be read in conjunction with this specification:

[195]	STD-LRM-CC-0001	Civil Engineering Work
[196]	STD-LRM-GN-0006	Corrosion protection
[197]	STD-LRM-GN-0007	Structural metalwork

19.3 BAFFLES

Each baffle shall be supplied complete with holding-down bolts, fixing brackets, spacers, bracing, supports, sealant materials and all other items required to render a complete and fully operational system.

All metal components shall be manufactured from 3CR12 corrosion-resistant steel.

For all adjustable-overflow weirs and otherwise submerged items, the holding-down bolts, nuts, washers, etc., shall be of stainless steel.

The baffle shall be suitably designed by the Contractor to prevent buckling under all operational conditions.

Where applicable, each baffle shall be supplied with a suitable seal to ensure a 100% drop-tightness, along all applicable edges under all normal operational conditions.

19.4 WEIRS

19.4.1 General

Each weir shall be manufactured from 3CR12 or stainless steel 304L corrosion-resistant steel as specified.

19.4.2 Fixed Weir

Unless otherwise specified in the detailed specification, a V-notch weir shall be installed.

The V-notch weir shall be installed along the entire length of the overflow, against the upstream side of the supporting structure.

The V-notch weir shall be at least 300mm high with 100mm deep notches. The V-notch weir shall allow for a 50mm vertical adjustment for levelling purposes, and shall be installed perfectly level with the inverts of all V-notches; and be horizontal at the same level, not less than 10mm above the top of the overflow wall of the supporting structure.

The weir plate-fasteners shall be of an approved material, and shall be spaced not more than 500mm apart, and measured centre to centre. The thickness of the weir plate shall be 4,5mm. Non-continuous weir plates shall be sealed watertight at joints. All holes for fixing shall be sealed after installation. Sealants resistant to biological and ultraviolet decay shall be used, subject to the approval of the Engineer.

A sealing strip resistant to biological and ultraviolet decay shall be used between the weir and the wall. The material of construction shall be in accordance with the detailed specifications.

19.4.3 Adjustable Weir

The length and vertical adjustability shall comply with the requirements specified in the detailed specification for each adjustable weir.

Unless otherwise specified in the detailed specifications, each adjustable weir shall be supplied with a scum baffle.

Each adjustable weir shall be supplied with a stainless-steel indicator showing the height position of the weir in millimeters, on a stainless steel face-plate. Increments of the travel in centimeters, shall be punched on the dial or face-plate, and the words "FULLY LOWERED/TEN VOLLE NEERGELAAT" and "FULLY RAISED/TEN VOLLE OPGELIG" shall be punched onto the face-plate, indicating the minimum and maximum position respectively.

Each weir shall be installed such that if lines are projected parallel to the still water level through the lowest and highest points of the top edge of the weir for any weir position, the maximum vertical distance between these lines shall not exceed 1mm.

Each weir shall be watertight along its hinged bottom, and along its sides.

Adjustment to the height shall be done with a lockable handwheel on a headstock. The handwheel, locking device, indicator, and rising spindle supported by a headstock, shall be included for each weir.

19.5 SPECIALLY FABRICATED DEVICES

Each specially fabricated device shall be in accordance with the detailed specification.

19.6 CORROSION PROTECTION

Corrosion protection of all materials, fasteners, and consumables, shall comply with the requirements of the standard specifications on corrosion protection. Where no corrosion protection is stipulated, the following shall apply *mutatis mutandis* as specified:

- a) Pickling and passivating on corrosion-resistant and stainless steels.
- b) Two-pack chemically used or solvent-free epoxy on cast iron.
- c) Galvanising, vinyl, two-pack chemically cured, or solvent-free epoxy or epoxy with aliphatic or elastomeric polyurethane topcoat on mild steel.

19.7 TESTING

Testing as specified for structural metalwork shall apply. In addition, the Contractor shall formally arrange with the Engineer for in-situ testing of all equipment, and recording of results on a checklist where simple operation of equipment is required.

19.8 TOLERANCES

Fabrication and assembly tolerances as specified for structural metalwork shall apply.

19.9 MEASUREMENT AND PAYMENT

Note:

Each rate tendered for supply and delivery shall include full compensation for preparing workshop details where they have not been provided in the drawings, the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading, and patent rights, royalties, etc. if applicable. They shall also include full compensation for all nuts, bolts, rivets, washers, holding-down bolts and seals.

The rates tendered for installation, testing and commissioning shall include full compensation for the installation, the making good of all damaged corrosion-protection areas, testing, commissioning and maintenance of the structural metal items, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal, if required for installation, shall be included in the tendered rates.

Item	Description	Unit
19.9.1	Supply and delivery of baffle	No

The unit of measurement shall be the number of mixer or aerator installations supplied and delivered.

The tendered rate shall include full compensation for the baffle, seal, brackets, spacers, fixing devices, and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete baffle.

Item	Description	Unit
19.9.2	Supply and delivery of fixed weir	No

The unit of measurement shall be the number of fixed weirs supplied and delivered as specified.

Individual fixed weirs will be listed in the schedule of quantities. Fixed weirs for settling tanks will not be listed, and will be deemed to be included in the tendered rates for settling tank equipment. Separate items will be scheduled in the schedule of quantities for different types or sizes of mixing or aeration equipment.

The tendered rate shall include full compensation for the weir, seal, fixing devices and all appurtenant items, including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete fixed weir.

Item	Description	Unit

19.9.3	Supply and delivery of adjustable weir	No

The unit of measurement shall be the number of adjustable weirs supplied and delivered as specified.

Individual adjustable weirs will be listed in the schedule of quantities.

The tendered rate shall include full compensation for the adjustable weir, spindle, handwheel, hinges, seal, fixing devices and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete adjustable weir.

Item	Description	Unit

19.9.4	Supply and delivery of specially fabricated device	No

The unit of measurement shall be the number of specially fabricated devices supplied and delivered as specified.

Individual specially fabricated devices will be listed in the schedule of quantities.

The tendered rate shall include full compensation for the specially fabricated device, frame, brackets, seals and all appurtenant items, including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete device.

Item	Description	Unit

19.9.5	Installation, testing and commissioning of baffle	No

The unit of measurement shall be the number of baffles installed, tested and commissioned.

Individual baffles will be listed in the schedule of quantities. Scum baffles and Stanford baffles for settling tanks will not be listed, and will be deemed to be included in the tendered rates for settling tank equipment.

The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.

Item	Description	Unit

19.9.6	Installation, testing and commissioning of fixed weir	No

The unit of measurement shall be the number of fixed weirs installed, tested and commissioned.

Individual fixed weirs will be listed in the schedule of quantities. Fixed weirs for settling tanks will not be listed, and will be deemed to be included in the tendered rates for the settling tanks equipment.

The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.

Item	Description	Unit
19.9.7	Installation, testing and commissioning of adjustable weir	No
The unit of measurement shall be the number of adjustable weirs installed, tested and commissioned.		

Individual adjustable weirs will be listed in the schedule of quantities.

The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.

Item	Description	Unit
19.9.8	Installation, testing and commissioning of specially fabricated device	No
The unit of measurement shall be the number of specially fabricated devices installed, tested and commissioned.		

Individual specially fabricated devices will be listed in the schedule of quantities.

The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.

SECTION 20: MECHANICALLY SCRAPED SETTLING TANKS

DOCUMENT NO.: STD-LRM- MM-0014

CONTENTS

20.1	SCOPE	625
20.2	STANDARDS.....	625
20.3	ROTATING BRIDGE	626
20.4	CENTRE PIVOT	626
20.5	END CARRIAGE AND DRIVE UNIT	627
20.6	HANDRAILS	627
20.7	STILLING BOX	627
20.8	INLET PIPE	628
20.9	SCUM BAFFLE.....	628
20.10	STANFORD BAFFLE	628
20.11	V-NOTCH WEIR	628
20.12	SCUM SWEEP	629
20.13	SCUM DRAW-OFF MECHANISM.....	629
20.14	SCRAPERS	629
20.15	ELECTRICAL REQUIREMENTS.....	630
20.16	CORROSION PROTECTION	630
20.17	TESTING	630
20.18	TOLERANCES	630
20.19	MEASUREMENTS AND PAYMENT	631

20.1 SCOPE

This section covers the detailed design, manufacture, transportation and erection of mechanical equipment for mechanically-scraped circular concrete settling tanks.

20.2 STANDARDS

20.2.1 Standard Specifications Included in this Contract Document

The following standard specifications shall be read in conjunction with this specification, and shall be deemed to form part thereof:

[198]	STD-LRM-GN-0004	General Design
[199]	STD-LRM-GN-0005	Testing and commissioning
[200]	STD-LRM-MM-0008	Electric motors
[201]	STD-LRM-MM-0020	Power Transmission Couplings
[202]	STD-LRM-MM-0021	Gear Boxes
[203]	STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
[204]	STD-LRM-GN-0006	Corrosion Protection
[205]	STD-LRM-GN-0007	Structural Metal Work

[206] STD-LRM-MM-0016 Pipe Work

20.3 ROTATING BRIDGE

The frame for the bridge shall be manufactured from mild steel profiles, and shall be designed to carry its own mass, the sludge load, and all other static and superimposed loads, including a superimposed load of 3 kPa on the walkway.

The maximum deflection in any direction shall be limited to 10 mm under full load. Each bridge shall be fitted with handrails, and shall include an open-grid flooring panel walkway of at least 950 mm wide that will not deflect by more than 2,0 mm. All elements of the bridge except the handrails and open-grid flooring panels for the walkway shall be Copon coated and painted.

The handrails and open-grid flooring for the walkway shall be fabricated from galvanised mild steel. Open-grid flooring with bearer bars of 40 mm vertical dimension shall be provided.

Each individual open-grid panel shall be banded. A continuous kick plate shall be included along any access way edge beneath a handrail, and where access is obstructed. A nosing edge shall be provided on the outer edge of each step. All balustrades, kick plates and nosing edges shall be in accordance with statutory safety requirements.

The design of each bridge shall be subject to the approval of the Engineer prior to manufacture. Approval granted by the Engineer does not absolve the Contractor from the Contractor's sole responsibility for the performance and safety of the bridges.

For circular concrete settling tanks, the bridge shall be a rotating half-bridge, spanning from a platform in the centre of the tank to the tank perimeter wall. The motor, gearbox and drive train shall be installed at the tank perimeter side of the bridge. At the centre of the tank, the bridge shall be supported on a pivot bearing that is fixed to a concrete platform.

Each bridge shall be provided complete, including all bearings, mounting mechanisms, drive units equipped with torque limiting devices, electrical gear, mounting steps, open-grid flooring, access ladder, hand railing, and all other specified fixtures like scraper blades and a scum sweep.

20.4 CENTRE PIVOT

A centre pivot-bearing assembly shall support the bridge at its pivot. Requirements for finalisation of the civil design of the central support platform in terms of conduits, anchoring openings, recesses, levels and other particulars shall be submitted to the Engineer within 14 days after the award of the tender. The centre pivot shall incorporate sealed ball bearing units designed to carry the bridge under superimposed loads, and any twisting loads imposed by the scrapers, scum sweep, descumming device, and all other mechanical devices interacting with the bridge.

An arrangement shall be incorporated to allow small vertical movement of the bridge at the outer end, without imposing undue twist to the bearing assembly. The assembly shall be provided with grease nipples to facilitate lubrication.

On top of the centre pivot a totally enclosed weather proof slip-ring assembly shall be mounted, which shall be adequately rated for the installed power of the drive unit.

At least eight separate slip-rings shall be provided. The slip-rings shall be used for the following:

- a) a slip-ring for earth;
- b) slip-rings for the N/C contact of the emergency stop push-button;
- c) slip-rings for the N/O contact of the start pushbutton; and
- d) slip-rings to provide power to the bridge drive motor.

20.5 END CARRIAGE AND DRIVE UNIT

The bridge shall rotate at a peripheral speed of 3 m/min to 4 m/min and shall be supported on two polyurethane wheels, one driven and one free turning. The leading wheel shall be provided with a guard in front of it to push any foreign object out of its way. The drive train shall incorporate a safety device, such as a shear pin, in order to prevent damage to the system should obstructions or overloads occur.

The gearbox shall be of the standard, helical-gear unit type with a service factor of 2,0 and a minimum L_{10h} , basic life rating of 100 000 hours at full torque rating, unless specified to the contrary in the detailed specification. The helical-gear unit shall be of such a type that it can be readily changed if another peripheral speed is required.

Electricity for the motor drive unit shall be supplied to the centre column inside a sleeve. During construction, a suitable sleeve shall be installed by others to accommodate the electrical cable, as shown on the drawings.

The leading wheel of the drive unit shall be driven by a TEFC weather proof, hollow-shaft, geared motor unit, mounted onto the wheel axle, which in turn shall be supported by two sealed pillow-block bearing units, which shall be rigidly fixed to the end carriage. This is to ensure that the gearbox shaft and bearings are isolated from any overhung load due to the bridge mass. Any exposed free-rotating shaft shall be provided with a safety cover.

In addition to the requirements specified elsewhere in these specifications, the electrical motor shall also comply with the following minimum requirements: -

Enclosure	:	Class IP 55
Insulation	:	Class F
Operating voltage and frequency	:	380/220 V, 50 Hz
Service class	:	S1
Minimum size	:	0,55 kW

20.6 HANDRAILS

The handrails shall be positioned as shown on the drawings with the material of construction, and all other particulars in accordance with the standard and safety requirements as specified for handrails elsewhere in these specifications. The fixing of the stringers to the stanchions shall be such that the stringers can easily be removed if required for maintenance of equipment in the settling tanks.

The handrails shall be such that access to the centre pivot bearing and electrical slip-rings is allowed.

20.7 STILLING BOX

A cylindrical stilling box shall be supplied for each settling tank as shown on the drawings. The downward velocity in the stilling box shall not exceed 50 m/h at maximum inflow.

The method of fixing shall be subject to approval by the Engineer. The Contractor shall timely arrange with the Engineer and civil Contractor to ensure the correct installation of the stilling box fixing mechanism.

Four openings shall be supplied per stilling box regardless of its material of construction. Each opening shall be at least 200 mm wide and 450 mm deep, of which 100 mm shall be above the water level. The Contractor shall design and fabricate a system whereby each opening can be opened and closed separately and with ease. When closed, an opening shall seal watertight and fatty deposits shall not hinder its operation. The method of opening and closing of an opening shall be such that it can be done from the rotating bridge, without endangering the operator.

20.8 INLET PIPE

The inlet pipe shall be as described in the project specifications and as shown on the drawings. The one end shall be flanged and suitable for installation and coupling to a duck-foot bend or other pipework installed by others. The nominal diameter and flange drilling requirements shall be timely confirmed by the Contractor with the Engineer in writing, and before manufacturing commences. All liaisons shall be done through the Engineer. The open end of the inlet pipe shall be fitted with a bell mouth. The pipe shall be braced at two levels between the concrete columns by a mechanism manufactured from 304L stainless steel. This mechanism shall be subject to approval by the Engineer before being installed. All nuts, bolts, washers, gaskets, glands, etc. for the connection to the duck-foot bend shall be supplied by the mechanical Contractor.

20.9 SCUM BAFFLE

A scum baffle shall be installed along the inside perimeter of the effluent launder, at a distance of 230 mm towards the inside of the tank from the V-notch peripheral weir.

The scum baffle shall be at least 450 mm high with 350 mm submerged beneath the top water level. The scum baffle shall be positioned vertically, and shall be so constructed that it shall remain fixed and rigidly in position under operating conditions.

The scum baffle shall allow for at least a 50 mm vertical adjustment and its top and bottom edges shall be installed parallel to the still water level. If the Contractor requires the holding-down bolts to be cast into the structure, he shall supply the civil Contractor with the holding-down bolts as well as a template. The scum baffle shall be supplied and installed with suitable brackets for mounting to the concrete tank wall.

The scum baffle fasteners shall be spaced not more than 500 mm centre to centre. The thickness of the scum baffle shall be 4,5 mm. The scum baffle sections shall be joined in a manner that is approved by the Engineer. The material of construction shall be in accordance with the detailed specification.

20.10 STANFORD BAFFLE

A Stanford baffle shall be installed along the underside of the effluent launder for the full circumference of the tank, at an angle of 45 degrees downwards towards the inside of the tank; as shown on the drawings and as stipulated in the detailed specification.

The Stanford baffle shall be provided with holes along its top edge to prevent the accumulation of sewage gases below the launder. The Stanford baffle shall be so constructed that it shall remain fixed and rigidly in position under operating conditions.

If the Contractor requires holding-down bolts to be cast into the structure, he shall supply the civil Contractor with the holding-down bolts and a template. The Stanford baffle shall be fixed to the underside of the concrete launder.

Sections shall be joined in a manner that is approved by the Engineer. The material of construction shall be in accordance with the detailed specification.

20.11 V-NOTCH WEIR

A V-notch weir shall be installed along the entire circumference of the tank, against the upstream side of the effluent launder wall.

The V-notch weir shall be at least 250 mm high with 50 mm deep notches. The V-notch weir shall allow for a 50 mm vertical adjustment for levelling purposes, and shall be installed perfectly level with the inverts of all V-notches, horizontal at the same level, and not less than 10 mm above the surface of the concrete.

The weir plate fasteners shall be independent clamps bolted to the wall, manufactured from the same material as the weir plate, and shall be spaced not more than 500 mm apart, measured centre to centre. The thickness of the weir plate shall be 4.5 mm. The weir plates shall be sealed watertight at joints and

brackets, with a sealant resistant to biological and ultraviolet decay, and subject to the approval of the Engineer.

A sealing strip resistant to biological and ultraviolet decay shall be used between the weir plates and the wall.

20.12 SCUM SWEEP

The scum sweep shall be fastened to the bridge with suitable brackets. It shall extend vertically down into the water for at least 200 mm below top water level. The scum sweep shall extend horizontally from the stilling box to the scum baffle and shall be provided with replaceable neoprene wearing strips on both horizontal ends.

The scum sweep shall be installed at an angle suited to trap the scum at the scum draw-off mechanism, with the wiper assembly located downstream of the bridge. The scum sweep shall be manufactured from a suitable thickness plate to prevent any buckling and twisting.

The material of construction shall be as specified in the detailed specifications.

20.13 SCUM DRAW-OFF MECHANISM

One scum draw-off mechanism of the submerged type shall be provided for each settling tank, so as to ensure single flushing at every full rotation of the bridge. The scum draw-off mechanism shall be positioned as shown on the drawings.

The scum sweep together with the scum draw-off mechanism shall ensure that all scum and floating objects are removed from the top water level of the settling tanks.

The scum trough for each mechanism shall be at least 750 mm long to enable a large amount of scum to be removed at a time. The scum sweep and beach shall be arranged such that the scum trapped in the skimming arm pocket is concentrated for large volume removal.

Each scum trough shall be fitted with a conical rubber plug to allow the scum to be removed from the scum trough. The rubber plug shall be activated by the passing bridge. The period of scum removal shall be adjustable. The scum removal mechanism shall be watertight during normal operation.

The pipe from each scum draw-off mechanism shall extend through the wall of the settling tank. The material of construction shall be 3 mm thick 316L stainless steel, unless specified to the contrary in the detailed specification, or as shown on the drawings.

Each scum removal pipe shall have a diameter of 200 mm.

The Contractor shall supply all fittings, seals, packings, gaskets, bolts, nuts, washers, duck-foot bends, and all other appurtenant fittings including all labour to effect coupling (subject to the approval of the Engineer) to any existing or future pipework installed by others. In the case of such future pipework not envisaged to be completed by others under a simultaneous or overlapping contract, the Contractor shall blank off pipework installed by him with a valve and a blind flange.

20.14 SCRAPERS

The scrapers shall be arranged in a rigid echelon formation to suit the floor slope, and each scraper blade shall be suspended from the bridge to the floor of the tank by two vertical support tubes; one fixed to the leading edge of the bridge and the other to the trailing edge. The vertical support tubes shall be sealed watertight and shall be suitably cross-braced for ensured stability.

Each scraper blade, slotted for easy individual adjustment, shall be fitted with a replaceable flexible neoprene wearing strip, or a wearing strip from a material unaffected by oil or water. They need to be resistant to biological attack and chemical decay, and are subject to the approval of the Engineer. Each wearing strip shall be at least 150 mm high and continuous along the entire length of the scraper blade. Adequate fastening with at least 50 mm adjustability shall be provided. Side wall scrapers from the same material as the bottom scrapers shall also be included.

On any tank deeper than 3,5m, the scraper blade shall be similarly arranged, but shall be fixed to a braced mounting frame, which shall be suspended and fixed to the bridge by a diagonally braced lattice structure. Tank depth in this case shall be interpreted as being the vertical distance between the top edge of the sludge hopper, and the bottom of any V-notch in the peripheral V-notch weir.

The angle of the blades in the horizontal plane shall be 60° to any radial line. This will prevent excessive deflection of the scraper assembly under varying operational loadings.

The scrapers shall be in contact with the tank floor when it is empty (dry), but the bridge shall be able to rotate in this condition without excessive damage to the scrapers.

The scrapers shall be fixed to a common angle profile tie at the bottom of the tank. A hopper scraper shall also be supplied.

20.15 ELECTRICAL REQUIREMENTS

20.15.1 General

Power shall be supplied to the settling tanks through a conduit pipe which passes under the concrete structure towards its centre, and inside one of the centre columns upwards to the slip-ring collector at the centre of the tank. Power shall then be transmitted from the slip-ring collector along the bridge to the geared motor drive.

An emergency STOP/START push button station shall be mounted on a suitable pedestal fixed to the bridge on the outside perimeter of the settling tanks. The STOP/START station shall be supplied and installed by others.

20.15.2 Scope of Supply for Electrical Equipment for a Settling Tank

- a) A slip-ring assembly as detailed elsewhere in this section.
- b) All metal parts of the bridge shall be electrically interconnected by means of suitable earthing, which shall be connected to the earth slip-ring.

20.16 CORROSION PROTECTION

Corrosion protection of all materials, fasteners and consumables shall comply with the requirements of the standard specification on corrosion protection.

20.17 TESTING

20.17.1 Testing by the Engineer

The Engineer may nominate a testing authority to inspect the works and to conduct such tests as he may consider necessary for testing compliance with the specifications. These shall include tests applicable to structural metal work.

The Contractor shall, where required and unless otherwise specified in the detailed specification, pay for the cost of testing.

20.17.2 Process Control

Welds shall be regularly inspected and tested by the Contractor. This shall include the visual inspection of welds to ensure that there is no undercutting, no uneven lengths, no porosity, nor evidence of cracking, and that full fusion has been achieved. If required by the Engineer, cores containing weld and adjacent parent material shall be cut, in doubtful areas. The cores shall be polished and examined and the hole reinstated.

20.18 TOLERANCES

Fabrication and assembly tolerances as specified for structural metal work shall apply.

20.19 MEASUREMENTS AND PAYMENT

Note:

Payment for structural metalwork related to equipment, which is specified in this section (such as open-grid flooring and hand railing for settling tank bridges, access stairways, platforms and specifically mounting frames for motors and gearboxes, etc.) shall be deemed to be included in the rates tendered for the equipment in this section.

The tendered supply and delivery rates below shall include full compensation for preparing workshop details where they have not been provided in the drawings; and the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading. They shall also include full compensation for all nuts, bolts, rivets, washers, holding-down bolts where specified for cutting, waste and temporary bracing, and transportation.

Item	Description	Unit
20.19.1	Supply and delivery of settling tank equipment for:	No

Settling tank description including diameter, etc.

The unit of measurement shall be the number of identical mechanically-scraped circular concrete settling tanks for which equipment is supplied and delivered as specified or shown on the drawings.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each mechanically scraped settling tank as specified with all appurtenances, and including the following per settling tank:

1. Rotating bridge.
2. Centre pivot including slip ring assembly.
3. End carriage and drive unit including motor and gearbox.
4. Handrails, open-grid flooring, access stairs, kick plates and nosing edges.
5. Stilling box.
6. Inlet pipe.
7. Scum baffle.
8. Stanford baffle.
9. V-notch weir.
10. Scum sweep.
11. Set of scrapers.
12. Two scum draw-off mechanisms.
13. Set of appurtenant electrical equipment.

Item	Description	Unit
20.19.2	Installation, testing and commissioning of settling tank equipment for	No

Settling tanks description including diameter, etc.

The unit of measurement shall be the number of identical mechanically-scraped circular concrete settling tanks for which equipment is installed, tested and commissioned as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete set of settling tanks equipment; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

SECTION 21: GAS CHLORINATION EQUIPMENT

DOCUMENT NO.: STD-LRM-MM-0002

CONTENTS

21.1	SCOPE	632
21.2	STANDARDS.....	632
21.3	MATERIALS	633
21.4	OPERATION OF THE PLANT	633
21.5	COMPONENTS OF THE SYSTEM	634
21.6	GAS CYLINDER STATIONS	634
21.7	CHANGE-OVER DEVICE.....	635
21.8	VACUUM REGULATOR.....	635
21.9	CONTROLLER	635
21.10	INJECTOR.....	635
21.11	BOOSTER PUMPS	636
21.12	PIPEWORK	636
21.13	SAFETY, EMERGENCY AND PROTECTION EQUIPMENT	637
21.14	EMERGENCY SHUT-OFF SYSTEM.....	638
21.15	CORROSION PROTECTION	639
21.16	TOOLS AND HOISTING EQUIPMENT	639
21.17	TESTING AND COMMISSIONING.....	639
21.18	MEASUREMENT AND PAYMENT.....	639

21.1 SCOPE

This specification covers the requirements for the the design, performance, manufacture, corrosion protection, supply and delivery to site, installation, erection, testing, adjustment and commissioning, handing over of the gas chlorination equipment to be supplied under the contract.

This specification also covers the required measurement and payment items for the specified equipment

21.2 STANDARDS

21.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[207]	SANS 10400	National Building Regulations
[208]	BS PD 5304	Guidance on safe use of machinery
[209]	SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
[210]	SANS 10104	Hand railing and balustrading (safety aspects)
[211]	SANS 10064	The preparation of steel surfaces for coating
[212]	SANS 10104	Hand railing and balustrading (safety aspects)

[213]	SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs
[214]	SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
[215]	SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress
[216]	SANS 10298 – 2009	Indirect small to medium-sized gas chlorination systems for the disinfection of water

21.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[217]	STD-LRM-CC-0001	Civil Engineering Work
[218]	STD-LRM-GN-0005	Testing and commissioning
[219]	STD-LRM-GN-0006	Corrosion protection
[220]	STD-LRM-MM-0016	Pipe work
[221]	STD-LRM-MM-0010	Dry Well Pumping Equipment
[222]	STD-LRM-MM-0019	Hoisting Equipment

21.3 MATERIALS

The chlorinator equipment, all associated chlorine dosing pipework and accessories that may come in contact with chlorine gas or solution shall be constructed of materials resistant to corrosion from the effects of chlorine.

21.4 OPERATION OF THE PLANT

The required mode of operation is briefly described below:

- Gas is released from high pressure liquid containers and transferred via a high-pressure pipework to a pressure reducing, or vacuum regulating device.
- The high pressure manifold shall be fitted with a liquid trap that is heated to prevent liquid gas into the downstream equipment and piping.
- The vacuum regulator opens and closes based on a negative pressure in the supply line that is created by an injector due to motive water flowing through a venturi.
- The quantity of gas in the two cylinder/drum banks should be sufficient so as to allow a maximum draw-off of 1 % of the mass of gas in the banks in the process of releasing the chlorine volume required for the specific application.
- If a set of duty and standby cylinders are utilised, (i.e. two banks) an automatic change-over device installed downstream of the vacuum regulator shall ensure that the system switches from the depleted bank to the full bank automatically. This same function can be fulfilled by special Auto Changeover vacuum regulators in which case no special switchover device is needed.
- A gas controller, generally referred to as the flow controller/rotameter meters the gas flow-rate and supplies the required quantity of gas to the injector.
- The flow controller can either be controlled manually or automatically (Autovalue) via a flow signal and/or a signal from an in-line analyser that measure free or total chlorine and preferably also temperature and pH and in conjunction with the controller on the Autovalue predict the dosing

needed with the parameters above and also taking the lag time between dosing and analysing into account.

- h) Gas is absorbed into a water stream in the injector. The water is either obtained from the mains supply directly, or is boosted by means of centrifugal pumps, to ensure the effectiveness of the injector.
- i) The chlorinated stream of water is dosed to wherever it is required.

21.5 COMPONENTS OF THE SYSTEM

A process flow diagram will be included in the Annexures to the detailed specification.

The equipment listed below is for a standard gas chlorination installation. Certain items may be deleted or added in the detailed specification.

The standard gas chlorination plant shall consist of the following equipment:

- a) Gas cylinder (68kg)/drum (920 kg) stations
- b) High pressure gas pipework,
- c) Liquid traps and heating system to evaporate liquid chlorine
- d) High pressure gas pressure gauge
- e) Automatic change-over device, either as a unit or through the vacuum regulators
- f) Vacuum regulator (s)
- g) Low pressure gas pipework from suitable chlorine gas resistant piping
- h) Manual or Autovalve flow controller
- i) Leak detection system with visual and audible alarms
- j) Dry media chlorine scrubber
- k) Injector
- l) Booster pumps
- m) Water pipework
- n) Water pressure gauge
- o) Strainer and flow switch in booster pump pipework
- p) Safety equipment.

21.6 GAS CYLINDER STATIONS

- a) Where 1 tonne gas cylinders are required in the detailed specification, the Contractor shall supply and install support cradles with castors to accommodate the standard 1-tonne cylinder (e.g. as supplied by NCP) in a horizontal position.
- b) Where 68 kg cylinders are required in the detailed specification, the Contractor shall supply and install lashing chains for each cylinder, in order to lash them into a vertical position against the designated wall.
- c) The number of support cradles or positions for vertical cylinders will be specified in the detailed specification.
- d) The support cradles and castors for drums shall be manufactured from mild steel. The frame and castors shall be coated to system D2 as detailed in the standard specification on general corrosion protection.
- e) The castor axles shall be supported on each end in sealed-for-life roller bearings selected for a design load of three times that imposed by the drum in its normal position.
- f) Lashing chains shall be manufactured from mild steel surrounded by plastic tubing. The fasteners, hooks and brackets attached to the wall shall also be from mild steel.
- g) One selected cradle per bank of drums supporting active (on duty) one-tonne drums, and the corresponding standby bank, shall be fitted with a mass meter (weight) as designated in the

detailed specification. The mass meter shall be complete with load cells, measuring instrumentation and LCD digital readouts, one for each cradle. Mass meters shall be of a proven type and shall be approved by the Engineer. Each scale shall have a separate display. A 4-20 mA output may be required for feed to PLC/SCADA.

- h) The tare weight of the container must be back balanced to give a net reading of the weight of liquid chlorine available in the container. The platform of the scale must have four trunnions mounted thereon for easy positioning of the chlorine containers. The scale must be sturdy and dependable and of high quality, suitable to operate under extreme condition of dust, moisture, corrosion and impact. The gross weight of a chlorine container is approximately 1 600 kg.
- i) Where the 68 kg cylinders are required, the Contractor shall supply one scale per bank of cylinders for determining the mass of a cylinder. The scale shall be supplied with a analogue display having a dial diameter not less than 125mm. The full-scale reading shall be 1,2 times the maximum mass of a full cylinder, but the scale shall be able to tolerate an accidental overload of 300% of the full-scale reading. A 4-20 mA signal to PLC/SCADA may be required. The scale should have a PVC platform to prevent oxidation by the chlorine.
- j) All scales, load cells and/or digital read-out displays shall be calibrated, and shall be supplied together with a calibration certificate.

21.7 CHANGE-OVER DEVICE

- a) Where a duty and a standby bank of gas cylinders are required in the detailed specification, the Contractor shall supply and install an automatic change-over system that is either incorporated in the vacuum regulator or a device in the high-pressure gas line, where the lines from the two banks join.
- b) The changeover device shall be installed in the same room or covered area as the gas cylinders/drums

21.8 VACUUM REGULATOR

If a separate changeover device is used, a suitable vacuum regulator shall be installed upstream of the change-over device and in the same covered area, the Contractor shall supply and install vacuum regulator(s) or pressure reducing device(s) as specified in the detailed specification. The regulator shall be compatible with the controller installed by the Contractor as described below.

21.9 CONTROLLER

The Contractor shall supply and install a gas metering controller in the control room as shown in the drawings.

The controller shall be rated to pass and deliver the amount or rate of Cl₂ as specified in the detailed specifications.

The rate of Cl₂ delivery shall be adjustable between zero and the maximum specified in kg/hr manually or by an Autovalve. It shall be possible to perform manual adjustment on the controller and remote adjustment, by means of a 4-20 mA signal from a flow meter and/or an analyser. The controller, in the case of an Autovalve, shall also supply a 4-20 mA signal to indicate the rate of Cl₂ delivery.

The controller shall be fitted with a clearly calibrated visual flow rate indicator.

The controller shall contain a filter on its inlet line to prevent fouling of the working mechanism.

21.10 INJECTOR

An injector shall be installed in the water pipeline in the position or location shown in the process flow diagram and/or drawings supplied together with the contract document.

The required water pressure for effective operation of the injector, shall be clearly stated in the tenderer's covering letter and the technical data sheets.

21.11 BOOSTER PUMPS

The pressure difference between the water supply point and the dosing point will be specified in the detailed specification.

The Contractor shall ensure that the water flow rate and pressure conditions are sufficient to ensure effective operation of the injector.

Booster pumps shall be supplied and installed if required by the detailed specification, or if deemed necessary by the Contractor for the effective operation of the dosing plant.

The booster pumps shall be selected and sized by the tenderer. The pumps shall be centrifugal or submersible pumps complying with the standard specification on dry-well pumping equipment.

At least two pumps, one duty and one standby, shall be installed. Duty rotation will be supplied by the contractor.

The pipework required, the location of injector(s), and the dosing point(s), are shown in the drawings and the process flow diagrams supplied together with the contract document.

21.12 PIPEWORK

The Contractor shall supply and install all the chlorine gas pipework and water pipework up to the mechanical or civil interfaces shown on the drawings; or as specified in the detailed specification. The pipework shall be in accordance with the following specifications:

21.12.1 High Pressure Chlorine Gas Pipework

- a) The gas cylinders shall be connected to the common manifolds connecting the cylinders in a bank, by means of nickel plated copper tubing. The tubing shall interface with the cylinders in a parallel thread BSP fitting, with sealing being effected by means of lead washers. The tubes shall be coiled to allow flexibility and to minimise loading on the pipework.
- b) It shall be possible to isolate each cylinder by means of a needle valve.
- c) The common pipeline connecting the cylinders in each bank, and the rest of the high-pressure pipeline, shall be manufactured from steam quality pipes to schedule 80.
- d) Immediately upstream of the joint between the two manifolds serving each bank of cylinders, the Contractor shall install a liquid chlorine trap or "catch pot" (i.e. two liquid traps in total).
- e) The chlorine gas piping shall be routed in the trenches provided or against suitable wall if no trenching is provided.
- f) The pipework shall be firmly fixed to the trench floors and/or walls.
- g) Steel pipework, fasteners and brackets shall be adequately protected against the corrosive effect of a chlorine rich environment.
- h) The catch pots, shall be fitted with 20 W/m heating tape attached to the side of the pipes

21.12.2 Low Pressure Chlorine Gas Pipework

- a) The gas pipework downstream of the vacuum regulator shall be manufactured from uPVC, class 16.
- b) uPVC pipework exposed to sunlight shall be coated in UV resistant paint as per the standard specification on corrosion protection.
- c) The Contractor shall seal the gaps between the pipework and the walls, where the pipes pass through walls. That is, between the vacuum regulator and the controller, and the controller and the injector. Refer to the drawings in this regard.

21.12.3 Water and Dosing Pipework

- a) Water pipes shall be manufactured from galvanised mild steel or uPVC. uPVC will be a requirement for the pipework downstream of the injector.

- b) uPVC pipework exposed to sunlight shall be coated in UV resistant paint as per the standard specification on corrosion protection.
- c) The Contractor shall supply, install and connect all water pipework up to the civil interfaces.
- d) Immediately downstream of the mechanical or civil interface on the water supply line, but inside the pump or injector room, the Contractor shall install a strainer and a flow switch in the pipeline.
- e) The interlocking of the pumps, the flow switch and the chlorinator controller will be supplied by the contractor.
- f) Immediately downstream of each pump, the Contractor shall install a reflux or one-way valve.
- g) Immediately upstream of each injector or bank of injectors, the Contractor shall install a suitably calibrated pressure gauge and an Union to facilitate easy maintenance.
- h) The Contractor shall route the chlorine-in-water solution pipework to the dosing point and shall connect up to the civil pipework with a suitable fitting.
- i) The Contractor shall refer to the process flow diagram and/or drawings for the required isolation valves.

21.13 SAFETY, EMERGENCY AND PROTECTION EQUIPMENT

In addition to the protection and/or safety devices described above, the Contractor shall ensure that the following is supplied, installed and/or implemented and included in the tendered rates:

- a) All vents from controllers, vacuum controllers and/or evaporators shall be fitted with chlorine neutralisers.
- b) All vents shall be piped to the outside of the building as designated.
- c) A positive means shall be available to relieve vacuum pressure in the controller in the event of exhaustion of the chlorine supply.
- d) Chlorine detection devices shall be installed in the area housing the cylinders, the control room and the pump and injector room, wherever applicable. The detector shall have a potential-free contact to signal an alarm, activating a visual alarm at a level of chlorine in the room (normally 2 ppm) and a subsequent audible alarm through a siren.
- e) The Contractor shall erect (or affix to suitable walls) safety signage and clear emergency procedure notices, which shall also contain emergency telephone numbers.
- f) In addition to the equipment described above, the Contractor shall supply, install, test and commission the following safety equipment:
 - i) Chemical cartridge respirators

Two respirators (gas masks), each complete with two cartridges, shall be supplied. The cartridges shall be of the disposable type and sealed in their packaging.

- ii) Footwear

Two pairs of rubber safety boots (Size 10) shall be specified.

- iii) Body, skin and arm protection suits

Two chlorobutyl-proof fabric protection suits shall be supplied. Each suit shall be tight fitting at the wrists, and shall be suitably sealed at the front opening. These suits shall be to the approval of the Engineer.

- iv) Gloves

Two pairs of chlorobutyl-proof or PVC rubber gloves shall be supplied.

- v) Safety Goggles

Two pairs of gas-tight chemical safety goggles shall be supplied.

vi) Emergency first-aid kit

An emergency first-aid kit containing the following shall be supplied:

- (1) Ventolin-spray (2-off)
- (2) Propan gel (2-off)
- (3) Vitamin E cream (2-off)
- (4) Resuscitube with non-return valve (10-off)
- (5) Instructions and inventory

vii) Emergency cabinet

An emergency cupboard, large enough with sufficient racks to house all the above-mentioned safety equipment without stacking individual items on top of each other, shall be supplied and installed in the position as indicated on the drawings.

The cabinet shall have a lockable front and back door to allow access from inside and outside the building. The keys to the cabinet lock shall be housed in two sealed weatherproof key boxes with a breakable but replaceable glass. Two separate replaceable glass panes shall be provided and stored with the rest of the safety equipment inside the cabinet. One key box shall be installed inside, and the other outside the building, adjacent to the cabinet, unless specified to the contrary in the detailed specification.

The emergency cabinet shall be manufactured from FRP

The emergency cabinet shall be marked according to the requirements for an emergency cabinet as detailed in SABS 0140.

The cabinet shall be airtight with replaceable rubber seals on the door edges to prevent the ingress of moisture and dust.

viii) Emergency repair kit and breathing apparatus (BA) set

Depending on the type of installation the following emergency repair kit shall be supplied to contain leaks which may be encountered in chlorine containers.

Emergency kit A: For installations using 68 kg chlorine cylinders

Emergency kit B: For installations using 1 tonne portable chlorine tanks

An approved self-contained breathing apparatus set, consisting of a full face piece and a single cylinder mounted on the back, shall be supplied to be used during a major leak.

The BA-set shall allow a minimum of 30 minutes of normal breathing through both nose and mouth.

The emergency repair kit and BA-set shall be kept outside the area of possible contamination in a purpose-made cabinet or storage facility. The place of storage shall be determined on site and shall be subject to approval by the Engineer.

21.14 EMERGENCY SHUT-OFF SYSTEM

An emergency shut-off mechanism of the outlet valve of the active containers shall be provided under this portion of the Contract. The system shall operate either electrically or pneumatically. In the case of pneumatic operation, compressor(s) and air storage vessel shall be provided.

The shut-off system shall be activated by a high chlorine level (typically 5 ppm) detected in the chlorine storage area. Once the detection level remains for say 30 seconds, a signal shall be generated initiating

the closure of the outlet valves. If the mechanism is operated electrically, the valves shall be closed in the event of a power failure.

21.15 CORROSION PROTECTION

Corrosion protection must be carried out strictly in accordance with the requirements of the Standard Specification on Corrosion protection [219].

- a) The Contractor shall ensure that all equipment utilised, are resistant to the corrosive effects of chlorine gas, chlorinated water, clear water and humid air and/or combinations thereof.
- b) Corrosion protection shall be affected in accordance with the standard specification on general corrosion protection or as approved by the Engineer.
- c) All pipework shall be colour coded in accordance with the standard specification on pipework [220].

21.16 TOOLS AND HOISTING EQUIPMENT

- a) The Contractor shall supply a torque wrench for the removal and tightening of the threaded fittings on the chlorine gas cylinders. The wrench shall be gauged and set to prevent the stripping of the threads with normal usage.
- b) Where one-tonne gas cylinders are to be utilised, the Contractor shall supply a suitable, purpose-made lifting beam certified to 3 to maximum load by a certified testing centre for lifting and handling of the cylinders.
- c) Where required in the detailed specification, the Contractor shall supply and install hoisting or crane facilities in accordance with the standard specification on Hoisting Equipment [222].

21.17 TESTING AND COMMISSIONING

All equipment shall be tested and commissioned in accordance with the standard specification on Testing and Commissioning [218].

Chlorine gas bottles will be supplied by the Employer in order for the plant to be commissioned.

The chlorine gas detection equipment shall be tested. The Contractor shall supply the necessary equipment and facilities to perform the tests. The ability to test at various levels of chlorine is a requirement)

The overall performance of the chlorine dosing system shall be tested during the commissioning period by determining the dosing rates of chlorine gas through each controller. This shall be achieved by monitoring the mass variation of the active gas cylinders over a continuous dosing period of not less than 18 hours. If the calculated dosing rate should be at variance with the rate set on the controller by more than 15%, the Contractor shall rectify or replace the controller and/or injector, in order to conform with the process requirements.

21.18 MEASUREMENT AND PAYMENT.

Separate items will be listed in the schedule of quantities under the relevant payment items for different types and sizes of the following equipment:

- a) Gas cylinder cradles and castors
- b) Mass meters
- c) High pressure gas pipework manifold
- d) Automatic change-over devices if not incorporated into the vacuum regulator.
- e) Vacuum regulators
- f) Residual chlorine analysers
- g) Low pressure gas pipework
- h) Controllers (chlorinators), manual or Autovalve

- i) Injectors
- j) Booster pumps and water pipework and fittings with control panels
- k) Chlorine gas detectors
- l) Torque wrenches
- m) Hoisting hooks
- n) Safety equipment

Item	Description	Unit
21.18.1	Supply and delivery of gas chlorination equipment	No

The unit of measurement shall be the number of pieces of equipment supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site, off-loading and all handling of equipment. The equipment shall include and conform to the requirements specified in the specifications and the Contractor shall ensure that the equipment is fit for the duty required.

Item	Description	Unit
21.18.2	Installation, testing and commissioning of gas chlorination equipment	No

The unit of measurement shall be the number of pieces of equipment installed and commissioned.

Separate items will be scheduled for different types and sizes of equipment.

The tendered rates shall include full compensation for the site handling and positioning of the equipment including the fastening of equipment in the designated positions. All required installation materials, labour and consumables to render a complete and working installation shall be included in the tendered rates.

The rates shall also include for the testing and commissioning procedures as required by the specifications

Item	Description	Unit
21.18.3	Supply and delivery of gas chlorination system	Lump Sum

The unit of measurement shall be the lump sum tendered.

The tendered sum shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery and test certificates, transport for delivery to site, off-loading; and all handling of equipment to render a complete and operational chlorination system. This includes all gas cylinder cradles and castors, mass meters, high- and low-pressure pipework, automatic change-over devices, vacuum regulators, chlorinator controllers, injectors, booster pumps and pipework, gas detectors, torque wrenches, hoisting hooks and safety equipment. All the above shall conform to the requirements specified in the specifications and the Contractor shall ensure that the equipment is fit for the duty required.

Item	Description	Unit
21.18.4	Installation, testing and commissioning of chlorination system	Lump Sum

The unit of measurement shall be the lump sum tendered.

The tendered sum shall include full compensation for the site handling and positioning of gas cylinder cradles and castors, mass meters, high- and low-pressure pipework, automatic change over devices,

vacuum regulators, chlorinator controllers, injectors, booster pumps and pipework, gas detectors, torque wrenches, hoisting hooks and safety equipment. This includes the fastening of this equipment in the designated positions. All required equipment installation materials, labour and consumables to render a complete and working installation, shall be included in the tendered rates.

The rates shall also include for the testing and commissioning procedures as required by the relevant specifications.

SECTION 22: COMPRESSORS AND BLOWERS

DOCUMENT NO.: STD-LRM-MM-0004

CONTENTS

22.1	SCOPE	642
22.2	STANDARDS.....	642
22.3	MOTOR	643
22.4	POWER TRANSMISSION COUPLING	643
22.5	COMPRESSORS	643
22.6	PROTECTION DEVICES	645
22.7	INSTALLATION	645
22.8	TESTING AND COMMISSIONING.....	646
22.9	MEASUREMENT AND PAYMENT	646

22.1 SCOPE

This section covers the design, manufacture, delivery, installation, site testing, commissioning and measurement and payment of compressors and blowers for gaseous media. Blowers are also referred to as compressors in these specifications.

22.2 STANDARDS

22.2.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[223]	BS 1553 Part 3 1950	Graphical symbols for compressing plant
[224]	BS 7316	Specification for design and construction of screw and related type compressors for the process industry
[225]	BS 7322	Specification for design and construction of reciprocating type compressors for the process industry
[226]	BS 6244	Code of practice for stationary air compressors
[227]	BS 1571, Part I and II	Specification for testing of positive displacement compressors and exhausters
-		

22.2.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[228]	STD-LRM-MM-0008	ELECTRIC MOTORS
[229]	STD-LRM-MM-0020	POWER TRANSMISSION COUPLINGS
[230]	STD-LRM-MM-0006	EQUIPMENT FOR THE MEASUREMENT OF FLUID/FLOW PROPERTIES
[231]	STD-LRM-GN-0005	TESTING AND COMMISSIONING

22.3 MOTOR

Each compressor shall, unless otherwise specified, be supplied complete with an electric motor which shall comply with the requirements specified in the section dealing with electric motors. The compressor and motor shall either be separately mounted on a common base frame or the motor shall be flange mounted to the compressor. In both cases the motor shall be directly coupled to the compressor by means of a flexible coupling.

22.4 POWER TRANSMISSION COUPLING

Couplings shall comply with the requirements of the section dealing with power transmission couplings. V-belt couplings will only be allowed for roots blowers and reciprocating compressors; all other compressors shall have direct, flexible or rigid couplings roots blowers and alternative proposals in this regard may be submitted with full details.

22.5 COMPRESSORS

22.5.1 General requirements

The compressor shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating free air delivery, delivery pressure, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The efficiency of the compressor shall not be less than 95% of its maximum efficiency at the selected operating point.

The possible percentage variation of data measured on site by the supplied and/or installed instrumentation when compared with the catalogued performance data must be submitted.

All calculations for static and dynamic pressures are to be based on an atmospheric pressure above sea level as specified in the detail specifications.

The engineer or his representative reserve the right to call for-

- a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or
- b) Site inspection, customer reports/references and user's interviews, and/or
- c) Full engineering, design and component selection details-in order to check the correctness of the service life claimed.

Rotary compressor impellers shall be statically, dynamically and aerodynamically balanced at the manufacturer's works to within the design operating range. Similarly, the moving parts of reciprocating compressors shall be statically and dynamically balanced.

Lifting eyes or lugs shall be provided for compressors exceeding 25 kg in mass.

All compressors/blowers shall have a pressure gauge fitted on the delivery side in accordance with the section dealing with the measurement of fluid/flow properties.

Complete overhauling of compressors shall be possible without causing damage to the pipework.

Metal lubrication instruction plates shall be attached to the compressor where they are clearly visible. The plates shall indicate the recommended lubricant, points of lubrication and the recommended frequency of lubrication.

All housings or casings containing oil shall have some form of convenient oil-level indication (dipstick or window), accessible filler and drain and breather plugs.

Compressors with journal bearings shall have forced lubrication to all journals. Oil shall be pumped by a gear pump through an externally-cleaned micro element filter. Ball or roller bearings shall have a minimum L_{10h} , basic life rating of 25 000 hours at the rated load and speed unless specified to the contrary in the detail specification.

Air cooled compressors are preferred, but if the specifications should dictate the use of water cooling, forced water cooling (by pump) shall be used.

Effective air filters requiring minimal maintenance shall be fitted as close as possible to the inlet flange. General purpose protection (GPP) to eliminate excessive contamination by solids or oil will normally suffice. However, for instrument air, oil-free protection (OFP) is required.

22.5.2 Rotary compressors

a) Rotary compressors are defined to include the following types:

- i) Eccentric, vane-type
- ii) Roots, lobed-type
- iii) Twin screw-type
- iv) Single screw-type
- v) Liquid ring-type

b) Roots or lobed-type compressors/blowers:

Roots-type compressors are preferred for low pressure, high flow applications.

The casings shall be manufactured from cast iron and the impeller shafts from high quality stainless steel. The lobes shall be manufactured from wear and temperature-resistant material.

No lubrication shall be necessary in the compression chambers, with air gaps and clearances between lobes being maintained by means of precision-ground, hardened-steel timing gears. The gearbox shall be isolated from the compression chamber and splash lubrication will suffice.

Bearings on the gear case end of the blower may be splash-lubricated, but the bearings on the opposite end shall be grease-lubricated and grease nipples shall be provided.

Roots-type blowers absorbing more than 50 kW shall have probes fitted to detect excessive closure of the working clearances inside the blower (which could be caused by overload). Should this happen, the prime mover shall shut down automatically to prevent seizure of the blower.

Unless otherwise specified, the blower shall have top air-inlet and bottom air-discharge with a right hand shaft rotating in a clockwise direction.

c) Eccentric, vane compressors:

The contractor shall supply eccentric vane type compressors such as those manufactured by Hydrovane or an equivalent with regard to manufacturing quality, delivery air cleanliness, noise levels and efficiency.

Vane type compressors shall be directly driven through a flexible coupling and the electric motor shall be flange mounted to the compressor body.

Oil circulation by means of differential air pressure is preferred to pump driven systems.

An oil cooler shall be fitted to compressors with motors rated above 10 kW.

The oil change interval shall not be less than 1 500 hours of running time.

The delivery air shall not contain more than 5 parts of oil per million by weight. The contractor shall supply and install the necessary filters or draw-off facilities to achieve this at no additional compensation.

The rotational speed of the compressor shall not exceed 1 500 rpm without prior approval from the engineer.

Except for the air filter, oil and oil seals to be replaced during routine maintenance, the compressor shall have a service life of at least 100 000 hours.

22.5.3 Reciprocating compressors

V-belts may be used to drive reciprocating compressors, but provision must be made for the additional loading of the drive-end bearing.

Bearings shall be white metal-type journal bearings, both on the crankshaft main journals as well as the connecting rod.

The crankshaft shall be fully counter-balanced and shall be supported by at least three main bearings.

Cylinder-heads shall be adequately lubricated and cooling shall be generously allowed for, whether it be air or water-cooled.

All valves shall be of the frictionless multiport plate-type of proven reliability, providing low air speed with minimum pressure loss and turbulence.

If 100% oil free air is required by the application, carbon filled PTFE rings shall be used in conjunction with a "distance piece" fitted with at least two sealing glands to ensure that the section of the rod entering the cylinder does not enter the crankcase. Because of increased corrosion problems in the cylinder, oil-free compressors shall be fitted with an extra large moisture separator before the inlet port. Rust-resistant austenitic liners shall be used.

The lubrication oil for cylinders of double-acting compressors shall be pressure-fed from a pump separate from the lubrication pump for the running gear.

Fusible plugs and safety valves shall be fitted to each stage of the compressors together with a fusible plug on the delivery pipe from the compressor and positioned within 300 mm from the delivery flange.

22.5.4 Compressors other than roots vane type or reciprocating compressors

Full details shall be submitted for evaluation at tender stage together with the tender documents.

22.6 PROTECTION DEVICES

In addition to the protection and safety devices specified above for each type of compressor, the following shall be installed where applicable:

- a) All positive displacement compressors/blowers shall have high pressure trip switches fitted to the delivery line.
- b) A low-oil pressure switch.
- c) A high delivered-air temperature thermal trip shall be fitted to all reciprocating compressors.
- d) For water-cooled compressors, a water-circulating failure trip switch.
- e) For oil-cooled compressors, a high oil-temperature thermal trip.

22.7 INSTALLATION

The compressor shall be installed in accordance with the manufacturer's instruction and shall be maintained in "as new" condition at start up.

The compressor shall be installed on a steel and concrete base and shall be levelled.

The compressor and electric motor shall be aligned to within 0,05 mm for compressors rated in excess of 50 kW, and to within 0,25 mm for compressors rated below 50 kW, both radially and directionally, to avoid vibration, and shall be bolted to the base.

The required unobstructed space left around the installation for maintenance and servicing of the equipment shall be in accordance with the manufacturer's instructions, local authority by-laws and with the Occupational Health and Safety Act, Oct 85 of 1993.

The compressor and electric motor shall be mounted on a combination base plate of fabricated steel construction or cast iron. Machined facings shall be provided to receive the equipment.

The base plate shall be bolted down onto a concrete base. The concrete base will be constructed by others. Detailed drawings of the combination bases including their exact positions in buildings shall be submitted to the engineer for approval before fabrication is commenced.

The contractor shall supply the required holding down or mounting bolts to be grouted into the plinth pockets by others. The contractor shall be responsible for the grouting of the base plates/frames.

The tenderer shall submit details with regard to the required plinth sizes and civil requirements in order to install the equipment.

The compressor shall be truly aligned with the motor and at least two dowel pins shall be installed in the base plate to facilitate further alignment.

The contractor shall be responsible for the rectification of any excessive noise and/or vibration caused by the operation of the compressor installation.

If required by the compressor manufacturer, or excessive vibration can be expected, vibration isolating mountings shall be installed in accordance with the manufacturer's instructions. However, the contractor shall be responsible to ensure that the amplitude of motion and vibration transmission will not exceed the specified limits. Details with regard to vibration isolating mountings shall be submitted at tender stage.

22.8 TESTING AND COMMISSIONING

Testing and commissioning shall be performed in accordance with that of the total compressing system as per the standard specification on testing and commissioning. Compressors will not be accepted if they do not function with the components specified in the section dealing with compressing plant as a complete system.

22.9 MEASUREMENT AND PAYMENT

Item	Description	Unit
22.9.1	Supply and delivery of gas compressing equipment	No

The unit of measurement shall be the number of gas compressing installations supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading including all handling of the complete compressor/blower unit which shall include the following:

1. The compressor/blower unit,
2. The required prime mover (electric motor unless otherwise specified in the detail specification),
3. Power transmission coupling,
4. All safety guards,
5. Pressure ports and all required bleeding or drainage valves,
6. Pressure gauges,

7. Base frame, onto which the above shall be mounted, and
8. All required fasteners and auxiliary materials to render a complete and operational pump unit.

Separate items will be scheduled in the schedule of quantities for different types and sizes of gas compressing pumping equipment.

Item	Description	Unit
22.9.2	Installation of gas compressing equipment	No

The unit of measurement shall be the number of gas compressing installations installed.

The tendered rate shall include full compensation for the site handling and positioning of the gas compressing equipment including the fastening of the equipment in its designated position, including full compensation for the following:

1. Alignment of prime mover and compressor/blower unit, if the unit was shop assembled the correct alignment shall never the less be proved on site.
2. Piping of all condensate draw-off drains to a suitable building drain.
3. Coupling of all required pipe flanges including all required gaskets, nuts, bolts and washers.
4. All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be scheduled in the schedule of quantities for different types and sizes of gas compressing equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the compressing equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the engineer.

Item	Description	Unit
22.9.3	Testing and commissioning of gas compressing equipment	No

The unit of measurement shall be the number of gas compressing installations tested and commissioned.

The tendered rates shall include full compensation for all preliminary and other tests required by the detail specification and commissioning tests. The commissioning tests shall include the day-01 and day-30 test sessions as well as the 30-day monitoring period as described in the section dealing with testing and commissioning.

Separate items will be scheduled in the schedule of quantities for different types and sizes of gas compressing pumping equipment.

SECTION 23: MECHANICALLY CLEANED MICRO CHANNEL SCREEN

DOCUMENT NO.: STD-LRM-MM-0027

CONTENTS

NO TABLE OF CONTENTS ENTRIES FOUND.

23.1 SCOPE

This specification covers the design, performance, manufacturing, supply and delivery to site, installation, testing, adjustment, commissioning and handing over in complete working order and upholding during the Defects Liability period of micro channel screens to be supplied under the contract.

23.2 STANDARDS

23.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[232]	SANS 10400	National Building Regulations
[233]	BS PD 5304	Guidance on safe use of machinery
[234]	SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
[235]	SANS 10104	Hand railing and balustrading (safety aspects)
[236]	SANS 10064	The preparation of steel surfaces for coating
[237]	SANS 10104	Hand railing and balustrading (safety aspects)
[238]	SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs
[239]	SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
[240]	SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress
[241]	DIN 8165	Conveyor chains with solid pins and attachments - Type FV
[242]	DIN 112 000	

23.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[243]	STD-LRM-GN-0004	General Design
[244]	STD-LRM-GN-0005	Testing and commissioning
[245]	STD-LRM-GN-0006	Corrosion protection
[246]	STD-LRM-CC-0001	Civil Engineering Work
[247]	STD-LRM-GN-0007	Structural Metal Work
[248]	STD-LRM-MM-0008	Electric Motors

[249] STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
[250] STD-LRM-MM-0020	Power Transmission Couplings
[251] STD-LRM-MM-0021	Gear Boxes

23.3 GENERAL REQUIREMENTS

Screens shall be designed with due consideration of the following requirements:

- a) To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- b) Ensure safe and satisfactory operation for an acceptable life expectation of 12 years under the ambient conditions prevailing at the Site,
- c) Prevent undue stresses being produced by expansion due to temperature changes.
- d) Keep maintenance costs to a minimum,
- e) To comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- f) To satisfy any specific requirement contained in the statutory codes and legislation, and
- g) Suitable for operation 365 days per year, 24 hours per day under specified design conditions.

The design loads of the screenings for the head of works screens shall be based on the influent sewage characteristics at the particular wastewater treatment works. The peak screening load shall be equal to 5 times that of the average daily load. The average daily screening loading is specified in the Project Specification.

The mechanical screens, must remove all screenings or debris larger than 3 mm in size. The screenings collected against the screen field shall be removed by means of a rake system. These screenings shall be carried by the rakes up the debris plate and discharged at the back end of the screen by the scraper bar into the discharge chute, for further processing.

The screens must be fitted with a single motor-gearbox drive mechanism.

The screens shall be fitted with a differential level system, so that the waste water at the upstream and downstream sides of the screens can be set to determine the frequency at which the rakes pass over the screenfield. Under normal operating conditions the controller (be it a PLC or differential level controller) ensures that the screen is operated intermittently, based on timers set for raking and standing.

The inflow channel shall not be divided into more than two channels at any division of a channel to maintain the minimum required inlet flow velocity. No fewer than two screens shall be in parallel.

The straight length of channel ahead of the screens shall not be less than 5 times the width of the approach channel unless site constraints prevent this arrangement.

The screen field bars shall be accurately set and secured to give the maximum clearance between bars as specified in the detail specification. The screen bars shall be manufactured from bars that have a tapered cross section.

The maximum velocity through the screen opening shall be 1,2 m/s.

The minimum approach velocity shall be 0,6 m/s

23.4 MATERIAL

The screen shall be manufacture using 304 L stainless steel or as specified in the Project Specification.

23.5 FRAME

The frame shall be formed entirely from 4,5 mm thick 304 stainless steel plate and shall be recessed to accommodate the scraping mechanism, chain guides and idler sprockets in order to maintain the full channel width and depth through the plane of the screen. The screen housing shall be fitted with rubber skirt and stainless steel diversion plates, ensuring and accommodating the total channel width detailed.

The frame shall be accurately set into position into the necessary recesses in the channel walls and invert and shall be grouted securely into place. Fixing bolts shall not be used.

The screen shall be set at 50 - 60 degree to the horizontal unless detailed otherwise elsewhere.

The frame shall be fully welded to the sole plate, the screen plane and the rear screenings retention plate. It shall also be fully welded to the head plate, the discharge chute and the closure plate between the underside of the discharge chute and the top channel. At the upstream face of the unit, box section cross members shall be securely welded to the side members of the frame at regular intervals between a point above the maximum top water level and the head of the screen. These cross members shall form the supports for removable cover panels.

At the upstream face of the unit, box-section cross-members shall be securely welded to the side members of the frame at regular intervals between a point above the maximum water level and the head of the screen. These cross-members shall form the supports for removable stainless steel grade 304L cover panels.

23.6 SAFETY / INSPECTION COVERS

All screen operating mechanisms and frame superstructure above the concrete level shall be completely clad in stainless steel cladding. Sufficient wind deflection shielding shall be provided to prevent light screening (e.g. paper and plastic) from being blown off the screen. Removable panels shall be provided wherever access is required for routine maintenance and/or repairs.

All covers must prevent any fluids from escaping, and must be manufactured in stainless steel. These covers will be water tight and bolted down.

23.7 ACCESS

The screens shall be provided with suitably designed 3CR12 hand railings and deck gratings which shall provide access to the screens for repair and maintenance.

23.8 SCREEN FIELD

The screen field shall be accurately set and secured to give the clearance between the wedge wires detailed in the detail specification.

23.9 SOLE PLATE

The screening field shall be provided with a sole plate.

The sole plate shall be profiled to induce screening and debris in the lower level of the flow to be directed onto the lower portion of the screen field and not to accumulate at the foot of the screen.

The leading edge of the sole plate shall be installed at the invert level of the receiving channel.

23.10 RAKING MECHANISM

Raking tynes shall be formed from single continuous brush/rubber strips of sufficient depth to ensure complete purging of waste across the full width of the screen field. The rake shall have a minimum thickness of 4,5mm and shall have tynes of the appropriate brush profile to suit the screen field. The brush tyne shall be bolted with counter sunk bolts to the main rake frames.

A facility shall be incorporated within the drive mechanism mounting arrangement to enable the scraping mechanism drive chains to be correctly tensioned and the raking bars to be accurately positioned across the screen field face. Such adjustments shall be possible without the dismantling of any part of the screen frame and without the necessity for any special tools.

The raking mechanism shall consist of multiple raking bars which shall restrict the headloss to a maximum of 250 mm at peak flow.

23.11 CLEANING MECHANISM

The cleaning mechanism shall comprise a single bar/plate, which shall engage each raking bar as it raises above the upper edge of the screening retention plate.

The scraper bar shall be fabricated and mounted so that it efficiently cleans the full width of each raking bar. The bearing for the scraper bar shall be self-lubricating.

23.12 CHAINS, GUIDES AND SPROCKETS

The chains connecting the rake frames to be to DIN 8165, Type FV112 with a breaking load according to DIN of 112 000 N or equal. The top drive system is driven through the specified gearbox and motor which in turn drive the two FV112 stainless steel sprockets, which are press fitted onto a stainless steel drive shaft, with the correct key way sizing.

The bottom chain support will be through stationary UHDPE turnabout system.

A mechanism shall be incorporated within the drive mechanism to enable the drive chains to be correctly tensioned, and the rake to be accurately positioned across the screen field face. This adjustment shall be possible without the dismantling of any part of the screen frame and without the necessity for any special tools.

23.13 DISCHARGE CHUTE

The discharge chute shall be set to guide all the screenings removed by the screen as efficiently as possible onto the screenings handling system.

The chute shall form an integral part of the screen. The discharge point of the screenings outlet shall be at least 1,5 m above the top of the platform of the structure housing the screen to allow for a screenings conveying system to be installed on the platform next to the screen.

23.14 DRIVE UNIT

The drive unit will be a Helical geared hollow shaft type, shaft mounted gearbox to accommodate the drive shaft. A torque arm will be attached to the drive unit to accommodate vertical adjustment and shall be fitted with an mechanical adjustable torque limiting switch.

The gearbox shall be selected for continuous operation 24 hours per day. The gearbox shall have a AGMA service factor of at least 2 on installed power and shall comply with the requirements of the standard specification on Gear Boxes [251]. The thermal power ratings shall be based on an ambient temperature of 40°C.

The drive motor shall comply with the requirements of the standard specification on Electric Motors [248] and shall have a minimum efficiency rating of IE3 or better.

Each drive unit shall be fitted with a nameplate showing at least the following information:

- a) Gearbox type or model number;
- b) Serial number;
- c) AGMA rating;
- d) Nominal reduction ratio

- e) Approximate oil quantity required.
- f) The electrical motor shall have a nameplate conforming with the requirements as set out in the standard specification on Electric Motors [248]

23.15 CORROSION PROTECTION

Corrosion protection must be carried out strictly in accordance with the requirements of the standard specification on Corrosion Protection [245].

23.16 TESTING AND COMMISSIONING

The Engineer shall witness a simulated test run of the equipment in the Contractor or supplier's workshop before delivery to site.

Site performance tests shall be undertaken to demonstrate the efficiency equipment.

23.17 INSTALLATION

Holding down bolts which are to be built into concrete work for securing the plant shall be grade 316 stainless steel and shall be supplied and installed under this section of the Contract. Grouting up of these bolts will be done by a suitable sub-contractor appointed by the Contractor, after completion of setting up of the plant by the Contractor under this Contract.

23.18 MAINTENANCE, SPARES AND REFURBISHMENT

The screening equipment shall be fully capable of being maintained by a local (South African) company that has experience in manufacturing and maintaining of screening equipment.

The design and assembling methods employed during manufacturing of the screen shall be such that refurbishment can be performed timeously, without the necessity of replacing the major structural components of the unit.

23.19 SPARE PARTS

The following Spare Parts shall be included and supplied together with the equipment:

- 4 off set of rake plates
- 4 off set of drive chains
- 4 off master links
- 1 off scraper blade

Spare parts shall be packaged with labels indicating the contents of each package, and shall be delivered to Employer as directed

23.20 ELECTRICAL CONTROL

Unless specified to the contrary, the electrical control equipment required for the screen shall be incorporated in the plant Motor Control Centre (MCC) for the plant area and shall be supplied as part of the MCC.

The screen supplier shall provide the Engineer with his detailed requirements for the control to be incorporated in the MCC within 14 days after the tender has been awarded.

The screen shall be provided with an Electrical interface panel to which all electrical connections shall be terminated on a suitable terminal rail. A clear interface document shall be provided to the electrical contractor detailing the connection required.

The control of the screen shall contain the following minimum requirements:

- a) A current sensing overload device with a built-in intelligent control facility shall be incorporated within the screen starter compartment in the motor control centre. The device shall have the facility to be able to reverse the direction of travel of the scraping mechanism, should a blockage occur on the screen and cause the overload device to trip the normal operation of the screen.
- b) The device shall have the additional facility to enable this reversing action to be affected twice for any one occurrence, before tripping the alarm. Further, the device shall either re-set automatically if the blockage causing the initial overload conditions is cleared, or should the blockage remain upon the completion of the second attempt at automatic clearance, an alarm shall be generated.
- c) The control of the screen shall provide for time switches (adjustable anywhere from zero and 60 minutes for selection of frequency cycles and adjustable between zero and 30 minutes for selection of duration of operation per cycle), water differential control equipment starter with overload and single phasing protection of three phase motors and stop/start push buttons for manual operation as an alternative to automatic operation.
- d) The screen, conveyor and press system shall be interlocked by the field mounted switch panel. The screen must be provided with an interlock overriding mechanism to ensure that the screen continues to operate during failure of the press, screenings conveyor and associated equipment.

23.21 MEASUREMENT AND PAYMENT.

Item	Description	Unit
23.21.1	Supply and delivery of Mechanically Cleaned Micro channel screen	No

The unit of measurement shall be the number of identical Mechanically Cleaned Micro channel screens supplied and delivered as specified or shown on the drawings.

Separate items shall be scheduled for different screen sizes and aperture openings.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each mechanically raked screen as specified with all appurtenances.

Item	Description	Unit
23.21.2	Installation, testing and commissioning of Mechanically Cleaned Micro channel screen	No

The unit of measurement shall be the number of identical Mechanically Cleaned Micro channel screen installed, tested and commissioned as specified or shown on the drawings.

Separate items shall be scheduled for different screen sizes and aperture openings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete mechanically raked screen; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

SECTION 24: MECHANICAL DEGRITTER SYSTEMS

DOCUMENT NO.: STD-LRM-MM-0023

CONTENTS

24.1	SCOPE	654
24.2	STANDARDS.....	654
24.3	GENERAL REQUIREMENTS.....	655
24.4	DESIGN CRITERIA	655
24.5	AIR LIFT SYSTEM.....	656
24.6	GRIT CLASSIFIERS.....	658
24.7	CORROSION PROTECTION	660
24.8	INSTALLATION	660
24.9	MAINTENANCE, SPARES AND REFURBISHMENT	660
24.10	ELECTRICAL CONTROL	660
24.11	MEASUREMENT AND PAYMENT.....	660

24.1 SCOPE

This specification covers the design, performance, manufacturing, supply and delivery to site, installation, testing, adjustment and commissioning of degritter systems to be supplied under the contract.

24.2 STANDARDS

24.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[252]	SANS 10400	National Building Regulations
[253]	BS PD 5304	Guidance on safe use of machinery
[254]	SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
[255]	SANS 10104	Hand railing and balustrading (safety aspects)
[256]	SANS 10064	The preparation of steel surfaces for coating
[257]	SANS 10104	Hand railing and balustrading (safety aspects)
[258]	SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs
[259]	SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
[260]	SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress

24.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[261]	STD-LRM-GN-0004	General Design
[262]	STD-LRM-GN-0005	Testing and commissioning
[263]	STD-LRM-GN-0006	Corrosion protection
[264]	STD-LRM-CC-0001	Civil Engineering Work
[265]	STD-LRM-GN-0007	Structural Metal Work
[266]	STD-LRM-MM-0008	Electric Motors
[267]	STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
[268]	STD-LRM-MM-0020	Power Transmission Couplings
[269]	STD-LRM-MM-0021	Gear Boxes
[270]	STD-LRM-MM-0028	Screenings Handling Equipment

24.3 GENERAL REQUIREMENTS

Mechanical grit removal systems shall be designed with due consideration of the following requirements:

- To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- Ensure safe and satisfactory operation for an acceptable life expectation of 12 years under the ambient conditions prevailing at the Site,
- Prevent undue stresses being introduced due to expansion as a result of temperature changes.
- Keep maintenance costs to a minimum,
- To comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- To satisfy any specific requirement contained in the statutory codes and legislation, and
- Suitable for operation 365 days per year, 24 hours per day under specified design conditions.

The removal of grit from the wastewater prevents grit deposits in pipelines, pump sumps and channels, unnecessary abrasion and wear of mechanical equipment and the accumulation of grit in anaerobic digesters and aeration basins.

Degritters shall be provided downstream of bar screens.

24.4 DESIGN CRITERIA

Degritters shall be designed to remove particles having a nominal diameter equal to or greater than 0,2 mm and a specific gravity of 2,65 and a settling velocity of 25mm/sec. The detention time of the particles shall be in the range of 2 - 5 minutes at peak hourly flow.

The degritters shall be designed to operate continuously and in such a way that the tangential inlet creates a rotary motion to the tank contents of such a velocity that the grit particles tend to settle out whilst leaving the organic particles in suspension.

24.4.1 Grit Chamber

The grit chamber shall be a conical vortex chamber. The particles and water move at the same velocity as they enter the chamber tangentially, creating a vortex flow pattern. The tangential inflow along the peripheral wall of the chamber assists in the grit removal process and results in additional head losses.

The grit settles by gravity and the effluent exists at the top of the tank. The grit chamber shall be designed to create an updraft at the centre of the chamber. This updraft draws the slurry across the tank bottom toward the centre where the grit falls into the hopper. The grit in the hopper is then removed by an airlift pump.

The grit chamber shall be covered to contain odours and all equipment that requires maintenance must be mounted outside of the covers and be easily assessable for maintenance purposes.

To get the maximum amount of grit collection in the hopper, a sloping bottom design shall be used.

In a sloping bottom design the grit flow follows a 270° path before leaving the chamber. This ensures that no short-circuiting occurs. The combination of the conical and circular shapes incorporated in the sloped design result in a considerable reduction of flow turbulence due to the natural vortex and the gravity forces in the chamber.

The resulting flow pattern results in efficient separation of the grit from the organic solids.

24.4.2 Walkways

Walkways and bridges access with handrails and landings to the grit removal systems shall be supplied, and shall not be obstructed with pipelines or cables. The access system shall be manufactured from 3CR12.

24.4.3 Welds and Fasteners

All stainless steel metals are to be welded together unless otherwise stipulated. All welds are to be in accordance with SANS 10044. All submerged fasteners shall be 316 SS and mating flanges shall be sealed against the ingress of any crevice corrosion by means of a sealant suitable for underwater conditions and approved by the Engineer.

24.4.4 Inlet Channels

The straight inlet length of the channel is typically seven times the width of the inlet channel or 4.6 m, whichever is greater. The ideal velocity range of influent is 0.6 to 0.9 m/s at 40 - 80% of the peak flow. A minimum velocity of 0.15 m/s should be maintained at all times to ensure that the grit is carried into the grit chamber.

Turbulent flow must be kept to a minimum when designing the approach channels as well as the inlet and outlet devices.

The heavier solids collect in the grit hopper and the lighter solids are retained in the water flow. The slurry is then separated into the basic components of water, organics and grit through the grit washing and dewatering process.

Grit removal from the chamber to the dewatering process shall be by an air lift system. The removal of grit shall be controlled on a timer basis.

24.5 AIR LIFT SYSTEM

24.5.1 Overview

The grit that accumulates in the grit hopper of the vortex degritter shall be removed by means of an air lift pump system consisting of:

- a) A high pressure air sparge system to loosen the accumulated grit before removing it.
- b) A fluidisation and wash system to fluidise the accumulated grit and wash any organics out of the grit
- c) An air lift pump system to pump the grit out of the grit hopper to a grit wash and classification system.

24.5.2 Air Sparge system

To loosen the accumulated grit air at high pressure shall be injected into the bottom of the grit hopper to fluidise the grit and help with the removal of organic material that may be trapped in the grit.

The air injection shall be controlled on a timer basis in conjunction with the water washing and airlift operation.

The high pressure air shall be obtained from a duty and standby compressors forming part of the degritting system. The compressors shall conform to the following requirements:

- a) The compressors offered shall be of the reciprocating type, of robust design, and applicable for industrial applications.
- b) The system shall be supplied with a central air receiver with a capacity sufficient for 4 times the combined air requirement of the total degritting system.
- c) The compressors can either be arranged as a duty and standby (i.e. 100% standby capacity, or three compressors two duty and 1 standby (i.e. 50% standby capacity).
- d) The compressors shall be rated for continuous operation of least 168 hours between servicing and maintenance checks .
- e) Pressure switches shall be provided to switch the compressors on and off as per the air requirements demand.
- f) The air supplied from the compressors shall be dried to prevent moisture build up in the air supply pipework. The air shall also be filtered in order to limit the oil content of the air to less than 0,5 mg/l. A duplicate air drier and filter system shall be provided in parallel to ensure that the units can be serviced without shutting down the system.
- g) Oil level sensors shall be provided in order to prevent the compressor from malfunctioning. It is a requirement of this specification that this malfunction in operation be reflected on the works SCADA system. For this purpose a potential free contact capable of switching 500 mA at 230 Volts AC shall be provided.
- h) The air reservoirs shall be drained automatically from the bottom at regular intervals to prevent the accumulation of water in the reservoir.
- i) Potential free contacts capable of switching 500 mA at 230 Volts AC shall be provided for the following interface signals to a PLC/SCADA system:
 - i) Compressor Running
 - ii) Low pressure in the air receiver
 - iii) Compressor fault of a general nature.
- j) The compressor shall noise output shall not exceed 85dB A at 1m distance from the compressor.

24.5.3 Wash water system

The required wash water shall be abstracted by means of dedicated washwater pumps. The abstraction point shall be downstream of the degritters.

The wash water system shall conform with the requirements of the wash water system described in the standard specification on Screenings Handling Equipment [270]. Should it screenings wash water system be required for the project and it is possible to combine the wash water systems into a single system – this would be preferred.

24.5.4 Air Lift Pump

After loosening the grit by air sparging and fluidising the grit by means of the wash water system, the grit shall be pumped out of the vortex degritter by means of a air lift pump.

The motive power for the air lift pumps shall be obtained from a roots type blower conforming to the following requirements:

- a) Blowers shall be of the positive displacement lobe type (roots type) and controlled by frequency converters.
- b) There shall be a duty and standby blower per vortex degritter. The duty shall alternate after each duty cycle.
- c) The blowers shall be provided with silencer at inlet and outlet.
- d) The blowers shall be installed in an acoustic enclosure. Noise level shall not exceed 22 dBA 1m away from the blower acoustic enclosure.
- e) The acoustic enclosure shall permit easy dismantling and mounting for maintenance and repair and if necessary shall be equipped with internal ventilation.
- f) The speed of blower shall not exceed 3600 rpm.
- g) The unit shall be equipped with a panel-mounted:
 - iv) filter restriction gauge,
 - v) pressure gauges on suction and discharge side and discharge temperature gauge
- h) Each blower shall be provided with all necessary instrumentation and valves such as:
 - vi) check-valves,
 - vii) blow-off valves,
 - viii) shut-off valves and
 - ix) a flexible connection to the pressure manifold.

24.5.5 Air Lift Pump Pipework

Pipes shall be designed to prevent possible damages to the pipes or concrete caused by vibrations and thermal expansions.

Distribution pipes shall be made of stainless steel grade 316L.

The pipes shall be designed for a maximum air velocity (Nm³) of 14 m/sec at maximum delivery.

The air lift pump shall discharge directly into the Grit Classifier.

24.6 GRIT CLASSIFIERS

24.6.1 Description of Operation

Water, grit and air will be discharged into the grit-receiving reservoir.

The grit removed from the grit removal system requires washing in order to reduce the odour of the grit removed.

The grit washing system shall have the following characteristics:

- a) Wash the grit to removal organic material at an efficiency removal better than 95%.
- b) Washed grit shall not have more than 5% organic material after washing and dewatering
- c) Overflow from the grit washing system shall have a grit content of no more than 5% and shall flow by gravity back to the inlet of the vortex degritter.

The grit washer shall comprise of a primary settling zone (concentrator) and a grit classifier. The primary settling zone separates the lighter substances and excess water from the grit, while the screw classifier further dewateres the grit and carries it to disposal.

The classifier shall be provided with an inclined grit washing-dewatering screw. The grit must be conveyed from the bottom of the hopper by a centreless spiral screw conveyor, washing the grit below the water level in the basin and dewatering the grit efficiently along the remainder of the inclined conveyor. The conveyor must deposit the dewatered grit into a container. The discharge level must be at least 2,0 m above the ground level. It is essential that the grit and organic matter is separated effectively to ensure minimal contamination of the classified grit.

24.6.2 Centreless Screw Conveyor

The centreless spiral shall be manufactured of continuous high tensile steel flat bar, cold formed into a strong, flexible spiral. The centreless spirals shall be cold formed to extremely accurate diameter and spiral pitch. The spiral flights shall have a width of at least 70 mm and a thickness of not less than 10 mm.

The centreless spiral is flanged at the drive end and bolted to the flanged drive shaft to facilitate ease of maintenance.

The spiral conveyor shall be designed such that all silt and fine material shall be positively removed.

The classifier shall be of robust construction. The screw trough, the steel pipe with the steel flight and the access chute shall be constructed of 4,5 mm thick, stainless steel grade 304L. The screw flight shall be manufactured from 4,5 mm thick grade 304 stainless steel.

The helix of the screw classifier shall be welded to the tubular shaft to form a smooth and continuous flight with its outer edges ground to an accurately cylindrical shape. The flights shall be accurately positioned and shall be at right angles to the tube axis at all points.

The tube shaft shall be manufactured from a single piece of tubing having a longitudinal seam. The tube must be straight and cylindrical over its entire length and shall be free of irregularities. End plates shall be firmly welded to the tube to form a water and airtight container. The end plates shall be machined to provide a surface perpendicular to the longitudinal axis of the screw. Axes of the stub axles attached to the endplates must be exactly concentric to the axis of the screw.

The finished screw shall be tested for shaft alignment and centricity before being dispatched to Site.

The entire drive assembly including reducer must be enclosed and the enclosure shall be of stainless steel grade 304 sheeting 3 mm thick and shall be equipped with inspection facilities to provide access to moving parts for maintenance.

The screw classifier shall be capable of discharging at least 1m³ of grit per hour.

The grit screw classifier motor shall be interlocked with the grit removal pumps in such a way that the classifier is activated when any of the grit removal pumps are activated. Furthermore, the classifier shall remain activated for a sufficient amount of time to allow passage of the grit through the classifier.

The supply and installation of motor control switchgear, local stop/start station and cables shall form part of a separate electrical installation Contract. Any special requirements of the Contractor completing this contract shall be specifically identified e.g. type of motor starting required etc.

24.6.3 DRIVE UNIT

The drive unit shall be of the Helical geared hollow shaft type, shaft mounted gearbox to accommodate the drive shaft. A torque arm will be attached to the drive unit to accommodate vertical adjustment and shall be fitted with an mechanical adjustable torque limiting switch.

The gearbox shall be selected for continuous operation 24 hours per day. The gearbox shall have a AGMA service factor of at least 2 on installed power and shall comply with the requirements of the standard specification on Gear Boxes [269]. Thermal power ratings shall be based on an ambient temperature of 40°C.

The drive motor shall comply with the requirements of the standard specification on Electric Motors [266] and shall have a minimum IE3 or better efficiency rating.

Each drive unit shall be fitted with a nameplate showing at least the following information:

- a) Gearbox type or model number;
- b) Serial number;
- c) AGMA rating;
- d) Nominal reduction ratio
- e) Approximate oil quantity required.
- f) The electrical motor shall have a nameplate conforming with the requirements as set out in the standard specification on Electric Motors [266]

24.7 CORROSION PROTECTION

Corrosion protection must be carried out strictly in accordance with the requirements of the Standard specification on Corrosion Protection [263].

24.8 INSTALLATION

Holding down bolts which are to be built into concrete work for securing the plant shall be grade 316 stainless steel and shall be supplied and installed under this section of the Contract. Grouting up of these bolts will be done by a suitable sub-contractor appointed by the Contractor, after completion of setting up of the plant by the Contractor under this Contract.

24.9 MAINTENANCE, SPARES AND REFURBISHMENT

The design and assembling methods employed during manufacturing of the equipment shall be such that refurbishment can be performed timeously, without the necessity of replacing the major structural components of the unit.

24.10 ELECTRICAL CONTROL

Unless specified to the contrary, the electrical control equipment required for the equipment specified in this standard specification shall be incorporated in the plant Motor Control Centre (MCC) for the plant area and shall be supplied as part of the MCC.

The equipment supplier shall provide the Engineer with his detailed requirements for the control to be incorporated in the MCC within 14 days after the tender has been awarded.

The equipment shall be provided with an Electrical interface panel to which all electrical connections shall be terminated on a suitable terminal rail. A clear interface document shall be provided to the electrical contractor detailing the connection required.

24.11 MEASUREMENT AND PAYMENT.

Item	Description	Unit

24.11.1	Supply and delivery of Airlift grit pumping system	No

The unit of measurement shall be the number of Airlift grit pumping systems supplied and delivered as specified or shown on the drawings.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each Airlift pumping system complete with all pumps, compressors, blowers, pipework, etc to render a complete and working airlift pumping system.

Item	Description	Unit

24.11.2	Installation, testing and commissioning of Airlift grit pumping system	No

The unit of measurement shall be the number of Airlift grit pumping systems installed, tested and commissioned as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete Airlift grit pumping system; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Item	Description	Unit

24.11.3	Supply and delivery of Grit Classifier	No

The unit of measurement shall be the number of Grit Classifiers supplied and delivered as specified or shown on the drawings.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each Grit Classifier system complete with all equipment necessary to render a complete and working Grit Classifier.

Item	Description	Unit

24.11.4	Installation, testing and commissioning of Grit Classifier	No

The unit of measurement shall be the number of Grit Classifiers installed, tested and commissioned as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete Grit Classifier system; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

SECTION 25: SCREENINGS HANDLING EQUIPMENT

DOCUMENT NO.: STD-LRM-MM-0028

CONTENTS

25.1	SCOPE	662
25.2	STANDARDS.....	662
25.3	GENERAL REQUIREMENTS.....	663
25.4	MATERIAL.....	663
25.5	CORROSION PROTECTION	663
25.6	SCREENINGS HYDRO CONVEYOR	663
25.7	WASH WATER SYSTEM	664
25.8	SCREENING WASTE WASHER COMPACTOR	665
25.9	INSTALLATION	667
25.10	MAINTENANCE, SPARES AND REFURBISHMENT	667
25.11	MEASUREMENT AND PAYMENT.....	667

25.1 SCOPE

This specification covers the design, performance, manufacturing, supply and delivery to site, installation, testing, adjustment and commissioning of the Screenings Handling Equipment to be supplied under the contract.

25.2 STANDARDS

25.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 10400	National Building Regulations
BS PD 5304	Guidance on safe use of machinery
SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
SANS 10104	Hand railing and balustrading (safety aspects)
SANS 10064	The preparation of steel surfaces for coating
SANS 10104	Hand railing and balustrading (safety aspects)
SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs
SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless- steel fasteners - Set screws and similar fasteners not under tensile stress

25.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

STD-LRM-GN-0004	General Design
STD-LRM-GN-0005	Testing and commissioning
STD-LRM-GN-0006	Corrosion protection
STD-LRM-CC-0001	Civil Engineering Work
STD-LRM-GN-0007	Structural Metal Work
STD-LRM-MM-0008	Electric Motors
STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
STD-LRM-MM-0020	Power Transmission Couplings
STD-LRM-MM-0021	Gear Boxes
STD-LRM-MM-0010	Dry Well Pumping Equipment

25.3 GENERAL REQUIREMENTS

All equipment supplied shall conform to the requirements of the standard specifications - General Design 0, Testing and commissioning and Corrosion protection.

The equipment shall be designed to:

- a) Facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- b) Ensure safe and satisfactory operation for an acceptable life expectation of 12 years under the ambient conditions prevailing at the Site,
- c) Prevent undue stresses being produced by expansion due to temperature changes.
- d) Keep maintenance costs to a minimum,
- e) Comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- f) Satisfy any specific requirement contained in the statutory codes and legislation, and
- g) Be suitable for operation 365 days per year, 24 hours per day under specified design conditions.

25.4 MATERIAL

Unless specified to the contrary all screenings handling equipment shall be manufacture using 304 L stainless steel.

25.5 CORROSION PROTECTION

Corrosion protection must be carried out strictly in accordance with the requirements of the standard specification on Corrosion Protection 0.

25.6 SCREENINGS HYDRO CONVEYOR

25.6.1 Scope

The hydro conveyor for screenings shall consist of the required U-shaped launders to convey screenings from the screen to the screenings washing and compacting plant and shall include the wash water pumps required to provide the motive energy in the launders.

25.6.2 Hydro Conveyor

The hydro conveyor shall be manufactured from grade 304 stainless steel. The launder shall be in a U-shape with a lip on both sides and shall be covered with bolted covers over the full length except where the screenings is introduced into the launder.

The launder shall be supplied in sections of a maximum length of 3m.

The launder shall be supported on purpose made H-shaped grade 304 stainless steel channel sections support legs. The maximum spacing between supports shall be 3000mm. The supports shall be bolted to the launder and the concrete floor by means of suitable stainless steel fasteners.

25.6.3 Installation

- a) The launders shall be run in straight lines and bends will only be allow if approved by the Engineer. Where bens are unavoidable, they shall be long radius bends with a minimum radius of 15x the launder width.
- b) For conveyor lengths up to 10m the slope of the launder shall not be less than 1,6%.
- c) For conveyor lengths of longer than 10m, the slope of the launder shall not be less than 1%.

25.7 WASH WATER SYSTEM

25.7.1 Scope

The motive power for the hydro conveyor and the required wash water for screenings post treatment processes shall be obtained from a dedicated wash water supply and control system.

A single system shall be designed and supplied capable to provide all the required wash water and motive power required for the plant inlet/head of works.

The system shall be adequately sized to provide sufficient motive power to remove the screenings to the downstream screenings handling system and provide for all wash water requirements of the screenings handling systems. Should the plant require wash water at the grit removal system, the wash water required for the grit removal system shall be incorporated into this system.

25.7.2 Design

The contractor shall design and size the system. The system shall at minimum consist of the following:

- a) Two surface mounted drywell self priming wash water pumps, one duty and one standby.
- b) The pumps shall be suitable to pump raw sewage and shall have a solids passing capability of at least 38mm.
- c) The abstraction point shall be downstream of the inlet/head of works screens and grit removal systems as detailed in the detail specification.
- d) The operation of the wash water system shall be linked to the operation of the screens and downstream screenings and grit treatment system to ensure that screenings and grit are removed at regular intervals to negate the creation of nuisance odour conditions. Unless indicated to the contrary in the detail specification, electrical equipment required shall be incorporated into the main MCC supplying the plant area. To facilitate this, the contractor shall provide the electrical supply and control requirements to the electrical contractor/sub contractor within 14 days after being requested for it by the Engineer.
- e) The design shall provide for required flow control devices such as valves, hand stops, weirs, etc. and actuators where applicable.
- f) The contractor shall provide the Engineer with his proposed design in the form of a complete P&ID drawing with control philosophy 14 days after being requested to do so but not more than 30 days after contract award.

25.7.3 Installation

The installation shall include all required pipe work from the pumps to the the required delivery points.

Underground pipe work shall be HDPE with a minimum pressure rating class 10 and all joints shall be welded joints.

All above ground pipe work shall be stainless steel from 500mm after day lighting.

25.8 SCREENING WASTE WASHER COMPACTOR

25.8.1 Introduction

The screening waste washer compactor shall comprise of the following:

- a) Receiving launder tank,
- b) Wash chamber with mechanical agitator to create high intensity washing of the screenings.
- c) Compression chamber.
- d) A conveying and compressing screw.
- e) Discharge chute at least 600mm above the waste skip when placed on a dolly system.
- f) Drainage trough.
- g) Support frame.
- h) Drive assembly, which will provide motive power to the screw.
- i) All wash water pipework and connections including valves and actuators as required.

Additional washing shall be done of the screenings in the compaction and dewatering zone prior to discharge via the discharge chute.

The wash compactor shall be able to accommodate a feed of screenings from either a screw conveyor or hydro conveyor, as stated in the Detail Specification.

The design and assembling methods employed during manufacturing of the compactor shall be such that refurbishment can be performed timeously, without the necessity of replacing the major structural components of the unit.

25.8.2 Operation

The wash compactor shall operate in a batch mode.

Once a batch of screenings has been fed to the receiving launder tank, the tank shall be filled with water from the wash water system (if necessary) and be agitated for an adjustable period by means of an impeller to loosen faecal matter from the screenings by means of turbulence and shear forces.

At the completion of the wash cycle, the waste water will be drained from the wash chamber through discharge pipe by way of regulated motorized ball valve back to the screen channel, upstream of the screen.

Before compaction, remaining organic matter shall be broken down through the action of spray nozzles and the forward and reverse action of the compactor/screw conveyor or other mechanical agitation means.

The washed screening waste will pass to the screw chamber of the press where dewatering will take place.

The washed and dewatered screening waste shall be discharged into the waste skip.

All wash water-return pipework shall form part of this installation.

The screenings washer compactor shall be capable of dewatering and compaction of screenings to a minimum dry solids content of the final product as it leaves the discharge chute of at least 35% dry solids. The washed screenings shall contain a BOD content of less than 20 mgBOD₅ /gDS.

It shall not be necessary for an operator to feed or handle screenings.

25.8.3 Material

All parts, including the screw, shall be manufactured from grade 304 stainless steel.

25.8.4 Drive Units

The agitator drive motor shall be directly coupled to the agitator impeller. The drive motor shall have an IP rating of IP65 or higher.

The drive unit for the screw and the compactor shall be suitably sized with an output speed selected to facilitate the load transported.

The drive units shall be Helical geared hollow shaft type, shaft mounted gear reducers to accommodate the drive shaft. A torque arm shall be attached to the drive unit to accommodate vertical adjustment and shall be fitted with a mechanical adjustable torque limiting switch.

The gear reducers shall be selected for continuous operation 24 hours per day. The gear reducers shall have a AGMA service factor of at least 2 on installed power and shall comply with the requirements of the standard specification on Gear Boxes 0. Thermal power ratings shall be based on an ambient temperature of 40°C.

The drive motor shall comply with the requirements of the standard specification on Electric Motors 0 and shall have a minimum IE3 or better efficiency rating.

Each drive unit shall be fitted with a nameplate showing at least the following information:

- a) Gearbox type or model number;
- b) Serial number;
- c) AGMA rating;
- d) Nominal reduction ratio
- e) Approximate oil quantity required.
- f) The electrical motor shall have a nameplate conforming with the requirements as set out in the Electric Motors 0

The drive motor shall be flanged mounted to the gear reducer, which shall be of the hollow shaft type. The protection rating of the drive unit (motor and gearbox) shall be IP 65 or higher.

The drive unit for the screw shall match the requirements of the press without overloading and shall be situated to allow unimpeded access to the press.

The drive units for the screw and wash impeller shall be isolated from the press area so as to prevent any water leakage into the drive unit.

25.8.5 Safety covers

Safety covers shall be provided to prevent any aerosol and odour from escaping. . The covers shall be water tight and bolted down.

The whole length of the screenings washer compactor shall be provided with a drainage trough which shall accumulate any fluids draining from the unit and transport this back to the inlet channel.

25.8.6 Electrical Control Gear

Unless otherwise specified in the detail specification, the electrical switchgear, control gear, and instrumentation for automatic and manual control of the plant and equipment shall be provided under a separate contract.

The control equipment should make it possible to stop/start the press and protect it against overload, under voltage, single phasing etc.

The Screenings washer compactor supplier shall however provide his detail requirements to the engineer 14 days after contract award.

25.8.7 Control Philosophy

The screenings washer compactor supplier shall provide a detail control philosophy to the Engineer 14 days after contract award.

At minimum, the control philosophy shall make provision for the following:

- a) In the case of overloading, the press must be automatically reversed for a few seconds before commencing a forward motion again. This sequence of reverse and forward operation shall only be allowed to occur three times, after which the press must trip and sound an alarm.
- b) In automatic mode, the operation of the wash compactor shall be interlinked with the operation of the screenings conveyor and associated equipment. It shall be possible to operate the washing compactor in manual mode by adjusting the relevant selector switch.

25.9 INSTALLATION

Holding down bolts which are to be built into concrete work for securing the plant shall be grade 316 stainless steel and shall be supplied and installed under this section of the Contract. Grouting up of these bolts will be done by a suitable sub-contractor appointed by the Contractor, after completion of setting up of the plant by the Contractor under this Contract.

25.10 MAINTENANCE, SPARES AND REFURBISHMENT

The design and assembling methods employed during manufacturing of the equipment specified in the standard specification shall be such that refurbishment can be performed timeously, without the necessity of replacing the major structural components of the unit.

25.11 MEASUREMENT AND PAYMENT.

Item	Description	Unit
25.11.1	Supply and delivery of Screenings Hydro Conveyor	Lump Sum

The unit of measurement shall be a lump sum.

Separate items shall be scheduled for Hydro conveyors from and to different locations.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each hydro conveyor system as specified with all appurtenances.

Item	Description	Unit
25.11.2	Installation, testing and commissioning of Screenings Hydro Conveyor	Lump Sum

The unit of measurement shall be a lump sum.

Separate items shall be scheduled for Hydro conveyors from and to different locations as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete Hydro conveyor; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Item	Description	Unit
25.11.3	Supply and delivery of Wash Water System	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete wash water system as specified with all appurtenances.

Item	Description	Unit
25.11.4	Installation, testing and commissioning of Wash Water System	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete wash water system; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Item	Description	Unit
25.11.5	Supply and delivery of Screenings waste washer compactor	No

The unit of measurement shall be the number of screenings waste washer compactors supplied and delivered.

Separate items will scheduled for screenings from different sources.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete screenings waste washer compactor as specified with all appurtenances.

Item	Description	Unit
25.11.6	Installation, testing and commissioning of Screenings waste washer compactor	No

The unit of measurement shall be the number of screenings waste washer compactors supplied and delivered.

Separate items will scheduled for screenings from different sources.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete screenings waste

washer compactor system; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Item	Description	Unit
25.11.7	Supply and delivery of Capstan Winch	No

The unit of measurement shall be the number of Screenings Capstan Winches supplied and delivered as specified or shown on the drawings.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each Capstan Winch system complete with all equipment necessary to render a complete and working Grit Classifier.

Item	Description	Unit
25.11.8	Installation, testing and commissioning of Capstan Winch	No

The unit of measurement shall be the number of Screenings Capstan Winches installed, tested and commissioned as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete Capstan Winch system; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

SECTION 26: DIFFUSED AERATION EQUIPMENT

DOCUMENT NO.: STD-LRM-MM-0005

CONTENTS

26.1	SCOPE	670
26.2	STANDARDS.....	670
26.3	COMPOSITION OF THE SYSTEM	672
26.4	BLOWERS	672
26.5	AIR SUPPLY PIPEWORK	673
26.6	DIFFUSERS	674
26.7	PIPE SUPPORTS AND FASTENERS.....	676
26.8	ACID CLEANING	676
26.9	INSTRUMENTATION	677
26.10	DIFFUSER INSTALLATION	677
26.11	FACTORY AND SITE TESTING	678
26.12	SPARES, TOOLS AND LUBRICANTS.....	679
26.13	CONFIRMATION OF SUITABILITY OF THE AERATION SYSTEM	679
26.14	MEASUREMENT AND PAYMENT	679

26.1 SCOPE

This Standard Specification covers the design, manufacturing, testing, supply, transport, handling, storage, erection, installation, testing, commissioning, adjustments, handing over in complete working order and upholding during the Defects Notification Period of a complete fine bubble diffused air aeration system.

The blowers offered for the aeration system shall comply with the Standard Specification on Blowers for aeration systems.

26.2 STANDARDS

26.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[271]	BS PD 5304	Guidance on safe use of machinery
[272]	SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
[273]	SANS 10104	Hand railing and balustrading (safety aspects)
[274]	SANS 10064	The preparation of steel surfaces for coating
[275]	SANS 966-1	Unplasticized poly(vinyl chloride) (PVC-U) pressure pipe systems
[276]	SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs

[277]	SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
[278]	SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress
[279]	ISO 4633 (SANS 4633)	Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for materials

26.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[280]	STD-LRM-GN-0004	General Design
[281]	STD-LRM-GN-0005	Testing and commissioning
[282]	STD-LRM-GN-0006	Corrosion protection
[283]	STD-LRM-CC-0001	Civil Engineering Work
[284]	STD-LRM-MM-0008	Electric Motors
[285]	STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
[286]	STD-LRM-MM-0020	Power Transmission Couplings
[287]	STD-LRM-MM-0021	Gear Boxes
[288]	STD-LRM-MM-0001	Compressors and Blowers
[289]	STD-LRM-MM-0016	Pipework

26.2.3 Abbreviations

The following abbreviations shall apply:

Abbreviation	Description/Meaning
DO	Dissolved Oxygen
FBDA	Fine Bubble Diffused Air
OUR	Oxygen Uptake Rate
AOR	Actual Oxygen Requirement (= OUR at site conditions)
SOTR	Standard Oxygen Transfer Rate
SOTE	Standard Oxygen Transfer Efficiency
STD	Standard Temperature and Pressure T = 20°C P = 101,325 kPa
Nm ³ /hr (also Nm ³ /hr)	Normal cubic meters per hour; SI unit for volumetric flow rate of air or gas at a temperature of 0 °C and pressure of 101,3 kPa, expressed in cubic meters per hour
Sm ³ /hr	Standard cubic meters per hour; SI unit for volumetric flow rate of air or gas at a temperature of 20 °C, pressure of 101,3 kPa and 0% relative humidity, expressed in cubic meters per hour.
SS	Stainless Steel
MLSS	Mixed liquor suspended solids measured in mg/l
DSVI	Dilute Sludge Volume Index
RAS	Return Activated Sludge, = Settled sludge recycled from the clarifier underflow to the reactor
A-recycle	Mixed liquor recycled from an aerobic zone to an upstream anoxic zone

Abbreviation	Description/Meaning
R-recycle	Mixed liquor recycled from an anoxic zone to an upstream anaerobic zone
EPDM	Ethylene Propylene Diene Monomer

26.2.4 Definitions

For the purpose of this Specification, the following definitions shall apply:

Air supply manifold:	The pipework running on the top of or next to the reactor tanks.
Feeder pipework:	The connections from the air supply manifold leading into the aeration zones comprising a downpipe for each zone and a horizontal header pipe.
Header pipe:	The pipe from which the laterals lead off.
Laterals:	Branches off the feeder pipework to which the air diffusers are fitted.
Zone:	Section of the reactor.
Air diffusers:	Porous membranes that discharge the fine air bubbles into the wastewater.
Flux ratio:	Air flow rate per diffuser effective membrane surface area. ($\text{m}^3/\text{hr}/\text{m}^2$)

26.3 COMPOSITION OF THE SYSTEM

The required FBDA aeration system shall consist of the following:

- Blowers,
- Air supply pipe work
- Distribution pipework,
- Fine bubble membrane diffusers,
- Isolating valves,
- Pressure and flow monitoring equipment as well as related electrical, control and instrumentation to maintain the desired DO levels.

The Contractor shall be responsible for the final design of the aeration system in order to achieve maximum operating efficiency under the specified range of operating conditions and in terms of the performance requirements specified in the Detail Specifications.

A description of the civil structures, normal operating water depth and general requirements of the aeration system shall be provided in the Detail Specifications and on the Drawings.

26.4 BLOWERS

The blowers shall be positive displacement blowers of the Roots type and shall conform to the requirements of the standard specifications on Compressors and Blowers [288].

Where the aeration basin is divided into multiple aeration zones, blowers shall be dedicated to aeration zones.

Air volume control shall be by means of altering the speed of the blowers using Variable Frequency (Variable Speed) drives. Control of airflow/air volume by means of valves will not be accepted.

Blowers shall be arranged in a duty/ standby arrangement per aeration zone. Depending on number of blower required, the percentage standby capacity shall never be less than a third of the capacity required.

26.5 AIR SUPPLY PIPEWORK

All air supply pipework shall conform with the requirements of the standard specification on pipework [289].

The Contractor shall be responsible to design and routing all pipework associated with the aeration system, including but limited to all inlet air pipework to the blowers and all outlet air pipework including the pipework from the blower house to the reactors and the distribution pipework in the reactors as well as all flushing and breather pipework, including air supply manifolds, feeder and header pipework, pipe laterals and diffuser configuration for the reactors to meet the air supply requirements of the reactors given in the Detail Specification.

All air pipework shall be suitably sized to limit airflow velocity to a maximum of 15 m/s under the max. design air flow with the highest possible air temperature and the lowest absolute pressure.

Where pipe temperatures exceed 50°C and pipework is accessible, contact with the pipework shall be prevented by the installation of hand railing. The appropriate safety signage shall also be installed. The cost for the above shall be included in the pipework cost.

26.5.1 Feeder Pipes and Air Supply Manifolds

All feeder pipes and air supply manifolds up to and including the down pipe into the reactor shall be manufactured in grade 304 stainless steel.

The Tenderer shall provide for sufficient means to accommodate expansion and to compensate for creep due to the changes in temperature under operating and non-operating conditions.

Any rubber seals between the couplings and or gaskets shall be heat resistant.

From after the down leg to the bottom of the aeration zone, the pipework may be uPVC pipes (plasticised polyvinyl chloride (PVC-U) pipes) complying with the requirements of SANS 966, subject to the following conditions:

- a) The maximum air temperature may not exceed 60°C.
- b) The pipe pressure rating after de-rating for an air temperature of 60°C in accordance with the pipe manufacturer's guidelines shall not be less than 9 bar.

The feeder pipes shall be installed in such a way that moisture which may collect in the pipes can be conveniently discharged at designated points in the system. Refer to paragraph 26.5.3 Condensate Purge System.

Air supply manifolds shall be installed on suitable stainless steel supports. The pipe supports shall be to the approval of the Engineer.

The Contractor shall be responsible for the supply and fixing to the concrete of such approved supports, brackets, straps and all necessary anchor bolts, all made of grade 304 SS, necessary for the proper support of these pipes.

The maximum spacing between supports shall be 1,5m.

The pipeline lengths and routing shall be such that the internal air temperature is reduced to below 60°C before connecting to any below water PVC pipe system.

The friction loss in the pipe network, from blowers to the header in the biological reactor shall not exceed 3 kPa.

A 1¼" nipple shall be provided on each feeder line to accommodate a blow-off assembly comprising a solenoid valve and silencer for periodic pressure release. In addition, a ½" nipple with a SS root valve shall be provided on each feeder line and flexible connection to a pressure gauge located on a suitable stand.

26.5.2 Laterals

Disc diffusers shall be installed on a lateral pipe system complying with the following requirements:

- a) The friction head loss in the lateral pipework shall be less than 1 kPa.
- b) The lateral pipework system shall be manufactured from plasticised polyvinyl chloride (PVC-U) pipes and shall comply with the requirements of SANS 966 and the following additional requirements:
 - i) The maximum air temperature may not exceed 60°C.
 - ii) The pipe pressure rating after de-rating for an air temperature of 60°C in accordance with the pipe manufacturer's guidelines shall not be less than 9 bar.
- c) The nominal diameter of the pipes shall not be less than 90 mm.
- d) The length of individual lateral pipes shall not exceed the standard manufactured length, i.e. no gluing or welding shall be allowed.
- e) Individual lateral pipes shall be provided with a proprietary integral joint incorporating a natural rubber seal ring complying with [279] ISO 4633 (SANS 4633).
- f) Additional joints shall be provided which shall permit removal and replacement of individual pipes without the need to dismantle a full row of pipes. The laterals shall be provided with joints to accommodate expansion.
- g) The ends of the laterals that form a common grid shall be interconnected with a pipe of the same material and diameter to form a closed loop in order to equalize the pressure in the grid of laterals.
- h) Each common grid of laterals shall be equipped with Condensate Purge System. (see paragraph 26.5.3).

26.5.3 Condensate Purge System.

A condensate purge system shall be installed to facilitate removal of moisture from the fine bubble diffuser grids. Each aeration zone shall be equipped with a manual purging system.

The moisture that may deposit shall be removed via dedicated condensate piping and a suitable purging system connected to the header pipe at a suitable location.

The Condensate purge system may either consist of a coarse bubble diffuser and/or a condensate purge line connected to the lowest point on the aeration grid. The coarse bubble diffuser system shall only be used in movable aeration grids in ponds. All fixed aeration systems shall be fitted with a condensate purge line.

The condensate purge line shall operate based on the air-lift principal and shall be manually operated by an operator at the reactor surface.

The condensate purge line shall start with a dip tube into a submerged manifold and shall rise to above the water surface. A butterfly valve shall be provided within safe reach of the operator, who will manually open the valve to drain the piping system.

The condensate purge system shall be designed for rapid removal of liquid from the pipework system present during initial start-up, or due to e.g. piping leaks or diffuser non-return valve failure.

The condensate purge pipework, valves, fittings and fasteners shall be manufactured from 316 stainless steel of adequate bore which shall terminate in 3-piece ball valves with 90° elbows, located at a convenient operating height and close enough to walkways to permit manual operation.

26.6 DIFFUSERS

New disc or strip-type fine bubble membrane air diffusers, designed and selected for maximum oxygen transfer efficiency, shall be installed in the aeration zones shown on the drawings. They shall produce evenly distributed bubbles not exceeding 2 mm in diameter at the design airflow rate.

26.6.1 Disc Diffusers

Air diffusers shall comply with the following minimum requirements:

- a) Diffusers shall be of the fine bubble type, with EPDM or Polyurethane membranes. Diffusers with ceramic or plastic type diffusion media elements are not acceptable as alternatives to the membrane diffuser.
- b) The same type of diffuser shall be used throughout all the aerated zones.
- c) The SOTE at the design airflow rate shall be better than 6%/m effective submergence and the design SOTE for the calculation of the system SOTR and the selection of the blower size shall be justified by SOTE test reports carried out with the same diffuser by independent institutions reduced by 15% to allow for efficiency drop during the life cycle of the diffuser.
- d) The maximum design airflow to each diffuser shall not exceed 80% of the maximum nominal capacity that the manufacturer recommends for continuous operation.
- e) The average bubble size produced by the membrane shall be smaller than 1.5mm in diameter.
- f) Membrane material shall be premium quality compression moulded EPDM with an oil content of less than 12%. Membranes which are injection moulded, or have an oil content of above 12% are not acceptable.
- g) The Tenderer shall determine the number of diffusers and configuration thereof required for each zone in order to achieve the specified performance under all operating scenarios and the Contractor shall submit confirmatory calculations to the Engineer after award of the Contract.
- h) The diffuser density within a particular zone shall be uniform.
- i) The flux ratio of the diffuser groupings shall not exceed 90 m³/hr/m² at STD.
- j) The aeration tank floor shall be cover uniformly covered by diffusers. The density of diffusers shall not be less than 0.7 discs/m². The distances between centres of consecutive diffusers shall not exceed 1.2 metres in both directions.
- k) A reputable international manufacturer shall manufacture the air diffusers. A contactable reference list of at least 5 installations for the offered diffuser shall be submitted in the tender submission.
- l) The Tenderer shall submit the manufacturer's mechanical warranty for the diffusers for an operating life of at least 5 years under the worst design conditions.
- m) Diffuser assemblies shall be resistant to corrosion or other chemical attack by the wastewater being treated and shall not cause precipitation of chemicals, which could block the membrane pores.
- n) The diffuser mounting shall be sufficiently robust and rigid to prevent leakage from occurring.
- o) At the designed airflow the maximum head loss in a diffuser which requires cleaning shall be less than 6 kPa while the head loss through a clean diffuser shall not exceed 3 kPa.
- p) The diffuser design shall incorporate an equal distribution aperture for controlling the rate of airflow from each diffuser in the event of potential major leakage due to disk breakage or similar event. This shall obviate the immediate need of draining the basins for repairs. Provision shall also be made for rapid removal of liquid within the pipework system during start up.
- q) In the event that disc diffusers are offered, preference shall be given to standard 9" or 12" units. Odd sizes and cylindrical diffusers shall not be acceptable. The offered diffusers shall utilize a membrane that is commonly available from at least 3 separate manufacturers to facilitate purchase of spare parts at a competitive price.
- r) Once the diffuser has reached the end of its lifespan, it shall be possible to only replace the membrane part of the diffuser with the rest of the unit remaining intact as originally installed.
- s) The disc diffusers shall consist of a membrane with integral gasket, base, retaining ring, airflow control orifice, and pipe saddle or grommet. Diffusers that require a centre bolt or webbing to limit membrane deflection are not acceptable.
- t) Diffusers shall be suitable for on/off operation and shall include a check valve system to prevent the entry of liquid and solids into the lateral piping.
- u) The Membrane design shall be such that air shall exit through the entire periphery of the membrane.

- v) Membranes shall be designed to resist clogging, and shall have a minimum of 6 600 perforations. Membranes shall be at least 70% hydrophilic.
- w) The diffuser base and retaining ring shall be constructed of moulded polypropylene with organic UV stabilizers. The use of any recycled material or plastics that are not UV utilized shall not be acceptable.
- x) The diffuser body shall be installed without gluing. It shall be clamped onto the lateral with a quick release clamp saddle allowing in-situ adjustment or replacement. The saddle shall preferably be moulded from polypropylene. A rubber O-Ring shall be fitted on the saddle to provide an air-tight seal between it and the diffuser lateral.
- y) The clamp saddle shall be adjustable and shall be levelled during installation to ensure that diffusers are on a common horizontal plane. The maximum allowable out of horizontal plane tolerance shall be 6mm.

26.6.2 Strip Diffuser Assemblies

- a) Plate or strip diffusers shall be acceptable if offered. Such strip diffusers shall have a minimum width of 180mm and shall comprise of a flat uPVC base plate, uPVC air inlet which is connected directly to the base plate and polyurethane membrane with a check valve.
- b) The strip diffusers shall be installed directly on the aeration tank floor with 316 stainless steel strip fasteners that are fixed to the concrete floor and the diffuser body.
- c) The diffuser shall be supplied with polyurethane membranes without plasticizers and fillers, free of tears, bubbles and other structural defects. Membranes with needled perforations shall be favored and the membrane shall be perforated with uniform pores, which shall close when aeration is stopped. The diffuser shall be suitable for intermittent operation.
- d) The membrane shall be removable for replacement.

26.7 PIPE SUPPORTS AND FASTENERS

- a) The pipes shall be fixed on the floor with stainless steel supports which shall allow temperature expansions. The supports shall also allow the vertical and horizontal alignment of the pipes by at least 50 mm in both (vertical and horizontal) directions.
- b) All fasteners shall be 316 Stainless Steel (SS).
- c) For disc diffusers, the lateral pipework shall be fixed to the concrete floor with 316 SS fixing supports. Each support shall be fixed by means of two 316 stainless steel threaded bolts of minimum diameter 8 mm chemically anchored to a minimum depth of 100 mm into the concrete floor. The supports shall be capable of a 50mm vertical height adjustment to compensate for variations in level and flatness of the reactor floors. Pipework shall be fixed to the supports with 316 stainless steel straps.
- d) 316 Stainless Steel supports shall be provided for the risers and downpipes to rigidly secure them to the concrete floor and walls. Each support shall have at least four 316 stainless steel chemical anchors of diameter not less than 16 mm and be set at least 100 mm deep. Straps shall not be used for axial restraint of down pipes, however they may be used for radial restraint.
- e) Tenderers shall provide information detailing dimensions and thickness, assembly, mounting, and adjustment arrangements and the materials of construction of the pipe supports with their tender submission; actual samples are preferred.
- f) Pipe support straps (only permissible for the horizontal lateral piping, not for down pipes) shall be of grade 316 stainless steel with a minimum thickness of 1.5 mm. The Engineer shall not accept reliance on any type of proprietary design that relies solely on plastic straps for radial or axial pipe restraint, as operational experience on various sites have proved these to be inadequate.

26.8 ACID CLEANING

Provision shall be made for either a fixed installation Acid Diffusor Cleaning system or a connection point for connecting a mobile Acid Diffusor Cleaning system as detailed in the detail specification.

26.8.1 Connection Point for a Mobile Acid Cleaning System

If required in the detail specification a connection point, accessible to the operator shall be provided after all inline instrumentation in the feeder pipework before the pipe drops into the aeration basin.

The connection point shall consist of a ½" socket, a ball valve for isolation and a plug. The acid cleaning system shall be connected to the feeder line by removing the plug and connecting to the ball isolation valve.

26.8.2 Permanent Connection of a Acid Cleaning System

If required in the detail specification a permanent connection to the fixed acid cleaning system, accessible to the operator shall be provided after all inline instrumentation in the feeder pipework before the pipe drops into the aeration basin.

The connection point shall consist of a ½" socket and a ball valve. The acid cleaning system shall be connected to the isolation ball valve.

26.8.3 Acid Cleaning Dosing System

A mobile or fixed unit capable of dosing acetic acid into the feeder pipework for cleaning of the diffusers shall be provided.

If a fixed Acid Cleaning Dosing System is specified, the unit shall be skid mounted and shall be permanently piped to the fixed dosing points on the feeder pipes.

If a mobile Acid Cleaning Dosing System is specified, the unit shall be trolley mounted.

The acid dosing unit comprising of a trolley or skid as appropriate, container for acid, compressor, dosing pump, electrical panel, ultrasonic atomizer, electrical cable and plug point.

The first charge of acid shall be provided as part of the supply of the cleaning unit.

26.9 INSTRUMENTATION

Approved airflow measurement devices and dissolved oxygen monitoring instruments shall be provided for each aeration zone.

Each device or instrument shall be connected to a local transmitter with local display and integration. All cabling between the sensor and transmitter as well as the transmitter and control system installed in the blower building must be allowed for by the Contractor.

All material used in the air flow material and metering units shall be of an inert material where in contract with the air passing through the distribution system.

26.10 DIFFUSER INSTALLATION

- a) At the commencement of the work, the position of the laterals and fixings shall be marked out.
- b) The levels of the concrete floor at each support shall be checked to ensure that the adjustment capacity of the support is not exceeded. Any deficiencies that may affect installation shall be brought to the attention of the Engineer in writing, who shall arrange for the correction thereof by the Civil Contractor.
- c) Each floor fixing for the lateral diffuser pipework or diffuser supports shall be subjected to a vertical "pull-out" test using a force of 2,0 kN before the installation of the laterals and diffusers commences. Fixings that fail the test shall be replaced and the test repeated.
- d) Diffusers shall be installed to a level tolerance of +/-3 mm.
- e) The internal surfaces of all the pipework and components shall be washed clean immediately prior to being installed.

- f) Before filling of the aeration basins, the completed system including air supply manifold, feeder pipework, laterals and condensate pipework shall be blown free of dust and debris by removal of the end caps and the operation of the blowers for a period of at least two hours.
- g) After the system has been blow cleaned, the end caps and condensate pipes shall be fitted. The air pipework and diffusers shall then be covered with treated effluent to a depth of approximately 50 mm over membrane level.
- h) Using the blowers, the system shall be checked for leaks and tightening of all components in the system shall then proceed until all air leaks have been eliminated.

26.11 FACTORY AND SITE TESTING

26.11.1 General Requirements

The Contractor shall be responsible for conducting all testing described below until the specified performance requirements have been achieved.

26.11.2 Diffuser Assemblies/Pipe Connections Load Tests

- a) The results of the tests shall be recorded and form part of all the other required test documentation to be inserted in the final version of the Operation and Maintenance Manual.
- b) The testing shall be executed by the Contractor in the presence of the Engineer during the installation of the diffuser pipework:
- c) Load testing shall be carried out on the diffuser assemblies/pipe connections. Load tests shall be performed on 1 in 300 randomly selected diffuser units. The Contractor shall advise the Engineer in advance of such tests to enable these tests to be witnessed and accepted by the Engineer.
- d) To perform the tests, the Contractor shall provide a test rig to apply gradually increasing vertical loads to each selected diffuser assembly/pipe connection to a maximum of 2,5kN. The assemblies/connections shall be accepted only if they withstand a vertical pull of 2,5kN.
- e) If one or more of the samples fail the test, further tests on twice the number of samples shall be performed. If any number of the samples fail the second round of tests the Engineer shall have the right to reject the installation, and the Contractor shall then submit a different installation system for consideration. The test samples shall be destroyed on completion of the tests.

26.11.3 Leak Testing/Air Distribution

- a) Before introducing water into the aeration zones, the Contractor shall leak test with compressed air all feeder and manifold pipework from the blower building up to the header pipes against a temporary end-cap to confirm a leak-tight installation.
- b) To facilitate the leak testing and air distribution tests, the contractor shall fill the aeration basins with water, the source of which shall be to the approval of the Engineer, to a level of approximately 300 mm over membrane disk level.
- c) Air shall then be introduced by operating the blowers at rates equivalent to the maximum and minimum airflow. The aeration zones shall be visually checked for even air distribution and leaks. All leaks shall be fixed and uneven air distribution rectified.
- d) After completion of the test above, The Contractor shall fill the aeration zones with water approved by the Engineer to normal top water level. The Blowers shall then be operated at maximum airflow for a continuous period of 24 hours. Should any poor distribution or leaks be observed the module shall be drained and the procedure repeated until all poor distribution or leaks have been rectified.
- e) The diffuser and piping installation in a module shall only be considered complete and ready for the tests on completion once the above test has been successfully completed. Only after this test has been completed may raw sewage be introduced into the plant.
- f) The Contractor shall allow in his tendered rate for the supply of all water into the reactor basin in order to perform the test. If a test is unsuccessful, the Contractor shall empty the basin, address the relevant defects, fill the basin again and repeat the test until it proves successful.

26.11.4 Oxygenation Efficiency

Oxygenation efficiency, where called for in the Technical Data Sheets, shall be expressed as kilograms oxygenation capacity per kilowatt-hour i.e. as the mass of oxygen measured in kilograms which the

diffusers are able to introduce over a period of time, into a body of completely de-oxygenated water divided by the power input to the blower motor over the same period, measured in kilowatt-hours, at Standard Conditions of 101,325 kPa and 20°C.

26.11.5 Certification

Tenderers shall provide proof of sufficient evidence of diffuser oxygenation capacities and oxygenation efficiencies (for instance by submitting a report on performance by some recognised testing authority) and shall state clearly how diffuser performance was assessed. Failure to submit this information may lead to the rejection of the tender on the grounds of it being non-compliant.

26.11.6 In-situ Oxygenation Efficiency Determination

- a) *In-situ* testing of aeration equipment shall be carried out by the Contractor in the presence of the Engineer or his representative, to verify the oxygenation capacity and efficiency of the equipment in the aeration basins.
- b) All results, readings and other information regarding the tests shall be freely available to the Engineer during testing, and copies of the Contractor's calculations shall be submitted to the Engineer.

26.12 SPARES, TOOLS AND LUBRICANTS

10% complete diffusers with membranes and pipe supports shall be provided as spares.

26.13 CONFIRMATION OF SUITABILITY OF THE AERATION SYSTEM

It is the Contractors responsibility to prove the Oxygen Transfer, Aeration Efficiency and performance of the system offered, **PRIOR** to Design Approval and System manufacturing, at an independent Test Facility of the Client's choice and the cost of these testing will be as per the Bill of Quantities.

The personnel to witness the testing shall include the following persons:

- a) Client – 1 person
- b) Consultants - 2 persons
- c) Supplier / Contractor – at the contractor's choice

The Costs shall include for the following:

- i) All Testing Costs
- ii) Return Airfare at a minimum Premium Economy rate on all Intercontinental flights,
- iii) Accommodation at a minimum 4 Star Hotel
- iv) All local Transport abroad
- v) Subsistence of attending personnel

26.14 MEASUREMENT AND PAYMENT

Item	Description	Unit
26.14.1	Design, Drawings and General	Lump Sum

The unit of measurement shall be a sum.

The tendered sum shall include full compensation to execute the design of the aeration system in accordance with the requirements of this Standard Specification and the requirements detailed in the Detail design including but limited to the provision of design drawings and design information as specified.

Item	Description	Unit
26.14.2	Supply and delivery of aeration blowers	No

The unit of measurement shall be the number of blowers specified.

The tendered rate shall include full compensation for the supply and delivery to site and site handling of the blowers selected by the Contractor in his design.

Where separate blowers are specified for different aeration zones, separate items will be scheduled for each aeration zone.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

Item	Description	Unit
26.14.3	Supply Air Manifold and main feeder pipework	Lump Sum

The unit of measurement shall be a Lump sum.

Separate items shall be scheduled for each air manifold and feeder pipework where separate manifolds are specified.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the complete air manifold from the blowers to the feeder pipework tee-offs, including any/all T-pieces, bends, couplings and supports and connection to main feeder line from the blower installation.

Item	Description	Unit
26.14.4	Supply Stainless Steel feeder pipework	Lump Sum

The unit of measurement shall be a Lump Sum.

Separate items shall be scheduled for and feeder pipework aeration zone.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the complete feeder pipework to header, including supports, couplings, provision of socket and plug for acid injection, nipple for blow-off facility as well as nipple and root valve for pressure gauge installation, one complete system per aeration zone.

Item	Description	Unit
26.14.5	Supply Header pipework	No

The unit of measurement shall be the number of header pipework designed and supplied.

Separate items will be scheduled for each aeration zone.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the header pipework, including connection to feeder line and aeration grids, one complete system per aeration zone.

Item	Description	Unit
26.14.6	Supply Aeration Grids	Lump Sum

The unit of measurement shall be a Lump Sum.

Separate items shall be scheduled for each aeration zone/basin

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the Aeration Grids, including diffusers, membranes, diffuser connection to laterals, lateral pipework, lateral fasteners, air distribution pipework between header and diffusers.

The tenderer shall state the number of diffusers per aeration zone/basin.

Item	Description	Unit
26.14.7	Supply Insert-type air flow meters with integrated display	No

The unit of measurement shall be the number of insert-type airflow meters.

Separate items shall be scheduled for each aeration zone/basin.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

Item	Description	Unit
26.14.8	Supply Pressure gauges	No

The unit of measurement shall be the number of pressure gauge installations.

Separate items shall be scheduled for each aeration zone/basin.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the specified pressure gauges installed in feeder pipework, including connector pipework and support stand.

Item	Description	Unit
26.14.9	Supply Acid injection system	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the specified Acid Injection System.

Item	Description	Unit
26.14.10	Supply Condensate purging system	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the specified condensate purging system, one per aeration zone.

Item	Description	Unit
26.14.11	Supply Dissolved oxygen sensors	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall include full compensation for the specified Dissolved oxygen sensors and swivel-type fixing arrangement, including common controller with local display in suitable pedestal-mounted protective housing, one per aeration zone.

Item	Description	Unit
26.14.12	Supply Electrical and signal cabling between instruments, controllers and blower room control system to complete installation	Lump Sum

The unit of measurement shall be a Lump Sum.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

Item	Description	Unit
26.14.13	Installation of aeration blowers	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for the installation of the blowers selected by the Contractor in his design.

Where separate blowers are specified for different aeration zones, separate items will be scheduled for each aeration zone.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

Item	Description	Unit
26.14.14	Install Air Manifold and main feeder pipework	Lump Sum

The unit of measurement shall be a Lump sum.

Separate items shall be scheduled for each air manifold and feeder pipework where separate manifolds are specified.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the complete air manifold from the blowers to the feeder pipework tee-offs, including any/all T-pieces, bends, couplings and supports and connection to main feeder line from the blower installation.

Item	Description	Unit
26.14.15	Install Stainless Steel feeder pipework	Lump Sum

The unit of measurement shall be a Lump Sum.

Separate items shall be scheduled for and feeder pipework aeration zone.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the complete feeder pipework to header, including supports, couplings, provision of socket and plug for acid injection, nipple for blow-off facility as well as nipple and root valve for pressure gauge installation, one complete system per aeration zone.

Item	Description	Unit
26.14.16	Install Header pipework	No

The unit of measurement shall be the number.

Separate items will be scheduled for each aeration zone.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the header pipework, including connection to feeder line and aeration grids, one complete system per aeration zone.

Item	Description	Unit
26.14.17	Install Aeration Grids	Lump Sum

The unit of measurement shall be a Lump Sum.

Separate items shall be scheduled for each aeration zone/basin

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the Aeration Grids, including diffusers, membranes, diffuser connection to laterals, lateral pipework, lateral fasteners, air distribution pipework between header and diffusers, including fixing into position of lateral pipework, air, distribution pipework, diffusers and connection to header pipes.

Item	Description	Unit
26.14.18	Install Insert-type air flow meters with integrated display	No

The unit of measurement shall be the number of insert-type airflow meters.

Separate items shall be scheduled for each aeration zone/basin.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

Item	Description	Unit
26.14.19	Install Pressure gauges	No

The unit of measurement shall be the number of pressure gauge installations.

Separate items shall be scheduled for each aeration zone/basin.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning..

The tendered rate shall include full compensation for the specified pressure gauges installed in feeder pipework, including connector pipework and support stand.

Item	Description	Unit
26.14.20	Install Acid injection system	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the specified Acid Injection System.

Item	Description	Unit
26.14.21	Install Condensate purging system	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the specified condensate purging system, one per aeration zone.

Item	Description	Unit
26.14.22	Install Dissolved oxygen sensors	No

The unit of measurement shall be the number.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

The tendered rate shall include full compensation for the specified Dissolved oxygen sensors and swivel-type fixing arrangement, including common controller with local display in suitable pedestal-mounted protective housing, one per aeration zone.

Item	Description	Unit
26.14.23	Install Electrical and signal cabling between instruments, controllers and blower room control system to complete installation	Lump Sum

The unit of measurement shall be a Lump Sum.

The tendered rate shall include full compensation for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, repair to damaged corrosion protection and getting ready for testing and commissioning.

Item	Description	Unit
26.14.24	Testing and Commissioning	

The tendered rate shall include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, testing apparatus, instruments and equipment, any/all temporary works, any/all sampling and analysis and compilation of final commissioning report.

26.14.24.1	Diffuser Assemblies/Pipe Connections Load Tests	Lump Sum
26.14.24.2	Leak Testing/Air Distribution testing	Lump Sum
26.14.24.3	In-situ oxygenation efficiency determination	Lump Sum

Item	Description	Unit
26.14.25	Confirmation of suitability of the Aeration system	Lump Sum

The unit of measurement shall be the Lump Sum.

The tendered rate shall include full compensation for the witnessed tests including all cost, travel costs and incidentals as specified for the confirmation of the aeration system.

Item	Description	Unit
26.14.26	Provision of spare parts as specified in the Standard Specification.	Lump Sum

The unit of measurement shall be the lump sum.

The tendered rate shall include full compensation for the supply delivery and handing over to the Employer of the specified spare parts.

SECTION 27: CHEMICAL DOSING PLANT

Document No: STD-LRM-MM-0003

CONTENTS

27.1	SCOPE	687
27.2	STANDARDS.....	687
27.3	NATIONAL AND INTERNATIONAL STANDARDS	687
27.4	INTRODUCTION	688
27.5	GENERAL DOSING EQUIPMENT	689
27.6	POWDER POLYELECTROLYTE MAKE UP AND DOSING	692
27.7	CORROSION PROTECTION	695
27.8	SAFETY	695
27.9	TESTING AND COMMISSIONING.....	696
27.10	MEASUREMENT AND PAYMENT	696

27.1 SCOPE

This section covers the requirements for chemical dosing installations as well as the supply, delivery, installation, testing and commissioning of certain equipment for the dosing of chemical reagents in liquid or powder form.

This specification also covers packaged chemical dosing/make-up plants.

27.2 STANDARDS

27.3 NATIONAL AND INTERNATIONAL STANDARDS

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[290]	SANS 10140-1	Identification colour marking Part 1: General
[291]	SANS 10140-2	Identification colour marking Part 2: Identification of hazards and equipment in work situations
[292]	SANS 10140-3	Identification colour markings Part 3: Contents of pipelines
[293]	SANS 10140-4	Identification colour marking Part 4: Contents of taps and valves in laboratories
[294]	SANS 10140-5	Identification colour marking Part 5: Coding of containers for carrying lubricants and associated fluids
[295]	SANS 10400	National Building Regulations
[296]	BS PD 5304	Guidance on safe use of machinery
[297]	SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
[298]	SANS 10104	Hand railing and balustrading (safety aspects)
[299]	SANS 10064	The preparation of steel surfaces for coating
[300]	SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs

[301]	SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
[302]	SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress
[303]	BS 292 Part 1	Dimensions of ball bearings, cylindrical and spherical roller bearings
[304]	IEC 60529	Degrees of protection provided by enclosures (IP Code)
[305]	ANSI Z358.1	American National Standard for Emergency Eyewash and Shower Equipment

27.3.1 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[306]	STD-LRM-GN-0004	General Design
[307]	STD-LRM-GN-0005	Testing and commissioning
[308]	STD-LRM-GN-0006	Corrosion protection
[309]	STD-LRM-MM-0016	Pipework
[310]	STD-LRM-GN-0007	Structural Metal Work
[311]	STD-LRM-MM-0008	Electric Motors
[312]	STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
[313]	STD-LRM-MM-0020	Power Transmission Couplings
[314]	STD-LRM-MM-0021	Gear Boxes
[315]	STD-LRM-MM-0010	Dry Well Pumping Equipment
[316]	STD-LRM-IN-0002	Measuring Instruments

27.3.2 Abbreviations

In this Specification the following abbreviations will apply:-

uPVC:	un-Plasticized polyvinyl chloride
FRP:	Fibre Reinforced Plastic
EPDM:	Ethylene Propylene Diene Monomer
FPM:	Fluoroelastomer (also known as Viton®)

27.4 INTRODUCTION

It is a purification process requirement that ferric chloride, ferric sulphate, alum, lime, powder activated carbon or other chemical reagents in liquid form be dosed for chemical treatment such as the removal of excess phosphate, etc. In the case of powder chemicals, the powder shall be mixed with water in suitable containers and in order to dose in liquid form.

The system shall include storage tanks, make-up tanks, feeders, silos, vibrators, dosing pumps and pipework as specified and shown on the drawings. All equipment shall be included in the relevant tendered rates to ensure an efficiently working system.

The reagent shall be dosed into the effluent at various points as shown on the drawings. The system shall be designed so that the operator can choose which configuration of dosing points he wishes to

utilize. The tenderer/contractor shall pay particular attention to the process flow diagrams provided in order to ensure that all facilities and components have been provided for.

27.5 GENERAL DOSING EQUIPMENT

27.5.1 Materials

All materials selected or adopted in the design must be suitable for installation in the proposed environment, and suitable for use with and contact with the chemical involved. They must be corrosion resistant and selected to match the relevant specified design life. Where required, materials must be coated in accordance with the Standard Specification on Corrosion Protection 0 STD-LRM-GN-0006.

All components of the chemical dosing system should be from the same manufacturer (and where possible, supplier) for a specific dosing system and where possible, for any existing chemical dosing system on site. All valves of the same size, duty and type supplied under the contract must be identical.

27.5.2 Gaskets, "O" rings and rubbers

Only approved gaskets, O rings and rubber that are compatible for use with the specific chemicals must be used. FPM and EPDM products are to be used for chemical applications as specified in the table below. For any chemicals not listed below, direction to be requested from the Engineer.

Table 14: Approved Gasket, "O"-Ring and rubbers

FPM (Viton®)	EPDM
Ferrous Chloride	Ammonium Hydroxide
Ferric Chloride	Sodium Hydroxide
Ferric Sulphate	Methanol/ Ethanol
Spent Pickle Liquor	
Aluminium Sulphate	
Sodium Hypochlorite	
Sodium Bisulphite	
Hydrofluosilic Acid	
Biocides	
Anti-scalants	
Powder and Liquid Polyelectrolytes	
Magnesium Hydroxide	
Hydrochloric Acid	
Sulphuric Acid	
Acetic Acid	
Citric Acid	
Carbon Dioxide Solutions	

27.5.3 Design and selection for temperature effects

Different chemicals are influenced by site ambient conditions, leading to crystallisation, off-gassing and chemical breakdown. Consideration is required during the design process to ensure appropriate controls such as shading, heat tracing and expansion/contraction loops are included to minimise the effects of these impacts.

27.5.4 Storage tanks

Storage tanks shall comply with the section dealing with storage tanks and shall be installed in the positions shown on the drawings.

27.5.5 Make-up tanks

Make-up tanks shall each be fitted with a mixer as described below.

Make-up tanks shall comply with the specifications for storage tanks unless they are to be installed by others, in which case they will be civil structures (concrete) as specified in the detail specifications. GRP make-up tanks shall be open at the top unless otherwise specified.

The contractor shall refer to the drawings and shall ensure that his equipment is compatible with the civil structures.

The volume capacity of each make-up tank shall depend on the maximum rate of dosing for which the installation is designed. At least two identical make-up tanks shall be supplied unless otherwise measured in the schedule of quantities. Each shall have a sufficiently large volume capacity to contain enough solution for a duration of 15 hours of continuous dosing at maximum dosing rate.

The tanks shall only be used as supports for mixers when authorized as such in the detail specification.

27.5.6 Dosing pumps

Dosing pumps shall comply with the section dealing with pumps and the performance requirements specified in the detail specification.

Unless otherwise indicated, each plant shall have two dosing pumps installed, one duty pump and one stand by pump. Duty rotation will be facilitated by others but the contractor shall specify the requirements of the equipment in this regard.

The interlocking and control of pumps, whether they be driven by variable speed drives or not, will be provided by others. However, the contractor shall supply full details with regard to the requirements of his equipment.

27.5.7 Constant head tanks

Constant head tanks from glass reinforced fibre or the material specified in the detail specifications shall be installed immediately adjacent to dosing points supplied from gravity fed systems only except if otherwise specified in the detail specification.

The tank shall have an active capacity of at least 500 ℓ and shall be fitted with an inlet control ball float valve and all other pipework required.

The tenderer shall indicate the position and height of the tank on the drawings and shall allow for all fixing and brackets to supply a satisfactory working system. Details with regard to plinths required shall be provided at tender stage.

27.5.8 Pipework

- a) All pipework shall comply with the sections dealing with pipework. The contractor shall use uPVC pipework to convey all chemicals in liquid form as far as possible.
- b) The following pipework shall be included in the tendered rates for each dosing plant, as applicable:
 - i) One domestic water supply line from the nearest supply point to each make-up tank. Each tank shall be fitted with a ball float valve and a solenoid valve immediately upstream of the float valve. Interlocking of the solenoid valve will be provided by others.
 - ii) A concentrated chemical supply line network from the bulk storage tanks to the make-up tanks with isolation valves on both ends. It shall be possible to supply any one of the make-up tanks from any one of the storage tanks.
 - iii) A chemical solution supply pipeline network from the make-up tanks to the dosing pumps (or constant header tanks in the case of gravity fed systems) with isolation valves on both ends. It shall be possible to supply any one of the pumps (or header tanks where

- applicable) from any one of the make-up tanks. Gravity fed systems shall have ball float valves installed in the header tanks.
- iv) A chemical solution delivery pipeline reticulation including an isolatable inlet point from each dosing pump or header tank and an isolatable branch up to the point of delivery or point of release of the chemical.
 - v) A specially fabricated pipe fitting, range of fittings or manifold as shown on the drawings at each point of delivery or release for the even distribution or dispensing of chemical solution into the main stream.
 - vi) An isolatable drainage pipeline to waste from each storage tank, calibration tank, make-up tank and constant head tank.
 - vii) A non-isolatable emergency overflow pipeline to waste from each storage tank, make-up tank and each constant head tank.
 - viii) An isolatable pipeline to a calibration tank as indicated on the process flow diagrams.
- c) Diameters for rising main pressure pipelines shall be suited to not exceed a flow velocity of $0,8 \text{ ms}^{-1}$ at maximum dosing rate.
 - d) Diameters for gravity pressure pipelines shall be suited to not exceed a full bore flow velocity of $0,1 \text{ ms}^{-1}$ at maximum dosing rate.
 - e) The diameter of gravity pipelines shall be sized not to exceed a flow depth of 75 % of the pipe diameter in the event of a flow generated by discharging the entire contents of a full tank within 30 seconds down the pipeline.
 - f) The contractor shall ensure that all the necessary pressure relief valves, reflux valves, isolation valves and ball float valves are included to ensure an efficiently working system. Reference shall be made to the process flow diagram provided for guidance.
 - g) The dosing nozzles shall be designed to ensure that the reagent is dosed evenly across the width of the relevant channel. The nozzles shall be placed such that the reagent is dosed 150 mm upstream from the step intended to cause a hydraulic jump/flash mixer. The point of dosing shall be above the liquid level in the channel unless otherwise specified.
 - h) The contractor shall be responsible for the proper colour marking of all exposed pipes, taps and valves to denote their contents as well as for the erection of the necessary safety signs that may be required. The markings and signs shall conform to the requirements of [290] SANS 10140-1, [291] SANS 10140-2, [292] SANS 10140-3, [293] SANS 10140-4 and [294] SANS 10140-5. No separate payment will be made for the markings and signs and the cost thereof will be deemed to be included in the rates tendered for the various items requiring marking.

27.5.9 Chemical mixers

- a) An electrically driven impeller-type mixer shall be provided for each make-up tank. The power input shall be adequate for ensuring a uniform motion and mixing in the mixing tank, and to prevent the settling of un-dissolved chemical particles. Performance details will be specified in the detail specification.
- b) Mixer electric motors shall comply with the section dealing with electric motors and gearboxes with the section dealing with gearboxes. The AGMA service factor for gearboxes shall not be less than 1,5 as defined in the relevant section.
- c) The mixers shall be provided with attaching brackets and mechanisms for positional adjustment and shall be fixed onto an included mounting frame fixed to the concrete floor next to the make-up tank unless otherwise specified.
- d) The impeller of each mixer shall be enclosed by a static circular cage which, in all circumstances, shall prevent the impeller from impacting with wall of the tank and so damaging it.
- e) The mounting frame, shaft of the mixer and other configuration details shall be such as to allow positioning of the impeller in the tank. The normal position of the impeller shall be two thirds the tank depth unless otherwise recommended by the mixer manufacturer.
- f) All fixing brackets, fasteners, impeller shafts and impellers shall be from stainless steel, unless otherwise specified.

27.5.10 Silos

- a) Silos shall be provided for the storage and provision of powder chemicals such as lime. The silo shall be positioned such that it deposits the powder directly into the make-up tanks via a metal chute attached to the feeder.
- b) The contractor shall provide details with regard to civil requirements to install his silo as indicated on the drawings.
- c) The silo shall comply with the section dealing with silos and all appurtenant equipment shall be included in the tendered rates.

27.5.11 Calibration Cylinders

Each dosing system suction header must be provided with a graduated calibration cylinder for determining the discharge rate of the pump. The measurable capacity of the cylinder must be sized to the normal operating range of the pump (rather than maximum flow). Volume of the cylinder should enable test to be performed in 45 seconds to 1 minute. Each cylinder must be permanently calibrated in litres and millilitres. The volume of the tank shall be such that one dosing pump shall not empty the tank from full in less than 30 seconds when pumping at maximum operating flow rate.

The calibration cylinder must be complete with isolation valve and be capable of being easily dismantled for maintenance purposes. The calibration cylinder vent line, in rigid uPVC pipework, must be connected to the storage/day tank. The pressure relief vent line must also be connected to this vent line to the storage/day tank.

The top of calibration cylinders must be below the “re-order” level in the associated storage tank.

Calibration cylinders are to be manufactured from a minimum of schedule 40 uPVC clear pipe, and solvent welded fittings. Screwed fittings are not acceptable, with the exception of standard unions upstream and downstream of the cylinder for dismantling purposes.

Isolation valving on the main suction header upstream of the calibration cylinder, and the calibration cylinder isolation valve must be located in close proximity such that they may both be operated simultaneously by a single operator when performing a drop test.

27.5.12 Pulsation dampeners

Pulsation dampeners must be provided in the discharge pipework from the dosing pump and must be suitably sized for the displacement of the pump so that discharge pressure fluctuation does not exceed 10 %. The pulsation dampeners must have a diaphragm separating the air chamber from the liquid chamber. The air chamber must be pressurised and be capable of re-pressurising by air pump via a Schrader valve. An air pressure gauge must be installed.

Where possible, pulsation dampener should be located vertically at the top of the common discharge from the dosing pumps, such that discharge flow is directly into the dampener before a change of direction along the dosing line.

Pulsation dampeners must have a bolted flange arrangement for jointing of the two halves of the diaphragm chamber.

Each pulsation dampener must be fitted with an isolation ball valve.

Process connection is to be solvent welded type. This includes jointing to the isolation valve.

27.6 POWDER POLYELECTROLYTE MAKE UP AND DOSING

27.6.1 General

- a) The system shall include all necessary equipment and controls for storage, mixing of powder polyelectrolytes, aging, transfer and the dosing of the polyelectrolyte solution.
- b) The bulk storage powder capacity shall allow for a 30 days storage at future capacity.

- c) The polyelectrolyte make-up and dosing systems shall be fully automatic. The dosing rate shall be controlled by a signal from the SCADA. The system shall be capable of preparing a polyelectrolyte solution ranging from 0.25 % to 0.35% by weight.

27.6.2 Polyelectrolyte bulk storage hopper (High Capacity Systems)

- a) Where specified in the detail specification Polyelectrolyte will be delivered to the site by bulk loading tankers, parked at the truck loading bay, and pneumatically conveyed into the storage hopper with a 30 day capacity.
 - i) The hopper shall be designed to accept pneumatically operated bulk loading from a road tanker.
 - ii) The storage hoppers shall be stainless steel having a conical bottom with a minimum slope 60 degrees to the horizontal. All internal surfaces shall be finished smooth and all internal welds finished flush. The hopper shall be complete with a supporting structure and installed on suitable footings.
 - iii) Electric vibrators (hammer types are not acceptable) shall be provided and mounted to the conical portion of the hopper to facilitate free material flow and to prevent any bridging, arching and hanging-up of polyelectrolyte powder.
 - iv) A knife gate type isolating valve shall be provided at the outlet of the hopper, complete with a discharge section to connect to the screw feeders.
 - v) The hopper shall be fitted with a dust separator on the outlet of the air venting frame, to filter the air exhausted.
 - vi) The hopper loading hatch shall be fitted with a dustproof and moisture proof lid which shall be easily removable without hand tools.
 - vii) The hopper shall be installed on raised concrete feet of min. 100 mm height to enable clean out and hosing of spilled polymer material.
 - viii) The hopper shall be fitted with a pressure relief valve.
- b) Floor drainage shall be installed adjacent to the polyelectrolyte area to direct hose down water to the chemical hose-down sump. A non-slip floor surface shall be provided around the polyelectrolyte preparation and dosing system.
- c) If in a humid environment, the silo shall be fitted with a dehumidifying unit to ensure that the silo internal air is kept dry.
- d) Unloading pipework

Unloading pipework for commercial delivery of polyelectrolyte must be provided. A filling line must be provided with no horizontal or near horizontal sections and with bends having a radius of at least 0,5 m. The unloading pipework must be anti- static and the pipe connections must be located and secured at a convenient position for powder transfer.

- e) Weighing system

A weighing system shall be supplied and installed for the storage hopper utilising "bolt-on" strain transducers, one for each supporting leg. Alternatively, load cells may be considered. Accuracy shall be better than $\pm 0,5$ % and resolution better than 1 kg. A local display unit shall be visible to the driver of the bulk tanker.

- f) Dust collection equipment
 - i) Dust collection equipment shall be supplied and installed in order to minimise escape of polyelectrolyte dust to the atmosphere during unloading from the bulk tanker. Filtered air from the dust extractor shall exhaust to outside the building or structure. Exhaust air shall comply with air quality standards.
 - ii) The dust collection equipment shall be installed adjacent to the storage hopper and in the vicinity of the unloading area.
 - iii) The separator shall include a vibrator or approved means to clear the filter cloth dust. The vibrator shall be operative whenever the hopper receives polyelectrolyte powder.

27.6.3 Low capacity systems

- a) For smaller systems, the powder storage hopper shall be designed to accommodate a minimum of 50 kg of polyelectrolyte powder.
- b) Polyelectrolyte powder will be supplied and stored in 25 kg bags. A designated polyelectrolyte storage area must be provided with sufficient space for a standard pallet. Access must be provided for a forklift truck to deliver and remove pallets.

27.6.4 Powder metering equipment

- a) Powder metering shall be performed by means of a Volumetric Screw Feeder. The following powder metering equipment shall be provided:
 - i) Screw feeder
 - ii) Venturi eductor
 - iii) Air blower
 - iv) Anti-static delivery hose
 - v) A high level switch (LSH) on the eductor lid.
- b) The feeder shall be of the volumetric [screw] type which shall convey the polyelectrolyte powder at a constant pre-set rate to the wetting assembly. A heater must be supplied and installed for the discharge spout and eductor.
- c) The powder shall discharge to a venturi eductor and be transported by air to the wetting assembly through an anti-static delivery hose.
- d) The eductor shall have a high level switch installed to prevent poor batching and polymer powder spills.
- e) An air blower shall be supplied to transport the powder. The air flow and pressure must be capable of transporting 1,5 times the maximum powder flow from the screw feeder to the powder wetting unit.

27.6.5 Mixing tank

- a) A stainless steel or FRP mixing tank shall be supplied and installed. The mixing tank shall have at least 200 mm freeboard above static top water level and shall be fitted with the following:
 - i) Outlet connection
 - ii) Drain connection
 - iii) Overflow connection
 - iv) Feed water inlet line
 - v) Support beams for mixer shaft and wetting unit
 - vi) Platform for the accessibility of all the equipment and instruments
 - vii) High and low tank level sensors securely mounted
 - viii) Powder wetting unit
 - ix) Mixer
 - x) Level transmitters (hydrostatic type) and switches to control the addition of water, polyelectrolyte mixer operation and the transfer of polyelectrolyte solution.
- b) The mixing tank shall be mounted on a steel base frame suitable for installing on a concrete floor plinth using stainless steel grade 316 anchor fasteners. Larger mixing tanks can be secured directly to the concrete plinth subject to the Engineer's acceptance. An access platform and stairs shall be provided for maintenance of equipment on the top of the tank. The access platform shall be fabricated from mild steel and hot dip galvanised or painted. This platform shall be connected with the bulk storage hopper platform.
- c) The preparation unit shall completely dissolve the dry polyelectrolyte such that a minimum of 60 minutes aging time is achieved after batching a clear solution is produced (with no "fish eyes").

27.6.6 Mixing tank accessories

- a) Mixer
 - i) The mixer shall be purpose designed and built for complete homogenous mixing of powder polymer dilution batching.

- ii) The stirrer shall be of the propeller type with grade 316 stainless steel shaft and impeller(s). The stirrer shall be automatically controlled. The mixer shall be supported on a mild steel or stainless-steel frame independent of the mixing tank.
- b) Polyelectrolyte Wetting and Make-up Systems
 - i) A proprietary wetting system shall be provided to ensure that uniform and thorough wetting of all polyelectrolyte particles takes place. The wetting system shall be supported on a galvanised or painted steel frame, independent of the tank. If stainless steel tanks are provided the wetting head can be supported from the tank.
 - ii) The wetting and make-up systems shall use potable water.
 - iii) A booster pump shall be supplied as an integral part of the batching system, should the supply pressure be inadequate for optimum operation of the batching system.
 - iv) A pressure gauge shall be fitted to the polyelectrolyte preparation unit batching water piping at the top of tank level and adjacent to the service water isolation valve.

27.6.7 Dosing tank

A stainless steel or FRP dosing tank shall be supplied and installed. The dosing tank shall have an active storage capacity sufficient for at least 2 X batch volumes (working batch volumes made up in batching tank) under normal operating conditions and with at least 200 mm freeboard above static top water level and shall be fitted with the following:

- a) Outlet connection
- b) Drain connection
- c) Overflow connection
- d) High and low tank level sensors securely mounted.

27.6.8 Transfer pumps

- a) The transfer pumps shall transfer batched polymer to the dosing tanks.
- b) Transfer pumps shall comply with requirement for progressive cavity pumps specified in the Standard Specification [315] STD-LRM-MM-0010.

27.6.9 Metering pumps (Dosing Pumps)

Metering pumps shall dose the polymer to the receiving process and comply with requirement for progressive cavity pumps specified in the Standard Specification [315] STD-LRM-MM-0010

27.6.10 In-line mixers

In-line static mixers shall be supplied and installed to ensure complete mixing of the dilution water and polyelectrolyte prior to the point of injection. The mixers shall achieve complete mixing without causing excessive turbulence or destroying the polyelectrolyte flocculant chains.

27.7 CORROSION PROTECTION

Corrosion protection shall be in accordance with the Standard Specification on Corrosion Protection 0 STD-LRM-GN-0006 and the use of non-metallic components shall be maximised.

27.8 SAFETY

Even if no safety equipment is specified the contractor shall install the necessary warning signs and emergency procedures as required by the relevant acts. The cost involved shall be included in the tendered rates for the equipment.

27.8.1 Safety showers and eyewash

For all chemical dosing systems, deluge type safety shower and eye wash stations, conforming to [305] ANSI Z358.1, shall be supplied and installed adjacent to the dosing equipment. Water to these facilities shall come from the potable water supply line. Water supply to safety showers and eyewashes shall be connected directly to the main supply and not be subject to disruption from plant maintenance.

Long water lines to the safety shower and eyewash station that are exposed to sunlight shall be lagged, as water may be heated and therefore unsuitable for use. Lagging shall consist of suitable insulation with fixed/hard covering to prevent water ingress and damage. Examples of suitable covering would be aluminium sheet, or some proprietary plastic lagging systems (subject to the Engineer's acceptance). Aluminium foil tape type lagging covers are not acceptable.

The installation shall be complete including the necessary cut-in into the nearest potable water supply line, fittings, isolation valves, etc. The shower shall be free standing and shall be foot operated. The eye/face wash shall be capable of being operated by both hand and foot and include two double aerated outlets complete with dust covers. The material of construction shall be stainless steel.

27.9 TESTING AND COMMISSIONING

The plant shall be tested and commissioned as a whole in accordance with the Standard Specification on testing and commissioning, 0 STD-LRM-GN-0005.

27.10 MEASUREMENT AND PAYMENT

Item	Description	Unit
27.10.1	Supply and delivery of chemical dosing plant mixers	No

The unit of measurement shall be the number of mixers supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing, transport for delivery to site and off-loading including all handling of the complete unit, which shall include the following:

- Mixer motor and gearbox.
- Mixer impeller shaft and impeller.
- All mounting brackets and fastening equipment.

Separate items will be scheduled in the schedule of quantities for different types and sizes of equipment.

Item	Description	Unit
27.10.2	Installation, testing and commissioning of chemical dosing plant mixers	No

The unit of measurement shall be the number of mixers installed, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment in its position, including full compensation for all required installation materials, labour and consumables, as well as testing and commissioning in order to render a complete and working installation.

Separate items will be scheduled in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the engineer.

Item	Description	Unit
27.10.3	Supply and delivery of chemical Dosing System	No

The unit of measurement shall be the number of Dosing Systems supplied and delivered.

Separate items will be scheduled for different types/chemicals that need to be dosed.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing, transport for delivery to site and off-loading including all handling of the complete unit, which shall include all items to render a complete and operational dosing system.

Item	Description	Unit
27.10.4	Installation, testing and commissioning of chemical Dosing System	No

The unit of measurement shall be the number of Dosing Systems supplied and delivered.

Separate items will be scheduled for different types/chemicals that need to be dosed.

The tendered rates shall include full compensation for the site handling and positioning of the equipment in its position, including full compensation for all required installation materials, labour and consumables, as well as testing and commissioning in order to render a complete and working installation.

No taking-over certificate (or partial taking-over certificate) will be issued for the equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the engineer.

SECTION 28: LINEAR SCREENS AND BELT FILTER PRESSES

DOCUMENT NO.: STD-LRM-MM-0029

CONTENTS

28.1	SCOPE	698
28.2	STANDARDS.....	698
28.3	CORROSION PROTECTION	700
28.4	BELT FILTER PRESS	700
28.5	LINEAR SCREEN	704
28.6	SPIRAL CONVEYOR FOR BELT PRESS DISCHARGE	704
28.7	INSTALLATION	705
28.8	MAINTENANCE, SPARES AND REFURBISHMENT	706
28.9	MEASUREMENT AND PAYMENT.....	706

28.1 SCOPE

This specification covers the design, performance, manufacturing, assembly, factory testing, supply and delivery to site, storage, handling, erection, installation, on site testing, adjustment and commissioning, handing over in complete working order, upholding during and servicing after the Defects Notification Period of mechanical linear screens, mechanical belt filter presses and ancillary equipment for the dewatering of anaerobic digested sludge and waste activated sludge generated at wastewater treatment works.

28.2 STANDARDS

28.2.1 National and International Standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 10400	National Building Regulations
BS PD 5304	Guidance on safe use of machinery
SANS 10162-4	The Design of Cold-Formed Stainless Steel Structural Members (South African code)
SANS 10104	Hand railing and balustrading (safety aspects)
SANS 10064	The preparation of steel surfaces for coating
SANS 9606-1	Testing of welders, where applicable to the type of welding required
SANS 1700-5-8	Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs
SANS 1700-5-9	Fasteners Part 5: General requirements and mechanical properties Section 9: Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
SANS 1700-5-10	Fasteners Part 5: General requirements and mechanical properties Section 10: Mechanical properties of corrosion-resistant stainless-steel fasteners - Set screws and similar fasteners not under tensile stress
BS 292 Part 1	Dimensions of ball bearings, cylindrical and spherical roller bearings

IEC 60529

Degrees of protection provided by enclosures (IP Code)

28.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

STD-LRM-GN-0004	General Design
STD-LRM-GN-0005	Testing and commissioning
STD-LRM-GN-0006	Corrosion protection
STD-LRM-MM-0016	Pipework
STD-LRM-GN-0007	Structural Metal Work
STD-LRM-MM-0008	Electric Motors
STD-LRM-MM-0018	Installation, Erection and Fixing of Equipment to Concrete Structures
STD-LRM-MM-0020	Power Transmission Couplings
STD-LRM-MM-0021	Gear Boxes
STD-LRM-MM-0010	Dry Well Pumping Equipment
STD-LRM-IN-0002	Measuring Instruments

28.2.3 Abbreviations

In this Specification the following abbreviations will apply:-

ANSI :	American National Standards Institute
ASTM :	American Society for Testing and Materials
BS :	British Standards Institution
SANS :	South African National Standards
SIS :	Swedish Institute of Standards
DIN :	Deutsch Industry Normen
ISO :	International Organisation for Standardization
ASME :	American Society of Mechanical Engineers
SAECC :	South African Electrolytic Corrosion Committee
AGMA :	American Gear Manufactures Association

28.2.4 GENERAL REQUIREMENTS

All equipment supplied shall conform to the requirements of the standard specifications - General Design 0, Testing and commissioning 0 and Corrosion protection 0.

The equipment shall be designed to:

- a) Facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- b) Ensure safe and satisfactory operation for an acceptable life expectation of 12 years under the ambient conditions prevailing at the Site,

- c) Prevent undue stresses being produced by expansion due to temperature changes.
- d) Keep maintenance costs to a minimum,
- e) Comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- f) Satisfy any specific requirement contained in the statutory codes and legislation, and
- g) Be suitable for operation 365 days per year, 24 hours per day under specified design conditions.

28.3 CORROSION PROTECTION

Corrosion protection must be carried out strictly in accordance with the requirements of the standard specification on Corrosion Protection 0.

28.4 BELT FILTER PRESS

28.4.1 General Performance Requirements

- a) The solids content of the feed stream will be between 2% and 6% by mass (20 000mg to 60 000mg TSS/litre).
- b) The maximum loading per belt shall not exceed 400kg dry solids per hour.
- c) The belt press discharge shall be at least:
 - i) 22% dry solids content for digested sludge, and
 - ii) 20% dry solids content for waste activated sludge.
- d) The filtrate Suspended Solids (SS) content shall not exceed 300mg/l SS.
- e) The wash water shall not contain more than 1000mg/l SS.
- f) The effective filter belt width shall not exceed 1,8m.
- g) The above performance shall be achieved while not dosing more than:
 - i) For digested primary sludge - -3,0kg flocculants per ton of dry solids.
 - ii) For mixed primary and waste activated digested sludge – 6,0kg flocculants per ton of dry solids.
 - iii) For waste activated sludge – 6,0kg flocculants per ton of dry solids.

28.4.2 Construction Requirements

- a) The belt filter press design shall comprise of three process sections, being:
 - i) A flocculation and mixing section,
 - ii) A gravity dewatering section, and
 - iii) A pressure dewatering section.
- b) In order to contain and manage splashing and to minimize aerosol escape from the press, the design shall be of the enclose type, with all components such as bearings, limit switches and drives units outside of the enclosed area.
- c) The press shall be suitable for operation under a negative pressure. When operating under negative pressure the air extraction opening(s) shall be positioned such that the amount of spray water drawn directly into the ducting is minimized.
- d) Inspection hatches shall be provided on both sides of the press and at the top of the press enclosure to allow examination inside the enclosure of the belts, rollers and general operation of the press.
- e) All moving mechanical and electrical components requiring on-line adjustments and servicing shall be located outside the press enclosure.
- f) An emergency trip wire switch shall be provided on either side of the machine, the trip wire shall extend the full length of the machine, to switch off the machine in case of an emergency.

28.4.3 Sludge Flocculation

- a) The inlet end of the press shall be fitted with an upward flow flocculation tank.
- b) The flocculation and mixing section shall ensure the proper flocculation of the sludge that has been pre-dosed with flocculants.
- c) A suitably designed mixer with continuously variable speed adjustment shall be provided in the flocculation tank for gentle mixing of the sludge and flocculent ensuring that any heavy sludge particles are kept in suspension. The mixer impellor shall be manufacture from 304 L stainless steel.
- d) If an in-line mixer is offered as part of the sludge flocculation, an inspection box is required before discharging onto the gravity drainage section of the press as a visual check on the flocculation process.
- e) The design of the sludge flocculation section shall be such that adequate contact time between the feed sludge and the gravity dewatering section is provided.

28.4.4 Gravity Dewatering

- a) In the gravity dewatering section the sludge shall be pre-thicken prior to entering the press stages of the dewatering section.
- b) The gravity dewatering section shall have strategically positioned sludge ploughs to assist with the removal of excess liquid from the flocculated sludge. The sludge ploughs shall be adjustable.

28.4.5 Pressure Dewatering

- a) The pressure dewatering section shall comprise of sets of dewatering pressure rollers of adequate size to achieve the required degree of dewatering with the pressure being evenly distributed on the sludge to prevent it from being squeezed through or out of the sides of the filter cloth.
- b) The pressure rollers shall be of rigid design to prevent uneven pressure and cake distribution due to deflection of the rollers. The minimum diameter of the pressure rollers shall be 215mm.
- c) The pressure rollers shall be designed using a minimum design load of 10 Newton per linear millimetre with a maximum deflection of 1mm per meter of roller length.
- d) The filter belts shall be driven via drive rollers using externally mounted variable speed drive units controlled by a frequency inverter (VSD). The VSD shall be installed in a controlled environment away from the belt press in a room designed for that purpose.
- e) It shall be possible to adjust the belt speed while the machine is in operation.
- f) The belt tension shall be adjustable and shall be automatically maintain at a predetermined belt tension.
- g) The filter belt tension shall be provided by two adjustable, parallel motion, synchronized belt tensioning devices of an approved design, mounted outside of the side frames.
- h) The filter belt shall be automatically aligned by automatically controlled electrically operated belt edge tracking sensors.
- i) A suitable belt misalignment switch shall be provided to automatically switch off the filter belt press in the event of the belts not being maintained on track. Activation of the misalignment switch shall initiate a local alarm and if connected to a central control room with a SCADA system – on the SCADA system as well.
- j) The belt misalignment switch shall be designed such that it will operate under all operating conditions.

28.4.6 Dewatered Sludge Handling

- a) A chute shall be provided to remove the dewatered sludge from the belt press. The chute shall deposit the dewatered sludge as directed in the detail specification.
- b) A suitable belt scraper/squeegee shall be provided to ensure that the return belt is free from dewatered sludge.
- c) The spray system shall be self cleaning and the brush system shall be removable for inspection purposes.

28.4.7 Wash Water

- a) Final effluent will be made available for wash water purposes. This wash water can contain up to 30mg/litre suspended solids.
- b) The tenderer shall indicate with his tender the amount of wash water required per belt press.

28.4.8 Filtrate and Wash Water Handling

- a) Adequately sized collection trays and sumps within the press housing shall be provided to collect wash water and filtrate from the sludge and to prevent re-wetting of the dewatered sludge.
- b) All liquids shall be piped to a common outlet at the base of the press and suitably flanged for external drainage piping.

28.4.9 Flow Monitoring

The following flows shall be monitored by means of Magnetic Flow meters, conforming to the requirements detailed in [316] STD-LRM-IN-0002, that are an integral part of the belt filter press. Both totalised flow and instantaneous flows shall be displayed locally and be available on the plant SCADA system:

- a) Sludge flow
- b) Polyelectrolyte flow
- c) Dilution water flow
- d) Wash water flow

28.4.10 Material of Construction

- a) Materials of construction and all parts in contact with the sludge, wash water and liberated gases, shall be manufactured from grade 304 and 316 stainless steel. Parts not subject to load may be from other suitable corrosion resistant material such as PVC.
- b) All steelwork outside the enclosure shall be 304 Stainless Steel.
- c) The press shall be of a robust construction incorporating:
 - i) a stainless steel frame and rollers,
 - ii) a stainless steel filtrate collection trays and sump,
 - iii) a stainless steel sludge inlet distribution and flocculation system,
 - iv) a stainless steel sludge distribution chute.
- d) The pressure rollers shall be manufactured using a stainless steel shell to ensure optimum life. Rubber coated mild steel pressure rollers are not acceptable.
- e) Wash water pipe work installed and supported off the belt press shall be manufactured from 304 L stainless steel. PVC piping is not acceptable.
- f) The filter belt shall be of the seamless type manufactured from durable monofilament polyester fibre.
- g) All under water fasteners shall be 316 stainless steel.

28.4.11 Bearings

- a) All bearings shall be grease lubricated and effectively sealed against penetration by dust and water.
- b) All bearings shall be housed external to the press side frames.
- c) All bearings shall have a L10 bearing life of at least 100 000 hours. If the design L10 bearing life exceeds 150 000 hours, then bearings mounted internally to the press side frames may be accepted (at the sole discretion of the Engineer) provided that the greasing points for the bearings are mounted externally to the press side frames and are easily accessible.

28.4.12 Gearboxes

Gearboxes shall preferably be of the hollow shaft, shaft mounted design complying with the requirements of 0.

28.4.13 Motors

- a) Electric motors shall comply with the requirements of 0.
- b) The minimum enclosure protection (IP rating) of electrical motors shall be IP55 with IP65 preferred.
- c) To prevent ingress of moisture, all terminal boxes shall be installed so that the terminal box cable entries are facing downwards.

28.4.14 Pipework

- a) All pipework shall comply with the requirements of [309].
- b) All pressure pipes on the press and sludge pipework shall be manufactured from 304 stainless steel.

28.4.15 Maintenance Platform

A maintenance platform with associated access ladder/s shall be provided as part of the belt press to facilitate maintenance, cleaning and inspections.

The maintenance platform and access ladder/s shall comply with the following requirements:

- a) The platform shall give access to all areas requiring inspection, cleaning and/or maintenance. If it is not practical to access all areas with a single platform, multiple platforms shall be provided.
- b) The platform shall have a minimum width of 1200mm.
- c) One or more access ladders shall be provided to facilitate access to the platform/s.
- d) The platform shall be fitted with kick plates made from angles or flats that rise at least 100 mm above the platform.
- e) The platform shall be fitted with handrails that shall extend up from the ladder and shall continue along the length of the platform and enclose the platform at the far edge.

28.4.16 ELECTRICAL CONTROL PANEL

The filter belt press shall be supplied complete with an integral control panel which shall provide for the following and/or conforms to the following requirements:

- a) The control panel shall have an enclosure rating (IP rating) of not less than IP65 in accordance with [304] IEC 60529.
- b) Provide the following interlocks and/or indication:
 - i) Belt track condition
 - ii) Belt misalignment interlock to prevent belts from being damaged.
 - iii) Belt tear/rip detection
 - iv) Low flow or pressure of wash water
 - v) Low or no flocculent supply
 - vi) Low or no sludge flow
 - vii) Manual stop/start
 - viii) Local Forward and reverse control facility on the belt drive to assist mechanical maintenance to replace belts
 - ix) All of the necessary fault conditions within the belt filter press that will cause damage, system failure or injury.

- x) All indication/warning lights shall be of the cluster LED type.
- xi) An hour meter
- xii) All indications and alarms shall be transferred to the plant SCADA System.

28.5 LINEAR SCREEN

Linear Screens shall conform to all the requirements as specified for Belt Filter Presses as specified in clause 28.4 Belt Filter Press above with the following exceptions/changes:

28.5.1 General Performance Requirements

- a) The solids content of the feed stream will be between 0,4% and 0,5% by mass (4 000mg to 5 000mg TSS/litre).
- b) The linear screen discharge shall be at least 5% dry solids content.
- c) The effective linear screen belt width shall not exceed 2,0m.
- d) The above performance shall be achieved while not dosing more than:
 - i) For digested primary sludge - 3,0kg flocculants per ton of dry solids.
 - ii) For mixed primary and waste activated digested sludge – 6,0kg flocculants per ton of dry solids.
 - iii) For waste activated sludge – 6,0kg flocculants per ton of dry solids.

28.5.2 Construction Requirements

- a) The linear screen design shall comprise of two process sections, being:
 - i) A flocculation and mixing section,
 - ii) A gravity dewatering section.

28.6 SPIRAL CONVEYOR FOR BELT PRESS DISCHARGE

A continuous, reversible centre-less spiral conveyor shall be supplied and installed on the delivery side of the belt press to facilitate the transfer of dewatered sludge as directed in the detail specification. The conveyor shall be supplied complete with all the components as described below. This conveyor shall be equipped with all the safety mechanisms as dictated by the regulations.

28.6.1 General

Conveyor equipment shall be manufactured by a reputable and established supplier with a proven track record of local screw conveyor installations exceeding 15 years. The design shall be adequate for conditions prevailing in treatment works and only new material and components may be used in the manufacture of the conveyors.

A single conveyor may be required to be equipped with multiple intake hoppers as detailed in the detail specification. The material from which the centre-less spiral conveyor is to be fabricated shall be stainless steel grade 304. The constituent elements of the centre-less spiral conveyor shall comprise those detailed below.

28.6.2 The Conveyor Trough.

- a) The Conveyor trough must be manufactured in a “ U “ shape with a lip on either side to accommodate the centre-less spiral with a bent trough. Support legs shall be fitted every 6 m maximum or to suit the application. These support legs will be manufactured in a “ H “ shape from channel steel and be welded to the side of the Conveyor trough and bolted to the floor.
- b) The Conveyor trough shall be flanged at either end to facilitate the mounting of the drive unit and discharge chute or other attachments.

28.6.3 Stainless steel pipes.

Drainage water from the spiral conveyor shall be returned to filtrate sump through stainless steel pipes to be supplied by the contractor.

28.6.4 Drive Unit.

- a) The drive unit shall be suitably sized with an output speed selected to facilitate the load transported and with a minimum service factor of 1.8 on installed power. The drive unit shall be a flanged mounted Inline Helical Bevelled Geared hollow shaft type to accommodate the drive shaft. The drive unit shall be bolted to a drive end flange, machined with spigots and tapped holes for accurate alignment. The protection rating to be IP 55 or higher.
- b) The electric motor shall comply with standard specifications for electric motors. The gearbox also shall comply with the standard specifications for gearboxes.

28.6.5 Conveyor Trough Liners.

The Conveyor trough will be fitted with replaceable two colour 10mm thick liners, complying with the following requirements:

- a) The replaceable liner (pre-bend to the correct trough diameter in 1 meter sections) will be manufactured from material with a low friction co-efficiency combined with high resistance to abrasion.
- b) The standard liner supplied will be a two-coloured liner (6 mm green & 4 mm red) ultra high molecular polyethylene (UHMPE), with the red as an indicator to wear.
- c) The liner must be restrained in position by hold down lugs, welded to the Conveyor trough. The liner will simply be clipped in or out from behind these lugs.

28.6.6 Centre-less Spiral.

- a) The centre-less spiral consists of steel flat bar, cold formed into a strong, flexible spiral manufactured in high tensile Swedish steel. The centre-less spirals must be cold formed to extremely accurate diameter and spiral pitch.
- b) The centre-less spiral is flanged at the drive end and bolted to the flanged drive shaft to facilitate ease of maintenance.

28.6.7 Safety Covers.

Safety covers with a material thickness of no less than 2mm must be provided to cover the whole length of the conveyor. These covers can be hinged or bolted down

28.6.8 Safety Equipment

Any other safety equipment as detailed in the manufacture of conveyors must also be included for.

28.6.9 Discharge Chutes and Attachments.

A discharge chute must be fitted to the one end of the Conveyor trough.

28.6.10 Control Philosophy.

The Conveyor must be interlocked with the belt press control to start with any belt press that discharges into the hopper and to continue to operate for 2 minutes after the belt presses are switched off.

28.7 INSTALLATION

Holding down bolts which are to be built into concrete work for securing the plant shall be grade 316 stainless steel and shall be supplied and installed under this section of the Contract. Grouting up of these bolts will be done by a suitable sub-contractor appointed by the Contractor, after completion of setting up of the plant by the Contractor under this Contract.

28.8 MAINTENANCE, SPARES AND REFURBISHMENT

The design and assembling methods employed during manufacturing of the equipment specified in the standard specification shall be such that refurbishment can be performed timeously, without the necessity of replacing the major structural components of the unit.

28.9 MEASUREMENT AND PAYMENT.

Item	Description	Unit
28.9.1	Design Drawings and General	Lump Sum

The unit of measurement shall be a lump sum.

Separate items shall be scheduled for different systems that are Contractors design.

The tendered rate shall include full compensation to execute the design, prepare drawings including detailed P&IDs, control philosophy, documentation and data sheets in accordance with the applicable Standard Specifications and the requirements as detailed in the Detail Specification for each Contractor designed system as specified.

Item	Description	Unit
28.9.2	Supply and delivery of Linear Screens	No

The unit of measurement shall be the number of Linear Screens.

Separate items shall be scheduled for different sizes/duties as specified or shown on the drawings.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall further include full compensation for all the associated wash water, filtrate and flocculant dosing pipework, inline mixers and flocculant dosing ports and chutes and chute flap valves, couplings and supports and connection to supply points to render a complete and operational unit.

Item	Description	Unit
28.9.3	Supply and delivery of Belt Filter Press	No

The unit of measurement shall be the number of Belt Filter Presses.

Separate items shall be scheduled for different sizes/duties as specified or shown on the drawings.

The tendered rate shall include full compensation for all material, equipment, plant, testing apparatus, labour, manufacturing, corrosion protection, factory acceptance testing, transport, import/export duties, handling and possibly double handling, storage, delivery to and off-loading at Site.

The tendered rate shall further include full compensation for all the associated wash water, filtrate and flocculant dosing pipework, inline mixers and flocculant dosing ports and chutes and chute flap valves, couplings and supports and connection to supply points to render a complete and operational unit.

Item	Description	Unit

28.9.4	Installation, testing and commissioning of Linear Screen	Lump Sum

The unit of measurement shall be a lump sum.

Separate items shall be scheduled for different sizes/duties as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete Linear Screen; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Item	Description	Unit

28.9.5	Installation, testing and commissioning of Filter Belt Press	Lump Sum

The unit of measurement shall be a lump sum.

Separate items shall be scheduled for different sizes/duties as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete Belt Filter Press; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Item	Description	Unit

28.9.6	Supply and delivery of centre-less screw conveyor	No

The unit of measurement shall be the number of conveyors.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete conveyor system as specified with all appurtenances, supports etc.

Item	Description	Unit

28.9.7	Installation, testing and commissioning of Centre-less Screw Conveyor	Lump Sum

The unit of measurement shall be the number of conveyors installed.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete conveyor system; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system

Item	Description	Unit
28.9.8	Supply and delivery of stainless steel launder conveyor	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage and to the site, etc. and all royalties, patent rights, etc. for the complete set of equipment for each launder system as specified with all appurtenances.

Item	Description	Unit
28.9.9	Installation, testing and commissioning stainless steel launder conveyor	Lump Sum

The unit of measurement shall be a lump sum.

Separate items shall be scheduled for launder from and to different locations as specified or shown on the drawings.

The tendered rate shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, commissioning, and maintenance of the complete launder; and for all other costs and actions that are necessary for obtaining a complete and efficiently working system

SECTION 29: MEASURING INSTRUMENTS

DOCUMENT No.: STD-LRM-IN-0002

CONTENTS

29.1	SCOPE	709
29.2	STANDARDS.....	709
29.3	DATA SHEETS.....	710
29.4	GENERAL REQUIREMENTS.....	710
29.5	PNEUMATIC REQUIREMENTS.....	711
29.6	ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS	711
29.7	INSTRUMENTATION SOFTWARE REQUIREMENTS.....	711
29.8	CORROSION PROTECTION	711
29.9	INSTALLATION AND MOUNTING	711
29.10	ANALOGUE INSTRUMENTS.....	712
29.11	SWITCHES.....	716
29.12	THERMOWELLS	717
29.13	ROOT VALVES (SUPPLIED BY PIPING CONTRACTOR).....	718
29.14	IMPULSE LINES.....	718
29.15	CHEMICAL SEALS.....	718
29.16	LABELLING	719
29.17	DOCUMENTATION	719
29.18	FACTORY TESTING	719
29.19	VERIFICATION AND VALIDATION.....	719
29.20	MEASUREMENT AND PAYMENT	719

29.1 SCOPE

This section covers the supply, manufacture, delivery, installation, calibration, testing, commissioning and maintenance of instruments for the measuring of various process variables.

29.2 STANDARDS

29.2.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof (where a national standard (SANS) is referenced in brackets below an IEC or ISO standard the national standard is equivalent to the international standard):

[317]	IEC 61326-1 (SANS 61326-1)	Electrical equipment for measurement, control and laboratory use – EMC requirements
[318]	SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
[319]	IEC 60584	Thermocouples (Part 1-3)
[320]	IEC 60751	Industrial Platinum Resistance Thermometer Sensors
[321]	ISO 9001	Quality Management Systems - Requirements
[322]	IEC 60529 (SANS 60529)	Classification of degrees of protection provided by enclosures

29.2.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

[323]	STD-LRM-GN-0002	Contract administration and general requirements
[324]	STD-LRM-GN-0005	Testing and commissioning
[325]	STD-LRM-GN-0006	Corrosion protection

29.2.3 Standard drawings

The following standard drawings shall be read in conjunction with this specification and shall be deemed to form part thereof:

[326]	STD-BF1&EMA01	Hook-up: Thermal dispersion/ calorific type flow switch
[327]	STD-BF2&EMA01	Hook-up: Electromagnetic flow meter
[328]	STD-BP1&EMA01	Hook-up: Pressure instruments for gas service
[329]	STD-BP2&EMA01	Hook-up: Pressure instruments for liquid service
[330]	STD-BL1&EMA01	Hook-up: Ultrasonic/ radar level instruments
[331]	STD-UF1&EDC01	Floor mount instrument stand
[332]	STD-UF2&EDC01	Wall mount instrument stand

29.3 DATA SHEETS

This specification shall be read in conjunction with the project specific instrumentation data sheets. Where discrepancies are noted between this specification and the datasheet, the requirements as specified in the datasheet shall apply.

29.4 GENERAL REQUIREMENTS

- All wiring shall be compliant with SANS 10142-1 [318].
- All hardware items shall be suited to the chemistry of their application, measured variables, process conditions, mechanical interfaces and installed environment. (Chemistry pitfalls include devices not suitable for the process substance, and material of manufacture not suitable for the mechanical interface, due to electrolytic corrosion between dissimilar metals.)
- All measured process values shall be displayed, and calibrated in SI unit.
- With the exception of C&I cables and their installation, all C&I components shall be designed for at least 10 years' installed life in the specified operational and environmental conditions.
- The Ingress Protection (IP) rating of field mounted instrumentation or their enclosures shall be at least IP 66 as per IEC 60529 [322].
- The Ingress Protection (IP) rating of instrumentation mounted inside Motor Control Centres (MCC) shall be at least IP 20 as per IEC 60529 [322].

29.5 PNEUMATIC REQUIREMENTS

- a) Where applicable, instrument air of suitable quality will be supplied by the mechanical contractor (or others), and shall exhibit the following characteristics:
 - i) Supply pressure: 740 kPa(g) to 885 kPa(g).
 - ii) Dew point shall be -8°C maximum, at which any part of the system is exposed.
 - iii) A maximum 40 µm particle size is allowed.
 - iv) Lubricant content shall be < 1 ppm, measured by mass or volume.
- b) For all instrument air end-users (C&I hardware), a filter regulator with 5 µm filters and integral pressure gauges shall be supplied and installed. Filter regulators shall be used to reduce the supply to pneumatic instruments. However, actuators shall be designed to operate over the full supply pressure range.
- c) Redundant pneumatic sources and/ or reticulation should be considered where the lack pneumatic power reduces plant availability or where pneumatic power is required to perform safety functions.
- d) Multi-way instrumentation manifolds shall be used to distribute instrumentation air to individual consumers.

29.6 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

- a) All C&I equipment shall bear the *Conformité Européenne* (CE) marking.
- b) All instrumentation shall comply with IEC 61326-1 [317], Table 2 – immunity test requirements for equipment intended for use in industrial locations.

29.7 INSTRUMENTATION SOFTWARE REQUIREMENTS

- a) Where firmware is used, the software shall be held in non-volatile memory, which shall be Read-only Memory (ROM), e.g. Electrically Erasable Programmable Read-Only Memory (EEPROM).
- b) Where software is used, it shall be developed in accordance with the requirements of a recognized software development standard.
- c) Where Commercial-off-the-shelf (COTS) software is used, its development process shall comply with ISO 9001 [321].

29.8 CORROSION PROTECTION

Corrosion protection of instrumentation and supports shall comply with STD-LRM-GN-0006 [325].

29.9 INSTALLATION AND MOUNTING

- a) All cabling to and from instruments shall be installed with a drip loop.
- b) The drip loop shall be installed lower than the instrument and shall consist of the cable looped in a circle with diameter not less than 200 mm.
- c) Instrumentation installed outdoors shall either be immune against UV radiation or equipped with a suitable UV shield or canopy.
- d) When practical, instruments shall not be mounted on, or near hot process lines, ductwork or other hardware subject to temperatures > 60 °C.
- e) When locating each instrument, special consideration shall be given to its position and orientation, with regard to accessibility for monitoring, maintenance, repair and calibration.
- f) Transmitters or local controllers shall be located as close to the primary process connections as possible, whilst observing the instrument accessibility and mounting requirements already stated.
- g) Instruments shall be installed so as not to cause any obstruction to walkways, headroom or access to other plant items.
- h) Only approved cable compression glands shall be used for the glanding of un-armoured cables.
- i) The drilling of holes in structural steelwork is not permitted, except with the prior written approval of the responsible engineer.
- j) The drilling of holes in vessels or pipework is prohibited.

- k) When holes are drilled in galvanized steelwork, in order to fit support brackets, it must be with the prior written approval of the responsible engineer. All such drilled holes shall be treated in accordance with STD-LRM-GN-0006 [325] to restore the corrosion protection properties.
- l) Welding on any type of vessel, structural steel or pipe shall have the prior written approval of the responsible engineer.
- m) Field instruments (unless in-line) shall be mounted on 50 mm stanchions or wall mount supports with single or dual heads with respect to the number of instruments to be mounted, refer to drawing STD-UF1&EDC01[331] and STD-UF2&EDC01 [332].
- n) Instrument stanchions or wall mount supports shall be hot dipped galvanised as per STD-LRM-GN-0006 [325].
- o) Stands shall not be mounted on removable grating, or on handrails. Where mounted on a catwalk/platform, the preferred location shall be on the outside of the handrails.
- p) Instruments specified for surface mounting may be mounted on a wall or on a vertical flat steel plate suitably supported from a column, stanchion or platform, or mounted with brackets in accordance with the relevant drawing.
- q) Instrument supports and mounting brackets shall be of suitable strength and rigidity to ensure proper operation of the instrument. Careful attention shall be given to ensure that instruments are not mounted on or attached to hardware or structures which are subject to vibration. All proposed locations shall be approved by the responsible engineer before installation.

29.10 ANALOGUE INSTRUMENTS

- a) All transmitters shall provide a galvanically isolated 4...20 mA output signal linear to the measured process variable.
- b) Enclosures housing transmitters with local indication shall be fitted with a glazed door, for a clear view of the instrumentation installed inside. The glazing shall be safety glass.
- c) The detail specification or data sheet shall indicate where remotely mounted transmitters (i.e. separate from element) are required.

29.10.2 Differential Pressure Flow Instruments

- a) Differential pressure instruments shall support square root extraction, and this shall be configured at source. Signal noise filtering (if different from anti-aliasing filtering) shall be performed before square root extraction.
- b) The length of the impulse lines for differential pressure flow measurement shall be kept to a minimum.
- c) All differential pressure instruments shall be fitted with five-way manifolds to enable online calibration and proof testing.

29.10.3 Averaging Pitot Tube Flow Instruments

- a) The averaging pitot tube shall have opposite side supports irrespective of the application.
- b) All calculations are to be supplied, for each installation, including limiting conditions.

29.10.4 Electro Magnetic Flow Meters

- a) Refer to hook-up drawing STD-BF2&EMA01 [327].
- b) Electro magnetic flow meters shall not be specified for service with systems that contain a process medium with conductivity $\leq 20 \mu\text{S/cm}$.
- c) All necessary steps shall be taken to ensure that the process medium and the sensor have the same electrical potential. Sensors with standard installed reference electrodes which guarantee the required potential matching are preferred.
- d) The element shall be supplied complete with earthing discs manufactured from stainless steel grade 316 or better.
- e) The flow meter shall be positioned so that the pipework is full of liquid and no air can get trapped in the magnetic tube.

- f) The transmitter shall be equipped with a digital rate of flow indicator, preferably of the LCD type, a non-resettable flow totalizer, totalising in cubic metres, a galvanically isolated 4...20 mA output linear to flow and an isolated pulsed output for remote flow totalising.
- g) The flow meter shall be installed with sufficient upstream and downstream diameters, as per the manufacturer's recommendations, to ensure non-turbulent flow.
- h) The instrument shall preferably operate on a pulsed DC field or other means to reduce power consumed and prevent electrode polarisation and zero drift.
- i) The instrument shall have a variable span facility, with automatic zero control and a signal hold facility.
- j) For waste water treatment works, the detector liner shall be of hard wearing ebonite rubber suitable for sewage water applications and shall extend over the flange faces.
- k) The following requirements shall also be included:
 - i) Electrode cleaning circuitry to remove electrically conductive deposits in the measuring tube, e.g. in accretive mediums.
 - ii) Electrodes shall be manufactured from stainless steel grade 316 or better.
 - iii) Empty pipe detection for recognition of partially filled measuring tubes, or for degassing mediums or for applications with fluctuating process pressure.
 - iv) Replaceable measuring electrodes for abrasive mediums.
 - v) Meter calibration shall be traceable to an internationally acceptable prime standard.
 - vi) Safe access to the integral transmitter shall be provided for routine testing and calibration activities.
- l) The magnetic flow meter shall be maintenance free.
- m) Magnetic Flow Meter Accuracy
 - i) The accuracy of the instrument shall be guaranteed equal or better than:
 - (1) $\pm 0,5\%$ of measured flow in the flow range 50 - 100%
 - (2) $\pm 0,1\%$ of full scale for flows in all other ranges.
 - ii) The repeatability of the instrument shall be better than 0,1% of full scale deflection and the linearity of the instrument shall be better than 0,05% of full scale deflection.
- n) Magnetic Flow Meter Installation
 - i) Where electromagnetic instruments are required, a removable pipe section of adequate length will be provided by the piping Contractor. This pipe section will be flanged on one side and will be supplied with a Viking-Johnson (VJ) coupling on the other side.
 - ii) Before ordering the detector head, the Contractor shall ascertain the flange details of the pipe supplied so that the detector flanges and pipework flanges match.
 - iii) The lining of the flow meter element shall not be used as a gasket. Suitable gaskets shall be provided and installed between the flow meter head, earthing rings and adjacent pipe work.
 - iv) A suitable local earth shall be provided by means of 1,8 m copper earthing electrodes connected the element by means of 4 mm² bare copper earth wire. Sufficient electrodes shall be provided to obtain an earth resistance of less than 1°Ω.

29.10.5 Coriolis Mass Flow Meters

- a) The sensor shall be installed at least 0.6 m from any large transformer, motor or other large interfering electromagnetic field.
- b) When measuring gas flow, the equipment shall be installed in such a way as to prevent accumulation of condensate within the flow tubes.
- c) When measuring liquid flow, the equipment shall be installed inverted so that the case is below the pipeline, thereby avoiding the trapping of air in the tubes.
- d) When measuring liquid slurries, the sensor shall be installed in a vertical line to avoid particle accumulation in the flow tubes. This facilitates cleaning if process lines are purged with gas or steam.

- e) Note: It is important to ensure that vapour/air cannot collect in the meter (for liquid applications) during zero flow, nor be present in large quantities during normal operation.
- f) In batching operations the flow meter and shut-off valve shall be located as close as possible to the receiving tank to minimize errors.
- g) The accuracy of the instrument shall be guaranteed equal or better than 0.1% of the measured flow.

29.10.6 Pressure Gauges

Note: Pressure gauges for the pump suction and discharge monitoring are normally supplied complete with the pump set by the mechanical contractor. The requirements below are for other pressure gauges supplied by the C&I contractor.

- a) The maximum range of bourdon tube type pressure gauges shall be no more than 1,5 times the operating pressure.
- b) Pressure gauges shall be equipped with a condensate seals for hot vapour or steam service.
- c) Pressure gauges shall be remotely mounted (at grade) supplied with the following:
 - i) Pressure gauges with 316 SS bourdon tube and blowout disc located at the rear.
 - ii) 100 mm diameter dial with black characters on a white background.
 - iii) Where applicable, the dials shall be marked with the required red lines in accordance with governing regulations (i.e. design/test pressures).
 - iv) Glycerine filled.
 - v) Shatterproof glass.
 - vi) ISO 7 DN 15 mm male process connection, or flanged as indicated on the Piping and Instrumentation Diagram (P&ID), to the vessel or piping specification.
 - vii) All pressure gauges shall be fitted with two-way manifolds to enable online calibration, proof testing and venting for safe removal. Vent drains shall be provided for the safe depressurisation and venting of hazardous services.

29.10.7 Pressure Instruments

- a) Refer to hook-up drawings STD-BP1&EMA01 [328] and STD-BP2&EMA01 [329].
- b) Pressure instruments shall be equipped with a condensate seals for hot vapour or steam service.
- c) All pressure instruments shall be fitted with integral local indicators.
- d) Materials for the sensing elements shall be selected to resist corrosion by the process fluid and the mounting environment.
- e) Separate process connections shall be provided for each instrument, especially where a pressure instrument performs a critical duty, such as forming part of an emergency trip system.
- f) Pressure instruments subject to pulsation shall be fitted with pulsation dampers.
- g) All pressure instruments shall be fitted with two-way manifolds to enable online calibration, proof testing and venting for safe removal. Vent drains shall be provided for the safe depressurisation and venting of hazardous services.
- h) The manifold ports or isolation valves shall be ISO 228 DN 15 mm.
- i) The measured value of instruments with fluid filled impulse lines shall be compensated for static head.

29.10.8 Level Instruments

- a) Refer to hook-up drawing STD-BL1&EMA01 [330].
- b) The unit of measure for level shall be percentage (%), where 100% is the designed operating volume of a vessel.
- c) Where required to support operations and maintenance activities, level transmitters shall be fitted with integral local indicators. This indication shall display a linearized reading where practical.

- d) Level instruments that make use of moving parts to measure level shall be avoided.
- e) Where level transmission utilizes differential pressure techniques, a means of online calibration and proof testing shall be incorporated.
- f) Ultrasonic or radar (microwave) level instruments shall be microprocessor based, non-contact level meters and shall be programmable to read level or volume accurately in an irregularly shaped container.
- g) Ultrasonic or radar (microwave) level instruments shall include temperature compensation.

29.10.9 Open channel flow meters

- a) Open channel flow meter shall be microprocessor based, non-contact level meters and be able to be programmed to read flow accurately passing through any type and fume or over any type of weir.
- b) Open channel flow meters shall provide for the following standard primary flow elements:
 - i) Venturi flumes
 - ii) V-notched weirs
 - iii) Parshall flumes
 - iv) Broad crested weirs
- c) Open channel flow meters shall be equipped with a digital rate of flow indicator, preferably of the LCD type, a non-resettable flow totalizer, totalising in cubic metres, a galvanically isolated 4...20 mA output linear to flow and an isolated pulsed output for remote flow totalising.
- d) Open channel flow meters shall be supplied complete with mounting bracket and frame. The mounting frame shall be rigid and made from grade 316 stainless steel.

29.10.10 Dissolved Oxygen Instruments

- a) The probe shall be rigid and made from grade 316 stainless steel.
- b) The probe shall be mounted in such a way that it is free from all handrails, walkways, etc.
- c) The transmitter shall be mounted in an enclosure with an ingress protection rating of no less than IP65.
- d) Class 1 and 2 power and signal surge protection devices, of suitable rating, shall be supplied and installed within the field mounted enclosure, to protect the transmitter against switching and lighting surges.

29.10.11 Analytical Instruments

- a) The sampling of process streams to remote mounted analysers shall be kept to the minimum. Wherever possible, the detector shall be inserted in the process line by way of a suitable installation.
- b) Should there be a requirement for remote mounted analyser devices, the sample requirements and conditions shall be defined to enable the design of a suitable conditioning system, clearly indicating all utilities/ services required at this interface. The initial fill of calibration gas and six months of supply shall also be supplied.
- c) All the necessary components (e.g. enclosures) to ensure a proper operational environment for their instrument shall be supplied.
- d) Prefabricated analyser installations are preferred to reduce on-site fabrication works and shall provide a complete and functional installation that can be tested prior to delivery to site.
- e) Arrangements shall be provided for isolation from on-line operations, routine calibrations and maintenance.
- f) Where specialist services are a requirement for the calibration of the analysers, the supplier shall ensure the availability of client personnel for the commissioning and training.

29.10.12 Temperature Instruments

- a) The standard unit of measure shall be degrees Celsius (°C) for all measurements.
- b) Thermocouple and RTD sheaths shall have a maximum outer diameter of 6 mm.

- c) Thermocouples shall be ungrounded.
- d) Dual thermocouples should be provided wherever practical.
- e) Thermocouples shall comply with IEC 60584 [319], unless otherwise stated.
- f) The following options and deviations from this standard IEC 60584 [319] shall apply:
 - i) Class 2 thermocouples (measuring junction not grounded).
 - ii) Compensating/extension cable shall be of tolerance class 1 according to IEC 60584 [319].
 - iii) Sheath material: stainless steel, Inconel, or Nicrobell-C.
- g) Compensation/extension cable colour coding shall comply with IEC 60584 [319].
- h) Temperature transmitters shall include, as a minimum for the following:
 - i) Cold junction compensation.
 - ii) Linearization as per IEC 60584 [319].
- i) Compensating/extension cable, suitable for the environmental conditions and the type of thermocouple, shall be used between the thermocouple and its transmitter.
- j) An additional compensating/ extension cable length of 1,5 m shall be provided to facilitate the easy withdrawal of the sheath from the thermowell without having to disconnect the electrical terminations.
- k) RTDs shall only be used where the thermocouple alternatives will not be able to fulfil the functional requirement for the specific application. The RTDs shall comply with the following:
 - i) Three-wire Pt100 RTDs shall be used.
 - ii) The RTDs shall be manufactured to IEC 60751 [320] Class A tolerance band.

29.10.13 Bimetallic Temperature Gauges

Bimetallic temperature gauges shall have the following characteristics:

- a) Sheaths shall have a maximum outer diameter of 6 mm.
- b) Stem sockets and case material shall be 316 SS and shall be hermetically sealed.
- c) 100 mm diameter dial with black characters on a white background.
- d) Where applicable, the dials shall be marked with the required red lines in accordance with governing regulations (i.e. design/test temperatures).
- e) Shall be glycerine filled.
- f) Shall be fitted with shatterproof glass.
- g) ISO 7 DN 15 mm male process connection.
- h) Shall be of the 'every angle' type.

29.11 SWITCHES

29.11.1 Flow switches

- a) Refer to hook-up drawings STD-BF1&EMA01 [326].
- b) Where flow switches are implemented to protect pumps against low flow conditions, these switches shall be installed downstream of the protected equipment to provide the maximum possible diagnostic coverage.
- c) Thermal or calorific type flow switches are preferred for pump low flow protection.

29.11.2 Temperature switches

Bimetallic temperature switches shall have the following characteristics:

- a) Sheaths shall have a maximum outer diameter of 6 mm.
- b) Stem sockets and case material shall be 316 SS and shall be hermetically sealed.

29.11.3 Limit switches

Double Pole Double Throw configuration shall be used for switch-over contacts.

29.11.4 Pressure switches

- a) Refer to hook-up drawings STD-BP1&EMA01 [328] and STD-BP2&EMA01 [329].
- b) Materials for the sensing elements shall be selected to resist corrosion by the process fluid and the mounting environment.
- c) Separate process connections shall be provided for each instrument, especially where a pressure switch performs a critical duty, such as forming part of an emergency trip system.
- d) Pressure switches subject to pulsation shall be fitted with pulsation dampers.
- e) All pressure switches shall be fitted with two-way manifolds to enable online calibration and proof testing.

29.11.5 Differential pressure switches

- a) Materials for the sensing elements shall be selected to resist corrosion by the process fluid and the mounting environment.
- b) All differential pressure switches shall be fitted with five-way manifolds to enable online calibration and proof testing.
- c) Differential pressure switches subject to pulsation shall be fitted with pulsation dampers.
- d) Where Differential Pressure Switches are to be used in applications important to safety, they shall be independent of any differential pressure transmitting devices.

29.11.6 Float switches

- a) Float level sensing shall be by means of totally encapsulated mercury-free type float level switches suitable for the density of the measured medium, complete with the required length of cable.
- b) All mounting and support materials shall be grade 316 stainless steel
- c) All level switches shall be wired to the respective IP68 protection class connection boxes (e.g. Pratley boxes or similar) where they shall be terminated on an approved terminal strip mounted on the approved respective DIN rails.
- d) The minimum terminal strip length shall be 150mm.
- e) All cable glands shall have an IP68 protection rating or better.
- f) The Contractor shall supply the respective DIN rails, above, to fit inside the respective Pratley boxes.

29.11.7 Proximity switches

Proximity switches shall be fitted with status indication LEDs to assist adjustments and fault finding

29.12 THERMOWELLS

- a) Thermowells shall be installed to house thermocouples and RTDs, except when they are used for skin temperature measurements.
- b) The shank shall be fabricated out of bar stock only and bored out straight and smooth to allow for a tight fit of the temperature elements.
- c) The shank shall be of sufficient length to ensure that the sensitive length of the thermometer is fully immersed into the process medium. The shank shall be tapered on the outside for increased structural strength.
- d) Calculations shall be done to illustrate that the mechanical load of the thermowell conforms to design specifications. Mechanical loading shall be calculated with specific regard to process media, media flow rate, media pressure, media temperature, media flow-induced vibrations, method of fitting, shank length, material, fatigue life, response time and measurement accuracy.

29.13 ROOT VALVES (SUPPLIED BY PIPING CONTRACTOR)

Definition: "**Root Valve**" is a common term used in an oil refinery or other type of process plant as a generalization for a valve that, by its placement is the primary shut-off valve for a sub-header leaving a main header. The "Root" has more to do with the placement or location rather than the type of valve.

- a) Root valves will be supplied for all impulse lines.
- b) Root valves shall be accessible for isolation purposes.
- c) Root valves shall be installed as close as practically possible to the process connection. The root-valve stem and handle shall be clear of any main-line insulation. If a root valve close to the process connection is not accessible during normal operations (e.g. due to location), then the root-valve function shall be made accessible by one of the following means:
 - i) Relocation of the process connection to an accessible location.
 - ii) Installation of a reach rod, special tool facility or other arrangement to operate valve.
 - iii) Installation of a second root valve at a point where the sample line becomes accessible.
 - iv) Installation of a suitable platform and access ladder.

29.14 IMPULSE LINES

- a) Flow restrictors shall be installed on impulse lines where pressures can exceed 200 kPa or temperatures can exceed 100°C.
- b) Impulse line connectors suitable for the application shall be used. Test certificates issued by an independent test authority shall be made available on demand to prove that the connectors are suitable for a particular application.
- c) The design shall be such that it minimizes vibration, provides adequate support, allows for thermal expansion, and prevents mechanical wear (rubbing) on impulse lines.
- d) Flexible piping or pipe loops shall be used to connect components that have a relative movement to the other end of the piping connection.
- e) Flexible piping shall be kink resistant and be able to handle 10 bar at 60°C.
- f) Impulse and pneumatic lines shall be of stainless steel grade 316 with Outside Diameter (OD) stipulated as follows:
 - i) 12 mm for impulse lines for gas or liquid flow. Should the liquid have a high viscosity then a 16 mm line size shall be used.
 - ii) 12 mm for impulse lines for gas or liquid pressure.
 - iii) 20 mm for Pneumatic Air Supply lines.
 - iv) 8 mm for Pneumatic Control lines.
 - v) 12 mm for all steam applications.

29.15 CHEMICAL SEALS

- a) All pressure measuring points shall be fitted with chemical seals when:
 - i) It is indicated on the P&ID, MFD or other drawings or specified in the detail specification.
 - ii) Where the process medium would corrode the instrument connection and pressure sensing element.
 - iii) Where the process medium contains suspended solids or is viscous enough to clog the instrument connection and the pressure sensing element.
 - iv) Where the process medium might freeze or solidify in the instrument connection and sensing element due to temperature changes.
 - v) Where changing process medium requires flushing the system to prevent contamination.
 - vi) Where the process application requires "food grade" connections.
 - vii) Where the measuring instrument has to be remote mounted to protect it from high ambient temperatures, vibration, harsh environments, or accessibility problems.

- b) The seal displacement shall be greater than that of the instrument.

29.16 LABELLING

All instruments shall be provided with an engraved stainless steel Manufacturer's Data Plate specifying, where applicable, the following:

- a) Instrument tag
- b) Manufacturer's name
- c) Model and serial number
- d) Operating range
- e) Element type
- f) Calibration due date

29.17 DOCUMENTATION

- a) Notwithstanding the requirements of STD-LRM-GN-0002 [110] the following documentation requirements apply:
- b) The Tenderer shall supply completed data sheets for all the instruments offered with his tender.
- c) The Operational and Maintenance manuals shall include detailed drawings for configuration, installation, calibration, maintenance and operational aspects.
- d) Traceable calibration certificates shall be supplied by the vendor of C&I hardware.
- e) A relevant certificate shall accompany each type of hardware device certified for use in a hazardous area. These hazardous area compliance certificates shall be properly filed, with an index. Each certificate shall be cross-referenced to the applicable tag names of the devices.

29.18 FACTORY TESTING

- a) Notwithstanding the requirements of STD-LRM-GN-0005 factory testing shall include:
- b) Visual inspection of equipment and quality of material (before and after working) for soundness of construction, labelling and calibration certificates where applicable.

29.19 VERIFICATION AND VALIDATION

- a) All instrumentation sensors, transmitters, actuators, and other hardware devices shall be calibrated and tested by the vendor, to the satisfaction of the client, or his representative, prior to shipment.
- b) The supplier shall also certify instrumentation enclosures.
- c) Test and traceable calibration certificates shall be generated via the quality procedures of the supplier and be traceable to international standards.

29.20 MEASUREMENT AND PAYMENT

Item	Description	Unit
29.20.1	Supply and delivery of electro magnetic flow meters	No

The unit of measurement shall be the number of electro magnetic flow meters supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of electro magnetic flow meters, complete with control units, two earthing rings, brackets and pedestals, enclosures, interconnecting cables, earth spike, BCuEW, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.2	Install instruments	No

Separate items shall be scheduled under this payment item for each instrument type.

The unit of measurement shall be the number of instruments installed.

The tendered rate shall include full compensation for the installation of the required amount of instruments, inclusive of all labour, installation materials and sundries to give a fully operational and serviceable installation.

Item	Description	Unit
29.20.3	Commission instruments	No

Separate items shall be scheduled under this payment item for each instrument type.

The unit of measurement shall be the number of instruments to be commissioned.

The tendered rate shall include full compensation for the commissioning and calibration of the required amount of instruments including proving of all connected exterior indicating and control loops. The rate shall be all inclusive of all labour and commissioning materials and use of commissioning instruments.

Item	Description	Unit
29.20.4	Supply and delivery of flow switches	No

The unit of measurement shall be the number of flow switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of flow switches, complete with brackets and pedestals, where applicable amplifier enclosure, interconnecting cables and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.5	Supply and delivery of pressure instruments	No

The unit of measurement shall be the number of pressure instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of pressure instruments, complete with brackets and pedestals, interconnecting cables, tubing and tube fittings, manifold, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.6	Supply and delivery of pressure switches	No

The unit of measurement shall be the number of pressure switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of pressure switches, complete with brackets and pedestals, interconnecting cables, tubing and tube fittings, manifold and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.7	Supply and delivery of level instruments	No

The unit of measurement shall be the number of level instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of level instruments, complete with brackets and pedestals, interconnecting cables, tubing and tube fittings, manifold, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.8	Supply and delivery of float switches	No

The unit of measurement shall be the number of float switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of float switches, complete with mounting brackets, interconnecting cables, field termination boxes complete with terminals and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.9	Supply and delivery of differential pressure flow instruments	No

The unit of measurement shall be the number of differential pressure flow instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of differential pressure flow instruments, complete with brackets and pedestals, interconnecting cables, tubing and tube fittings, manifold, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.10	Supply and delivery of averaging pitot tube flow instruments	No

The unit of measurement shall be the number of averaging pitot tube gas flow instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of averaging pitot tube gas flow instruments, complete with control units, brackets and pedestals, enclosures, interconnecting cables, tubing and tube fittings, manifold, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.11	Supply and delivery of differential pressure switches	No

The unit of measurement shall be the number of differential pressure switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of differential pressure switches, complete with brackets and pedestals, interconnecting cables, tubing and tube fittings, manifold and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.12	Supply and delivery of pressure gauges	No

The unit of measurement shall be the number of pressure gauges supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of pressure gauges, complete with manifold, brackets and pedestals and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.13	Supply and delivery of open channel flow meters	No

The unit of measurement shall be the number of open channel flow meters supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of open channel flow meters, complete with control units, brackets and pedestals, enclosures, interconnecting cables, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.14	Supply and delivery of dissolved oxygen measurement instruments	No

The unit of measurement shall be the number of dissolved oxygen measurement instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of dissolved oxygen probes, complete with control units, transmitter, brackets and pedestals, enclosures, interconnecting cables, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.15	Supply and delivery of analytical instruments	No

Separate items shall be scheduled under this payment item for each type of analyser.

The unit of measurement shall be the number of analytical instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of analytical instruments, complete with sampling system where applicable, analyser, calibration gasses, transmitter, brackets and pedestals, enclosures, interconnecting cables, tubing, tube fittings, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.16	Supply and delivery of temperature instruments	No

The unit of measurement shall be the number of temperature instruments supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of temperature instruments, complete with specified element, brackets and pedestals, enclosures, compensating/extension cable, surge suppressors and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.17	Supply and delivery of temperature switches	No

The unit of measurement shall be the number of temperature switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of temperature switches, complete with brackets and pedestals and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.18	Supply and delivery of bimetallic temperature gauges	No

The unit of measurement shall be the number of bimetallic temperature gauges supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of bimetallic temperature gauges, complete with brackets and pedestals and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.19	Supply and delivery of thermowells	No

The unit of measurement shall be the number of thermowells supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of thermowells, complete with all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.20	Supply and delivery of limit switches	No

The unit of measurement shall be the number of limit switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of limit switches, complete with brackets and pedestals, interconnecting cables and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

Item	Description	Unit
29.20.21	Supply and delivery of proximity switches	No

The unit of measurement shall be the number of proximity switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the required amount of proximity switches, complete with mounting brackets, interconnecting cables, field termination boxes complete with terminals and all other sundry requirements, levies and royalties to make a complete and serviceable installation.

SECTION 30: PROPELLER PUMPING EQUIPMENT

DOCUMENT No.: STD-LRM-MM-0012

CONTENTS

30.1	SCOPE	724
30.2	DESIGN OF PROPELLER PUMPING EQUIPMENT	725
30.3	GENERAL DESCRIPTION OF PUMPS	726
30.4	PROPELLER PUMP DESIGN	726
30.5	MOTOR AND DRIVE	727
30.6	FLAP GATES	728
30.7	OPERATION	728
30.8	INSTALLATION	728
30.9	QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE	728
30.10	MEASUREMENT AND PAYMENT	729

30.1 SCOPE

This specification covers the detailed design parameters, manufacture, supply, installation, test and commissioning of mechanical type propeller pumping equipment for the (a) and (r) recycles within the biological reactor unit process of a wastewater treatment works. The Specification shall be read in conjunction with that of the Project Specification and all relevant other Particular Specifications. The scope of the equipment required under the Contract shall be project specification.

30.1.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof (where a national standard (SANS) is referenced in brackets below an IEC or ISO standard the national standard is equivalent to the international standard):

SANS 10400: 1990	National Building Regulations
BS 5304: 1988	Code of practice for safeguarding of machinery
SANS 9096-1: 1994	Testing of welders, where applicable to the type of welding required
BS 292 Part 1: 1987	Dimensions of ball bearings, cylindrical and spherical roller bearings
SANS 10044-3	Welding Part 3: The fusion of steel (including stainless steel): Tests for the approval of welding procedures
SANS 10044-4	Welding Part 4: The fusion welding of steel (including austenitic stainless steel): Tests for the approval of welders working where weld procedure approval is not required.
SANS 10064	The preparation of steel surfaces for coating
SANS 10111-2-1	Engineering Drawing Part 1: General principles Engineering Drawing Part 2: Geometric Tolerancing Section 1
SANS 10341	Installation and maintenance of bearings – General guidelines
SANS 1700-5-9	Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless-steel fasteners-Bolts, Screws & Studs
SANS 1700-5-10	Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless-steel fasteners-Nuts

30.1.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

STD-LRM-GN-0004	General Design
STD-LRM-MM-0008	Electric motors
STD-LRM-MM-0020	Power transmission couplings
STD-LRM-MM-0006	Equipment for the Measurement of Fluid/Flow Properties
STD-LRM-GN-0006	Corrosion protection
STD-LRM-GN-0005	Testing and Commissioning

30.2 DESIGN OF PROPELLER PUMPING EQUIPMENT

30.2.1 General Design Parameters

Axial flow pumping equipment shall be designed such that the following requirements are met:

- To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- To ensure safe and satisfactory operation for an acceptable life expectation of 12 years under the ambient conditions prevailing at the Site,
- To prevent undue stresses being produced by expansion due to temperature changes.
- To keep maintenance costs to a minimum,
- To facilitate inter-changeability of units and/or sub-parts throughout the Contract works with regard to new equipment and equipment and/or sub-parts currently being used on the existing JW Wastewater Treatment Works,
- To operate without undue vibration and excessive noise. Maximum of 85dBA measured at 1.0 metre from operating equipment,
- To comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- To satisfy any specific requirement contained in the statutory codes and legislation, and
- To be suitable for operation 365 days per year, 24 hours per day under specified design conditions.

30.3 GENERAL DESCRIPTION OF PUMPS

30.3.1 Specific Performance Design Parameters

The (a) and (r) recycle pumping equipment shall be of the axial flow type capable of pumping large volumes of mixed liquor at relatively low resistance - (Head)

The pumping duty for each pumping set shall be specified in the Project Specification.

The design of the propeller blades shall be such as to eliminate the undue accumulation of rags and debris material around the impellers and the shaft.

The design of the inlet throat tube, propeller blades, flap non return valves etc shall be such that there is no air entrainment in the recycled liquor.

The recycle flow rate shall be adjustable. Adjustability in the flow rate shall be accomplished by means of varying the pitch angle of the blades or by means of a v-belt driven pulley arrangement.

A surface mounted cantilever type design shall be required to eliminate submerged driven bearings supporting the driven shaft of the pump.

Different types of metals shall be isolated from one another to prevent corrosion due to galvanic reaction.

30.4 PROPELLER PUMP DESIGN

30.4.1 Body

The pump body shall be fabricated from Grade 300 W galvanised mild steel in accordance with SANS 1431: 2003 or made of cast iron and shall be designed to house the upper and lower bearing assemblies.

30.4.2 Propeller Shaft

The propeller shaft shall be manufactured from 304 L stainless steel suitable designed to transmit the imposed torque loads induced by the propeller and withstand all cantilevered loads imposed under undue conditions during operation.

30.4.3 Propeller Blades

The propeller blade shall be of a well proven swept back design selected to achieve the required head and flow characteristics and must be manufactured from 304 L cast stainless steel. The propeller blade shall be locked to the lower end of the shaft.

30.4.4 Balancing

The blade assembly shall be subjected to static and dynamic balancing before final onsite installation. Vibrations in operation shall be kept to a minimum and it will be the Contractors responsibility to check this torsional vibration for each pump set assembly, in-situ.

The propeller shall have a maximum vibration velocity of 2.5 mm/s at specified conditions. Static balancing alone is not acceptable as there is no qualitative measurement of the remaining amount of unbalance left in the assembly and does not confront the basic definition of checking unbalance against a known standard.

30.4.5 Throat Tube

A suitable designed throat tube constructed from 304 L stainless steel shall be provided. This item shall be grouted into the exiting civil structure.

The clearance between the propeller and throat tube must ensure that a minimum of liquid slip takes place thus maintaining maximum efficiency. Bell mouthed inlet and outlet openings must be incorporated to ensure smooth entry and exit flow conditions.

30.4.6 Corrosion Protection

All mild steel members shall be prepared and coated in accordance with Particular Specification STD-LRM-GN-0006.

The corrosion protection of Stainless-steel welds shall entail pickling and passivating in accordance with Particular Specification STD-LRM-GN-0006.

30.4.7 Bearings

All bearings shall be designed for a life of at least 100 000 hours at an (L 10) rating. Bearings for the output shaft shall be designed to withstand bending, up thrust, down pull and radial loads imposed by the pump impellor. Contractors shall indicate what these forces are and how these shall be accommodated.

Calculations shall be submitted with the Tender. Failure to do so may render the Tender invalid. The bearings shall carry all axial and radial loads and accommodate any thermal expansion. Bearings should be sealed against the ingress of liquid and must be selected for a L10 life in excess of 100 000 hours.

For ease of lubrication all bearing grease pipes must be piped to grease nipples on the outer cover of the pump support frame.

30.4.8 Fasteners

All submerged and concrete securing fasteners shall be 316 SS. All mating flanges shall be sealed against the ingress of any crevice corrosion by means of a sealant suitable for underwater conditions and approved by the Engineer.

30.4.9 Colour Coding

The standard final colour codes for equipment supplied under this Contract shall be in accordance with Particular Specification G01: Colour Coding.

30.5 MOTOR AND DRIVE

Belt driven pumps are preferable to gearbox driven pumps.

The upper end of the drive assembly must be fitted with an adjustable tensioning bracket for mounting the drive motor. This arrangement shall make provision for adjustment of “v” belt tension and allow for changing pulleys without difficulty. All rotating elements shall be provided with adequate guarding to cater for all probable pulley sizes.

The guards must be domed to avoid water ponding and contamination of the “v” belts and upper bearing, whilst allowing adequate air cooling for belts.

A suitably rated motor must be provided and the motor power transmitted to the shaft by adequately rated “v” belts. Should one belt break, the remaining belt / belts must be capable of transmitting the required power without overload.

The electrical motor supplied shall conform to the Particular Specification E01: Electrical Motors. The motor must be rated at least 20% above the maximum absorbed power and must be weatherproofed for unprotected conditions.

30.6 FLAP GATES

Each pump chamber delivery port shall be fitted with a 304 L stainless steel non-return flap to prevent the flow from the duty pump flowing back through the standby unit delivery port.

The gates shall be mounted in a suitable 304 L stainless steel frame correctly sized to suite the delivery port detailed. The flap gate shall be bolted over the opening onto the concrete wall surface. The frame shall be sealed against the concrete with a durable and approved material. A gate with robust hinges along the upper edge must be suspended from the frame and swing closed under no flow conditions with minimal pressure differential. The hinge design must allow the gate to seat squarely on the seat in the frame. Adequately sized Stainless Steel mounting bolts shall be used to fix the frame in position.

30.7 OPERATION

Provision must be made to vary the blade pitch and the rotational speed, the latter by changing a pulley on the V-belt drive.

30.8 INSTALLATION

The pump shall be placed on a mounted base which shall be suitable for bolting to the concrete plate form floor above the pump chamber. Levelling spacer with a minimum thickness of 20mm shall be grouted by means of a non-shrink grout between the base plate and the concrete surface.

30.9 QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE

QM shall be categorised as 'critical and major' for this section of the Project.

30.9.1 Manufacture

Tenderers shall submit with their tender a detailed Project Quality Plan, stating how they control the flow of paperwork from commencement of the Project through final handover to the Client, a sample of their Quality Control Plan, (QCP) and Project Quality Plan, (PQP) both during the course of the Project, manufacture and finally, installation.

All items of equipment shall be subject to inspections by the Engineer during design and manufacture per these QCP's.

In general, it is anticipated that this Project shall be in accordance with the relevant ISO 9000 requirements.

30.9.2 Installation

The successful Tenderer shall submit a QCP covering all aspects of the installation of each item of equipment to be installed under this Project. The Engineer shall be requested to attend certain stages of completion of installation to ascertain compliance with the Specifications and to witness the Contractor's site inspections at the Engineer's discretion.

30.9.3 Performance Testing

Works testing

Each item of equipment shall be subject to inspection and testing prior to despatch from the works. All test (including static and dynamic balancing) results shall be made available to the Engineer for verification or when the QCP's require intervention or hold points for inspection.

Before commissioning

- a) Check that all bearings are greased properly.
- b) Ensure that the belts are correctly tensioned.

- c) Ensure all HD bolts are torqued down correctly.
- d) The alignment and levelling of each assembly shall be checked and the results shall be available for inspection by the Engineer.
- e) Check that the correct clearance tolerance within the throat tube prevails.
- f) The electrical functions and control shall be checked by a responsible inspector prior to attempting to start any motor on this Project.

After Initial Commissioning

- a) Ensure all oil pumps and flow or pressure switches are functional
- b) Check for correct operation of aerator rotation, speed, vibration and noise.
- c) Note amperage drawn by each assembly.
- d) Measure the flow delivered by each pump

30.9.4 Before Expiry of the Defects Liability Period

The Engineer requires the Contractor to visit the site every quarter to inspect for the correct operation of the installed equipment. A report after each visit shall be submitted in writing

30.10 MEASUREMENT AND PAYMENT

Item	Description	Unit
30.10.1	Supply and delivery of Propeller pumping equipment	No
30.10.2	Installation of Propeller pumping equipment	No
30.10.3	Testing and commissioning of Propeller pumping equipment	No

Payment under scheduled items shall be made per complete supply and delivery as specified, electrical connections, etc and grouting, etc. Measurement and payment will distinguish between supply / delivery and installation / commissioning of the equipment.

The tendered rates or sums shall cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.

SECTION 31: PARSHALL FLUME

DOCUMENT No.: STD-LRM-MM-0027

CONTENTS

31.1	SCOPE	730
31.2	GENERAL.....	730
31.3	DESIGN CRITERIA	730
31.4	MANUFACTURE	731
31.5	WORKMANSHIP, FINISH AND APPEARANCE	731
31.6	MANUFACTURER'S QUALITY CONTROL	731
31.7	INSPECTION.....	731
31.8	FLUME DIMENSIONS AND FLOW RATES.....	731
31.9	INSTALLATION	737
31.10	MEASUREMENT AND PAYMENT	738

31.1 SCOPE

This specification shall govern all work necessary to furnish fibreglass Parshall Flumes.

31.2 GENERAL

Parshall flumes are metering devices for measuring flow of water or wastewater in open channels. They have a converging entrance section with a level floor, a short throat section with a floor inclined downwards at a gradient of 3:9, and a diverging exit section with a floor inclined upwards at a gradient of 1:6 (ISO 9826: 1992).

They operate on the principle that if a restriction of specific shape and form is placed across a channel, a rise in upstream liquid levels will result, which is a function of the rate of flow through the restricted section. A standard level measuring device can then be used to record the flow.

The flume shall be shipped as one integral moulded piece, ready for setting into the channel form work.

The flume shall be furnished with the wooden plug in the inside of the throat section, to maintain the sides of the flume vertical during pouring of the concrete. The plug shall not be removed from the flume until the concrete backing is thoroughly cured.

31.3 DESIGN CRITERIA

The fibreglass material must comply with the requirements of SANS 141:2006.

Materials

All materials shall be new and shall be specifically designed or selected for the function and service specified.

The inner surface of the flume will be a smooth UV stabilized isophthalic gelcoat. These gelcoats are designed to provide maximum UV and corrosion resistance over many years.

The resin shall be corrosion-resistant general purpose polyester, which has been determined to be acceptable for the service conditions.

The outside surface of the flume shall have a gritted rough finish, with galvanized fishtail lugs or fibreglass anchor brackets (TBD by client) attached to ensure firm, permanent anchorage to the concrete.

Cut edges or drilled holes shall be deburred and sealed with a paraffinated resin solution.

Physical properties of laminate (minimum)

Property	SANS 141:2006	Product Result
Tensile strength MPa	83	157.1
Flexural strength MPa		
a) moulded surface	140	249.9
b) reverse surface	135	239.6
Modulus in flexure MPa		
a) moulded surface	5500	9730
b) reverse surface	5500	9233
Punch-shear strength MPa	76	105.3
Compressive strength MPa	117	214.1
Barcol hardness	35	44
Glass Content % (m/m)	25	40.2

31.4 MANUFACTURE

The installation contractor shall confirm with the Engineer all field measurements with approved drawings before manufacturing commences. The flume shall have a throat width and depth as specified on the drawings.

31.5 WORKMANSHIP, FINISH AND APPEARANCE

The flume shall conform to the specific dimensions as per approved drawings. The inside of the flume shall be smooth and free of any irregularities.

31.6 MANUFACTURER'S QUALITY CONTROL

The manufacturer must use ISO 9000:2000 quality procedures, during the fabrication of the composite products. An approved process instruction shall be used during manufacture.

31.7 INSPECTION

Inspection of the flume shall be made as agreed upon between the purchaser and the seller as part of the purchase contract.

31.8 FLUME DIMENSIONS AND FLOW RATES

The discharge equation resulting from the depth/flow relationship in free flow conditions, is expressed as follows:

$$Q = C_K H_a^n$$

where:

Q : is the flowrate, the value of which is a function of the unit of measurement selected;

H_a : is the water depth measured at gage point (in centimetres for SI parameters in Table 2);

C_K : is a constant, which is a function of the dimension of the constriction and measurement unit chosen;

n : is the constant of the exponent, the value of which is a function of the dimension of the constriction, (without unit).

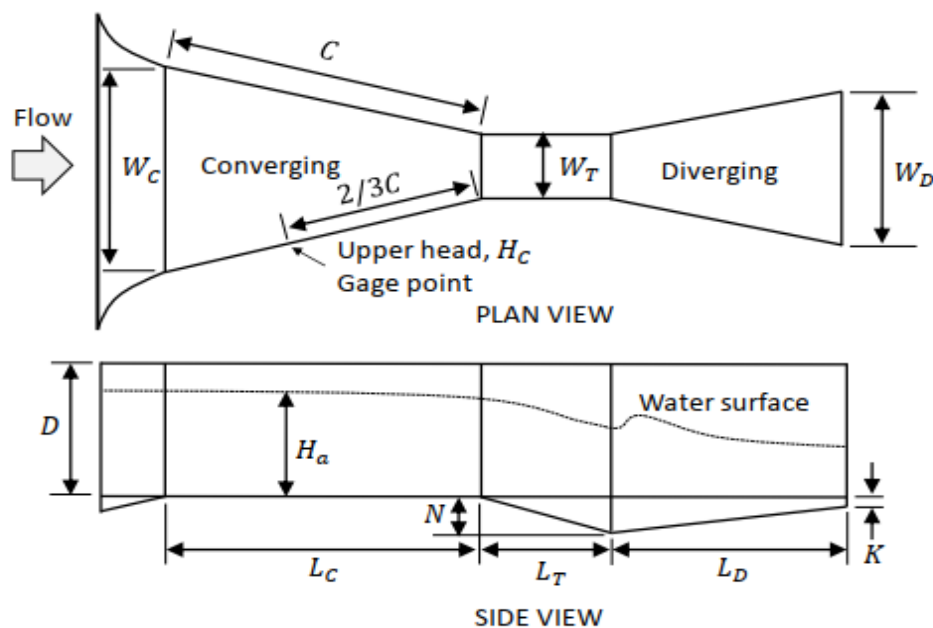


Figure 1: Parshall flume dimensions (Figure reproduced from ASTM D1914)

Parshall flumes according to ASTM D1941:

Table 1: Dimensions in mm (refer to Figure 1). (The throat width in this table was converted to SI units, rounded to the nearest 1/10th mm, from ASTM D1941, Table 2.)

Widths			Axial lengths			Wall depth	Vertical distance below crest		Converging wall length	Gauge point	
Throat		Up stream end	Down stream end	Converging section	Throat section	Divergence	Converging section	Dip at throat	Lower end of flume		
W _T		W _C	W _D	L _C	L _T	L _D	D	N	K	C	H _C
1"	25.4	167	93	357	76	204	152 to 229	29	19	364	243
2"	50.8	213	135	405	114	253	152 to 252	43	22	413	275
3"	76.2	259	178	457	152	305	305 to 610	57	25	466	311
6"	152.4	396	393	610	305	610	610	114	76	622	415
9"	228.6	573	381	863	305	457	762	114	76	880	587
1'	304.8	844	610	1344	610	914	914	229	76	1371	914
1'6"	457.2	1024	762	1420	610	914	914	229	76	1448	965
2'	609.6	1207	914	1497	610	914	914	229	76	1527	1018
3'	914.4	1573	1219	1646	610	914	914	229	76	1679	1119
4'	1219.2	1935	1524	1792	610	914	914	229	76	1827	1218
5'	1524.0	2301	1829	1945	610	914	914	229	76	1983	1322

Table 2 lists the constants for the above discharge equation. Also listed in Table 2 are the minimum and maximum discharges, respectively, as per ASTM D1941.

Table 2: Recommended minimum and maximum flows in free flow conditions. (From ASTM D1941, Tables 2 and 3.) (Note that the head is measured in cm as prescribed in ASTM D1941.)

Throat		C _K	n	Minimum discharge			Maximum discharge		
W _T				Depth (m)	m ³ /s (x10 ³)	l/s	Depth (m)	m ³ /s	l/s
1"	25.4	0.0479	1.550	0.020	0.28	0.28	0.180	0.0057	5.7
2"	50.8	0.0959	1.550	0.020	0.57	0.57	0.180	0.014	14.0
3"	76.2	0.1410	1.550	0.032	0.85	0.85	0.464	0.031	31.0
6"	152.4	0.2640	1.580	0.029	1.42	1.42	0.457	0.110	110.0
9"	228.6	0.3930	1.530	0.030	2.55	2.55	0.611	0.252	252.0
1'	304.8	0.6240	1.522	0.029	3.11	3.11	0.761	0.456	456.0
1'6"	457.2	0.8870	1.538	0.028	4.25	4.25	0.763	0.697	697.0
2'	609.6	1.1350	1.550	0.046	11.89	11.89	0.834	1.079	1,078.0
3'	914.4	1.6120	1.566	0.045	17.27	17.27	0.762	1.427	1,427.0
4'	1,219.2	2.0620	1.578	0.062	36.81	36.81	0.762	1.923	1,923.0
5'	1,524.0	2.5000	1.587	0.062	45.30	45.30	0.762	2.424	2,424.0

Table 3: Dimensions in mm (refer to Figure 1). (The data in this table was converted to mm from ISO 9826: 1992 (en), Table 1.)

Flume number	Widths			Axial lengths			Wall depth Converging section D	Vertical distance below crest		Converging wall length C	Gauge point H _c
	Throat	Up stream end	Down stream end	Converging section	Throat section	Divergence		Dip at throat	Lower end of flume		
	W _T	W _C	W _D	L _C	L _T	L _D		N	K		
1	152	400	390	610	305	610	600	115	12	622	415
2	250	780	550	1,325	600	920	800	230	72	1,352	900
3	300	840	600	1,350	600	920	950	230	72	1,377	920
4	450	1,020	750	1,425	600	920	950	230	72	1,454	967
5	600	1,200	900	1,500	600	920	950	230	72	1,530	1,020
6	750	1,380	1,050	1,575	600	920	950	230	72	1,607	1,074
7	900	1,560	1,200	1,650	600	920	950	230	72	1,683	1,121
8	1,000	1,680	1,300	1,700	600	920	1,000	230	72	1,734	1,161
9	1,200	1,920	1,500	1,800	600	920	1,000	230	72	1,836	1,227
10	1,500	2,280	1,800	1,950	600	920	1,000	230	72	1,989	1,329

Table 4 lists the constants for the discharge equation. Also listed in Table 4 are the minimum and maximum discharges, respectively, as per ISO 9826: 1992.

Table 4: Recommended minimum and maximum flows in free flow conditions. (The data in this table was converted from ISO 9826: 1992 (en), Table 3.) (The head is measured in m.)

Flume number	Throat	Discharge eq. coefficients		Minimum discharge			Maximum discharge		
	W_T	C_K	n	Depth (m)	$m^3/s (x10^3)$	l/s	Depth (m)	m^3/s	l/s
1	152	0.381	1.580	0.03	1.5	1.5	0.45	0.100	100
2	250	0.561	1.513	0.03	3.0	3.0	0.60	0.250	250
3	300	0.679	1.521	0.03	3.5	3.5	0.75	0.400	400
4	450	1.038	1.537	0.03	4.5	4.5	0.75	0.630	630
5	600	1.403	1.548	0.05	12.5	12.5	0.75	0.850	850
6	750	1.772	1.557	0.06	25.0	25.0	0.75	1.10	1,100
7	900	2.147	1.565	0.06	30.0	30.0	0.75	1.25	1,250
8	1,000	2.397	1.569	0.06	30.0	30.0	0.80	1.50	1,500
9	1,200	2.904	1.577	0.06	35.0	35.0	0.80	2.00	2,000
10	1,500	3.668	1.586	0.06	45.0	45.0	0.80	2.50	2,500

31.9 INSTALLATION

The flow entering the flume should be tranquil and uniformly distributed across the channel.

According to ASTM D1941 – 91, as a general guideline, a straight upstream approach length of 10 to 20 times the throat width will meet this entrance condition.

There should be no sudden drops, bends, flow junctions, etc., immediately upstream of the flume location. The flume should be located in a straight section of the open channel. The bed slope shall be such as to ensure subcritical flow with a Froude number, Fr , of less than 0.5 (ISO 9826: 1992),

$$Fr = \frac{Q_{max}}{A\sqrt{gH_{max}}}$$

Where

Q_{max} maximum discharge;

A cross-sectional area of the channel;

g gravitational acceleration, 9.81 m/s²;

H_{max} Maximum water depth.

Downstream channels should be straight for 5 to 20 times the throat width.

NOTE: THE CONVERGING SECTION OF THE FLUME MUST BE SET UPSTREAM AND MUST BE LEVEL ALONG AND ALSO ACROSS THE CHANNEL. A LEVEL INSTALLATION IS CRITICAL TO THE PROPER OPERATION OF THE FLUME.

Remove all external packaging, keeping the plug in-place. Normally angled brackets are fastened at the top of the flume to ensure that top opening does not distort during installation. If these brackets were removed for ease of shipment (especially for the larger flumes), they will be stored in the plug in the throat. Please remove them from the throat and fix them according to their markings onto the flume. The top opening may have to be opened slightly for the brackets to fit.

NOTE: IT IS RECOMMENDED THAT THE PLUG BE KEPT IN PLACE TO ENSURE THAT DISTORTION DOES NOT OCCUR.

Un-bend the galvanized lugs (if attached) to ensure proper bonding with the concrete.

The flume must be secured from floating. If anchor brackets are attached, these may be used to level and anchor the flume.

Sandbags may be placed inside the flume to prevent flume from floating.

Grout the flume in place. The first pour should just cover the bottom of the flume and should be allowed to cure before the sidewalls are grouted. For the larger flumes it is recommended that the grout should be added in layers, each layer should be allowed to cure before another layer is added.

The use of a vibrator is not recommended as excessive use may bulge or distort the flume sidewalls and bottom.

Remove the plug insert only after the grout is cured.

NOTE: NO VOIDS OR AIR POCKETS SHOULD REMAIN IN ANY GROUT POUR. FAILURE TO ELIMINATE VOIDS OR POCKETS MAY RESULT IN SETTLING OR BULGING OF THE FLUME.

31.10 MEASUREMENT AND PAYMENT

Item	Description	Unit
31.10.1	Supply and delivery of Parshall Flume measuring device	No.
31.10.2	Installation of Parshall Flume measuring device	No.
31.10.3	Testing and commissioning of Parshall Flume measuring device	No.

Payment under scheduled items shall be made per complete supply and delivery as specified, etc and grouting, etc. Measurement and payment will distinguish between supply / delivery and installation / commissioning of the equipment.

The tendered rates or sums shall cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.

SECTION 32: INSTALLATION, ERECTION & FIXING OF EQUIPMENT TO CONCRETE STRUCTURES

DOCUMENT No.: STD-LRM-MM-0018

CONTENTS

32.1	SCOPE	739
32.2	INSTALLATION AND ERECTION	739
32.3	FASTENERS	740
32.4	MEASUREMENT AND PAYMENT	741

32.1 SCOPE

This section covers the installation, erection and fixing of equipment to concrete structures.

32.2 INSTALLATION AND ERECTION

The Contractor shall be responsible for ensuring that any work carried out by his own staff or any subcontractor working for him is carried out to his satisfaction and that the equipment meets all the requirements of the specification as well as all statutory regulations applicable to the works.

All connectors such as anchor bolts (cast in situ or grouted), expansion bolts, base plates, etc, shall be designed or selected by the contractor to suit the equipment supplied by him and to ensure compliance with these specifications.

All mechanical equipment supplied and delivered under this Contract shall be placed and firmly fixed in position by the Contractor on holding-down bolts supplied by him to ensure that it will operate efficiently to the satisfaction of the Engineer. Affixing shall mean the supply and installation of all nuts, bolts, plates, grout, etc., and shall include all labour and other activities such as sawing, scabbling, cutting, filing, grinding, drilling, welding, the repair of corrosion protection, grouting, etc., required for the fixing of the equipment. If the Contractor does not have the qualified personnel at his disposal, he shall appoint the necessary specialists at his own cost. Specialists shall be approved by the Engineer prior to the commencement of such work.

If the Employer has entered into civil engineering contracts the duration of which overlaps with and of which the works interfaces with this Contract, those contractors will be required to leave openings in any concrete structures constructed by them in accordance with the requirements of the Contractor and as authorized by the Engineer. The Contractor shall then erect, install and affix all relevant equipment to the concrete, ready for commissioning.

The Contractor shall, within three weeks of the Contract having been awarded, submit details of pockets, sleeves, holding-down bolt holes, etc., for incorporation in the civil design, failing which the cost of cutting or drilling pockets, installing sleeves, etc., will be for the Contractor's account.

The sealing of holes made by others through concrete or left by them, intended for the installation of equipment supplied under this contract, shall be undertaken by the Contractor.

The Contractor shall be responsible for providing all bolts, nuts and washers, steel supports, brackets, etc for fixing mechanical equipment in position. The cost of fixing and providing supports shall be included in the tendered rates and sums.

All holding-down bolts cast into the concrete, and all bolts, nuts and washers which will be permanently or occasionally below water level, shall be of 316L stainless steel unless otherwise specifically approved by the Engineer. All other bolts, nuts and washers shall be galvanized in accordance with the section dealing with corrosion protection.

Before erection, the Contractor shall check all levels, dimensions of holes, supports, fixtures, pipes, and all other relevant work done under other Contracts to ensure that the plant will fit correctly into the structures provided.

All dimensions of all equipment shall be checked by the Contractor after manufacture and on delivery.

Grouting shall be carried out as specified in the section dealing with civil engineering work and shall be included in the tendered rates for the installation of equipment.

It is the Contractor's responsibility to verify that the concrete or civil structure will sustain the loads imposed by the fasteners and the installed equipment, before such equipment is installed.

Equipment shall be mounted and affixed in such a manner as to ensure:

- i. that it complies with the manufacturer's specifications.
- ii. that it is plumb and aligned with all structural elements.
- iii. that vibration is contained.
- iv. that the installation is safe.

32.3 FASTENERS

The Contractor shall refer to the detail specifications for the preferences in fastener types for this project. Notwithstanding the preferences indicated, it is the Contractor's responsibility to ensure that the load limits specified below are not exceeded.

The Contractor shall make alternative offers in a covering letter if the preferences indicated in the detail specifications should cause any application to be outside the limits as set out below.

Only currently catalogued standard equipment supplied by reputable suppliers shall be accepted.

32.3.1 Light duty expansion fasteners

A light duty fastener is defined as a nail or screw which, when driven or screwed into a nylon or light metal sleeve inserted in a drilled hole, forces the sleeve to expand. Typically, these fasteners are referred to as "Standard Fixings".

These fasteners shall only be used for light duty applications such as the surface mounting of small diameter pipes and ducts, wall mounting of signs and boards, etc.

The maximum allowable working loads in shear and tension shall not exceed 800 N in the application of these fasteners.

Only currently catalogued standard equipment supplied by reputable suppliers shall be accepted.

The Contractor shall ensure that the working load limits for fasteners, as specified by the supplier, are not exceeded.

Only drilled holes will be allowed, and the depth, diameter, spacing and distance from edges shall be in accordance with the supplier specifications.

The Contractor shall ensure that the correct tools, as specified by the supplier, are used in the installation of fasteners.

All fasteners shall comply with the corrosion protection requirements as set out in the section dealing with corrosion protection of these specifications. Suitably protected nails, screws, washers and sleeves shall be used. Plastic or nylon sleeves shall be supplied by reputable suppliers.

32.3.2 Heavy duty expansion fasteners

A heavy duty expansion fastener is defined as a stud with a nut, or a bolt, pulling an expansion cone(s) through a metal sleeve, usually split, causing the sleeve to expand. Typically, these fasteners are referred to as "Heavy Duty Fixings".

These fasteners may be used for medium to heavy duty applications such as the fixing of mechanical equipment (pumps, compressors, etc.), fixing of structures and brackets, etc to civil structures including fixing to suitably reinforced floors, plinths, walls and ceilings. The working loads in shear and tension for the application of these fasteners shall fall in the range 0,8 kN to 30 kN.

Only currently catalogued standard equipment supplied by reputable suppliers shall be accepted.

The Contractor shall ensure that the working load limits for the fasteners, as specified by the suppliers, are not exceeded.

Only drilled holes will be allowed, and the depth, diameter, spacing and distance from edges shall be in accordance with the supplier specifications.

The Contractor shall ensure that the correct tools, as specified by the supplier, are used in the installation of fasteners.

All fasteners shall comply with the corrosion protection requirements as set out in the section dealing with corrosion protection of these specifications. Suitably protected studs, bolts, nuts, washers and sleeve parts shall be used. Locking mechanisms or devices shall be utilised where high vibration levels are present. Studs and bolts shall be hot dipped galvanized, cadmium plated zinc coated or stainless steel, suitably selected according to the loads imposed and the corrosion environment of the application.

32.3.3 Chemical anchors

Chemical anchors are used for heavy duty applications and are defined as studs driven through a capsule filled with a suitable chemical substance. After a specified curing time the studs are set tight in their holes and ready for use. Typically, these fasteners are referred to as 'Chemical Anchors'.

These fasteners may be used for medium to very heavy duty applications such as the fixing of large mechanical equipment (pumps, compressors, etc.), fixing of large, heavy structures, etc to civil structures. This includes fixing to suitably reinforced floors, plinths, walls and ceilings.

The permissible working loads in shear and tension shall fall in the ranges 15 – 60 kN and 20 - 70 kN respectively for the application of these fasteners.

Only currently catalogued standard equipment supplied by reputable suppliers shall be accepted.

The Contractor shall ensure that the working load limits for the fasteners, as specified by the suppliers, are not exceeded.

Only drilled holes or pockets will be allowed, and the depth, diameter, spacing and distance from edges shall be in accordance with the supplier specifications.

The Contractor shall ensure that the correct tools, as specified by the supplier, are used in the installation of fasteners.

All fasteners shall comply with the corrosion protection requirements as set out in series 1 of these specifications. Suitably protected studs, bolts, nuts, washers and sleeve parts shall be used. Locking mechanisms or devices shall be utilised where high vibration levels are present. Studs and bolts shall be hot dipped galvanized, cadmium plated zinc coated or stainless steel, suitably selected according to the loads imposed and the corrosion environment of the application.

32.4 MEASUREMENT AND PAYMENT

All equipment and labour required for the installation, erection and fixing of equipment to structures shall be included in the tendered rates for installation for the relevant equipment, as measured in the relevant section.

Part B: Detail Specification

1.	SCOPE	742
2.	GENERAL INFORMATION AND INSTRUCTIONS	743
3.	INLET WORKS	748
4.	PRIMARY SETTLING	754
5.	BALANCING TANK.....	757
6.	BIOLOGICAL REACTOR.....	758
7.	SECONDARY SETTLING.....	765
8.	SLUDGE THICKENING AND DEWATERING	768
9.	DIGESTER MIXING SYSTEM	775
10.	METHANE GAS EXTRACTION PIPEWORK AND FLARE	775
11.	CHLORINATION EQUIPMENT	776
12.	SERVICE WATER SYSTEM	781
13.	POTABLE WATER SYSTEM.....	783
14.	SUBSOIL DRAINAGE SYSTEM.....	783
15.	DEWATERED SLUDGE HANDLING.....	784
16.	MEASUREMENT AND PAYMENT	788

1. SCOPE

This part of the Specification provides detail of the mechanical equipment and services required for this project and is additional to the Standard Specifications relevant to the plant and equipment described below.

While care has been taken to present the information provided in this Detail Specification as accurately as possible, the Contractor shall confirm all dimensions on site before any mechanical equipment is manufactured, so that any changes and inaccuracies in the final dimensions of the civil works can be considered.

The detail specification may also include description of items, which form the basis of payment in the Schedule of Quantities.

The work to be carried out under this Contract consists mainly of the following:

Supply, delivery, installation, testing and commissioning of channel-mounted sluice gates, wall-mounted sluice gates and fixed weirs.

Supply, delivery, installation, testing and commissioning of mechanically cleaned screens and micro-screens.

Design, fabrication, supply, delivery, installation, testing and commissioning of hand-raked screens.

Supply, delivery, installation, testing and commissioning of screenings hydro-conveyors.

Supply, delivery, installation, testing and commissioning of screenings wash compactors.

Supply, delivery, installation, testing and commissioning of grit classifiers.

Supply, delivery, installation, testing and commissioning of mechanical equipment for primary and secondary settling tanks.

Supply, delivery, installation, testing and commissioning of dry-well pump installations.

Supply, delivery, installation, testing and commissioning of surface mounted vertical shaft mechanical mixers.

Design, fabrication, supply, delivery, installation, testing and commissioning of fine bubble aeration system.

Supply, delivery, installation, testing and commissioning of hoists and hoisting frames.

Supply, delivery, installation, testing and commissioning of chlorination equipment.

Design, fabrication, supply, delivery, installation, testing and commissioning of ferric chloride dosing equipment.

Design, fabrication, supply, delivery, installation, testing and commissioning of polyelectrolyte dosing equipment.

Design, supply, delivery, installation, testing and commissioning of anaerobic digester mixing equipment.

Design, fabrication, supply, delivery, installation, testing and commissioning of methane gas extraction pipework and gas flare.

Design, supply, delivery, installation, testing and commissioning of waste activated sludge thickening equipment.

Design, supply, delivery, installation, testing and commissioning of sludge dewatering equipment.

Design, supply, delivery, installation, testing and commissioning of instrument quality air supply systems.

Supply and delivery of sludge handling vehicles and associated equipment.

Design, fabrication, supply, delivery, installation and commissioning of all ancillary components to ensure that a fully functional mechanical installation that complies with the specifications is provided.

Each section of the Detail Specification below makes reference to the most relevant standard specification applicable to the scope of supply described, but the Contractor shall make reference to all other standard specifications that are relevant to the equipment or systems to be provided to ensure that the minimum requirements are met.

All mechanical plant and equipment installed shall be suitable for operation within the specified performance parameters at an elevation of approximately 1,200m above mean sea level, and at ambient temperatures between 0 and 40°C.

2. GENERAL INFORMATION AND INSTRUCTIONS

2.1 INFORMATION EXCHANGE

The Contractor shall make every attempt to ensure that his installation conforms to the layout indicated on each drawing and process flow diagram. These drawings and flow diagrams are, however, only schematic and do not necessarily show all minor equipment and fittings.

Any deviation from the general layout indicated shall be detailed in a covering letter.

All equipment shall be labelled in accordance with the Standard Specification on General Design and to the approval of the Engineer.

The Mechanical Contractor shall submit all the relevant detail of all the mechanical equipment supplied under this Contract, including all civil requirements and modifications to structures, to the Engineer for

approval within six (6) weeks from tender award to enable the finalisation of the Motor and Equipment Schedule (MES) and construction drawings. Any revisions to the information shall be finalised in the two weeks following the six weeks in which the information must be submitted.

The Mechanical Contractor shall liaise with the Electrical Contractor regarding the cable sizes to all electrical equipment supplied by the Mechanical Contractor. The final electrical cable sizes shall be submitted to the Engineer for approval. The final cable sizes will however only be available 4 weeks after the information as submitted by the Mechanical Contractor has been finalised and approved by the Engineer. The Mechanical Contractor shall, however, not delay the ordering of the electric motors but shall only place the finalisation of the motor connection boxes on hold until the cable size information is available.

All electrical equipment supplied by the Mechanical Contractor shall be terminated by others. It remains the Mechanical Contractor's responsibility to ensure that the connections were done correct and properly.

2.2 STAINLESS STEEL AND 3CR12

Great care shall be taken not to contaminate the stainless steel / 3CR12 items with iron or mild steel particles. Stainless steel and/or 3CR12 parts shall be kept physically separated from any mild steel fabrication in the manufacturers workshop such that grinding particles and the like cannot contaminate the stainless steel and/or 3CR12 items. Tools and grinding wheels used shall be kept separate from those used for mild steel fabrications. Brushing shall be with stainless steel brushes only. All tools used for cutting, grinding, brushing or machining of the stainless steel and/or 3CR12 shall be dedicated to use on stainless steel and/or 3CR12 only.

Any parts that have been machined shall be passivated. Before commencing welding of stainless steel and/or 3CR12 items the Contractor shall notify the Engineer, in writing, of the type of electrode or welding rod he proposes to use. The Engineer's written approval for the same shall be obtained before welding commences. Standard stainless steel welding practices, as recommended by SASSDA, shall be employed. Finished welds shall be thoroughly cleaned and passivated.

2.3 POST-WELD CLEANING AND PASSIVATION FOR STAINLESS STEEL AND 3CR12

All welds and heat affected zones shall be properly treated in accordance with good engineering practice. Full details of the proposed methods of treatment are to be submitted with the tender.

2.4 BOLTS, NUTS AND WASHERS

Bolts, nuts and washers in their respective sizes shall comply in all respects with SANS 1700 series for ISO metric precision hexagon head bolts, screws and nuts.

Bolts, nuts and washers shall be of the sizes shown on the drawings, or as approved, and be of grade 4.6 unless otherwise indicated.

The bolts and nuts shall be fitted with a flat washer under the bolt head and a further flat washer under the nut. Bolt lengths shall be such that when in position and fitted with one washer under both nut and head, not less than 3 mm or more than 6 mm of thread protrudes from the nuts.

Bolts, nuts and washers for stainless steel or 3CR12 shall be of grade 304 stainless steel.

Bolts, nuts and washers for structural mild steel / mild steel shall be of mild steel and shall be hot dip galvanised to SANS 121 / ISO 1461 and once fitted in place shall be given two thorough coats of epoxy tar to give a dry film thickness of not less than 200 micrometres.

For stainless steel and/or 3CR12 connections to mild steel, grade 304 stainless steel nuts, bolts and washers shall be used.

Anchor bolts shall be installed in accordance with BS 5080 and the type of fixing bolt the Contractor proposes to use shall be approved by the Engineer.

All anchor and other fixing bolts to be cast into, grouted into or fixed into concrete, shall be made from stainless steel.

The threads of all bolts shall be coated with a nickel anti-seize compound or a similar approved release paste prior to fastening. The release paste shall be water resistant with no more than 40 % petroleum oil and shall meet Mil Spec. A.907D.

2.5 STRUCTURAL STEELWORK

All structural steelwork, materials, welding and workmanship shall conform to the requirements of the Standard Specification on Structural Metalwork.

Connections shall be designed to transmit the loadings specified, but where a connection is detailed on the drawing this shall be adhered to.

All welded joints shall be fully continuous on all sides to prevent ingress of moisture. Welding shall be carried out in such a sequence as to minimise distortion of the welded parts.

Splicing of the members will not be permitted without prior consent of the Engineer.

Samples of welding may be required by the Engineer for testing purposes. The Contractor shall make allowance in his tender for the cost of providing such samples.

Material or workmanship rejected by the Engineer's appointed inspector will be remedied immediately or removed from site by the Contractor at his own cost.

Unless otherwise specified all grating, staircases and hand railing shall be manufactured from mild steel and shall be hot dip galvanised in accordance with the Standard Specification on Corrosion Protection.

2.6 HOT DIP GALVANISED COATINGS

Items to be hot dip galvanised shall be hot dip galvanised in accordance with the requirements of SANS 121/ ISO 1461. The galvanising shall be of the "heavy duty" class.

All welded articles shall be seal welded before galvanising.

The Contractor shall handle, store and install all hot dip galvanised items with great care to avoid damage to their protective coatings. Should any damage be caused to the protective coatings the Contractor shall remedy such damage at his own expense in the following manner.

- Remove oil, grease and debris with clean solvent.
- Rub surface down with abrasive paper.
- Remove debris with clean solvent.
- Apply well-mixed two pack zinc rich primer to give a minimum dry thickness of 100 micrometres.

2.7 GENERAL REQUIREMENTS FOR SLUICE GATES

All sluice gates shall be manufactured and installed in accordance with the requirements as detailed below and as indicated on the drawings and in accordance with the Standard Specification on Flow Control Valves and Sluice Gates.

The sluice gates shall be manufactured from 304 L stainless steel and fitted with black neoprene or EPDM seals.

The head stocks and spindles shall also be manufactured from 304 L stainless steel and shall be fitted with cast iron or mild steel corrosion protected handwheels complete with direction indicators.

The sluice gates shall be supplied complete with mild steel epoxy coated spindle covers. The covers shall have slots on their sides to indicate the position of the gates.

The sluice gates shall be installed and grouted into position by the Mechanical Contractor in accordance with the requirements of the sluice gate manufacturer. The costs for grouting shall be included in the tendered rates for the installation of the sluice gates.

Access and operator platforms for the sluice gates shall be provided by others.

Any specific requirements or modifications required to either modify grating or concrete slabs or additional concrete nibs required for pedestal installation shall be submitted to the Engineer within the period for submission of information as detailed in Section 2 of the Detail Specification.

All sluice gates with extended spindles shall be fitted with suitable spindle guides equally spaced at distances as specified by the manufacturer.

Where spindles must pass through concrete slabs or grating the size of the openings or sleeves shall be submitted to the Engineer within the period for submission of information as detailed in Section 2 of the Detail Specification.

2.8 GENERAL REQUIREMENTS FOR DRY-WELL PUMPING EQUIPMENT

The pumps shall be supplied and installed in accordance with the Standard Specification on Dry-Well Pumping Equipment and additional requirements as detailed below.

Civil requirements for plinths shall be submitted to the Engineer within the period for submission of information as detailed in Section 2 of the Detail Specification.

All pumps shall be supplied complete with electric motors, couplings and base frames and shall be suitably corrosion protected in accordance with the Standard Specification on Corrosion Protection. The pump electric motors shall be supplied complete with heaters and thermistors / over-temperature cut-out switches embedded in the motor windings were required. Specific requirements for each motor shall be detailed in the technical data sheets.

The levelling, fastening and grouting-up of the pump base frames including all required anchor bolts and grout shall be done by the Mechanical Contractor and the cost for grouting shall be included in the tendered rates for the installation of the pumps.

All pumps shall be re-aligned after installation and when the pump base frames have been grouted up. An alignment certificate shall be issued for each pump and bound into the O&M manuals.

2.8.1 Pipework Associated with Pumps

The pipework associated with pump sets are measured as a lump sum, the lump sum shall be inclusive of all valves and check valves in the suction and delivery lines, pressure measurement equipment and common manifolds associated with the pump sets.

The lump sum shall include all pipework from the end of the civil pipework up to and including where the delivery pipework joins the civil delivery pipework and shall include all required interface flanges, etc.

2.9 GENERAL REQUIREMENTS FOR MIXERS

All mixers for this project shall be vertical shaft mechanical mixers.

Not all mixers shall rotate in the same direction. The direction of rotation of any particular mixer shall be selected by the Contractor, and approved by the Engineer, to achieve an effective mixing flow pattern. The drive units selected shall allow the direction of rotation of all mixers to be reversed individually, whenever desired.

All mixing equipment shall comply with the requirements of the Standard Specification on Surface Mounted Mechanical Mixers and Aerators, the Standard Specification on Gearboxes, the Standard Specification on Power Transmission Couplings, the Standard Specification on Electric Motors and the Standard Specification on Corrosion Protection.

When sizing mixers and gearboxes on standard electric motors sizes, the mixer and gearbox shall be rated to absorb the total mechanical power delivered by the standard electric motor. The power available for mixing at the motor shaft shall be derated to 90 % of motor rated power, i.e. an allowance of 10 % shall be made for additional losses at full load.

Motors installed outdoors in a vertical configuration shall be fitted with weather hoods to prevent the ingress of rainwater into the motor. All mixer motors shall be supplied with an over-temperature cut-out switch embedded in the motor windings and a heater. Electric motors shall be orientated to ensure the shortest possible length of cable to the motors. All unused holes for lifting lugs and other appurtenances in the motor and gearbox housing shall be plugged.

All mixer gearboxes shall be fitted with extended oil drainage pipes fitted with a ball valve and plugged to ensure ease of maintenance. The extended oil drainage pipework shall be suitably supported to prevent it from breaking off in the event of someone stepping on or kicking the pipe accidentally. All mixer gearboxes shall also be fitted with an external oil level indicator. The oil level indicator shall be clearly marked to indicate the required maximum and minimum oil levels.

The civil requirements for the installation of the mixer jacking bolts shall be provided to the Engineer as per the requirements of Section 2 of the Detail Specification.

In addition to the requirements of the Standard Specification on Power Transmission Couplings all power transmission couplings shall be rated with a service factor equal to or greater than that specified for the gearbox.

Detail drawings of the mixer impellers, drive unit and jacking bolt arrangement and installation details shall be submitted to the Engineer for approval within the period for submission of information as detailed in Section 2 of the Detail Specification prior to ordering and manufacturing of the equipment.

The following general requirements shall be applicable to all surface-mounted mixers supplied and installed under this contract:

- i. The mixer impeller design shall be such to ensure homogenously mixed water in unaerated zones.
- ii. The mixer impellers shall be manufactured from 304 L stainless steel.
- iii. The mixer base frames shall be grouted up by the Mechanical Contractor after the mixer has been levelled and secured. The cost for the grouting shall be included in the tendered rates for the installation of the mixers.
- iv. The mixer shaft and impeller design shall be submitted for approval by the Engineer. The mixer shaft shall be a solid shaft with a diameter sufficient to prevent excessive wobbling in the event of an unbalanced load on the impeller such as rags caught on one impeller blade.
- v. The direction of rotation of the mixers to be supplied shall be as indicated on the Piping & Instrumentation Diagram (P&ID).

2.10 GENERAL REQUIREMENTS FOR PIPEWORK

All pipe work supplied under this contract shall be manufactured, corrosion protected, delivered, tested and commissioned in accordance with the requirements of the Standard Specification on Pipework and the Standard Specification on Corrosion Protection.

Pipework supplied under this contract shall be complete with all valves, fittings, gaskets, couplings, fasteners, anchors and supports required.

All pipes and valves, where required, shall be properly supported by means of suitable corrosion protected supports which shall be approved of the Engineer.

All pipework and valves other than 304 L stainless steel shall be internally and externally corrosion protected in accordance with the specifications.

Where pipework connects to equipment such as pumps supplied under this contract, the pipework shall be aligned and properly secured into position before the pipework item is secured and grouted into position.

Where trenching for pipework is required this shall be considered included in the scope of supply. Trenching and backfilling shall be done in accordance with the requirements of SANS 1200DB.

2.11 GENERAL REQUIREMENTS FOR MOTORS WITH VARIABLE SPEED DRIVES

Where it is indicated in the specification that mechanical equipment will be fed from a variable speed drive, the motors supplied with the relevant mechanical equipment shall be suitable for a VSD application and shall, in addition to the requirements of the Standard Specifications on Electric Motors, also comply with the requirements of IEC 60034-25.

2.12 GENERAL REQUIREMENTS FOR HOISTING EQUIPMENT

Unless otherwise specified all hoisting equipment with a safe working load (SWL) in excess of 500 kg shall be equipped with electric crawl and lift.

Hoist beams and crawl beams shall be included in the scope of supply for all hoisting equipment.

3. INLET WORKS

Refer to PK278-01-PRC-DRG-1000-1001, -1002, -1003, -1004, -1005, -1006, -1007, -1008, -1009 & -1010.

3.1 GENERAL REQUIREMENTS

The inlet works essentially consists of two streams each rated at 25 megalitres per day (MLD). Each stream consists of a 15mm and a 6mm mechanically raked screen followed by a vortex degritter and finally a 3mm fine screen. Bypass channels are provided for the screens – these channels shall be equipped with hand-raked screens.

The Mechanical Contractor shall design, supply, deliver, install, test and commission the mechanical plant for the Inlet Works to suit the civil structures. The schematic representations on the P&ID drawings may be used as the basis for such design but are not prescriptive and are not necessarily complete.

3.2 PARSHALL FLUME

Refer to the Standard Specification on Parshall Flumes.

A standard Parshall flume with throat dimension 305mm shall be installed in the inlet channel as indicated on the drawings.

3.3 CHANNEL-MOUNTED SLUICE GATES

Refer to the Standard Specification on Flow Control Valves and Sluice Gates.

Twenty channel-mounted sluice gates shall be supplied and installed at the Inlet Works in the positions as indicated on the drawings.

The requirements regarding size, height and travel of gate, etc. for the channel gates to be supplied are detailed in Table 1.

Table 1: Inlet Works Channel-Mounted Sluice Gates

Detail / Requirements	Unit	Inlet Works Overflow	15mm Screen Isolation	6mm Screen Isolation	15mm & 6mm Screen Bypass	Degritter Isolation	3mm Screen Isolation
Tag No.		1I-SG-21-H	1I-SG-02-H 1I-SG-03-H 1I-SG-04-H 1I-SG-05-H	1I-SG-09-H 1I-SG-10-H 1I-SG-11-H 1I-SG-12-H	1I-SG-01-H 1I-SG-06-H 1I-SG-07-H 1I-SG-08-H 1I-SG-22-H	1I-SG-13-H 1I-SG-14-H 1I-SG-15-H 1I-SG-16-H	1I-SG-17-H 1I-SG-18-H 1I-SG-19-H 1I-SG-20-H
Number of gates	No	1	4	4	5	4	4
Max head when gate is closed	mm		1,600	1,600	1,370	1,500	1,500
Channel dimensions (W x D)	mm		1,200 x 1,700	1,200 x 1,800	1,200 x 1,700	1,200 x 1,800	1,500 x 1,950
Height of operator's platform above channel invert	mm		1,700	1,800	1,700	1,800	1,950
Height of handwheel above operator's platform	mm		1,100	1,100	1,100	1,100	1,100
Max unbalanced head against which gate will operate	mm		1,600	1,600	1,370	1,500	1,500
Height of gate	mm		1,700	1,700	1,500	1,600	1,600
Gate travel	mm		1,550	1,550	1,400	1,550	1,550

3.4 MECHANICALLY CLEANED SCREENS

Refer to the Standard Specification on Mechanically Cleaned Screens.

Mechanically cleaned front-raked screens as detailed in Table 2 shall be supplied, delivered, installed, tested and commissioned at the Inlet Works.

The screens shall be fitted with a differential level system, so that the wastewater at the upstream and downstream sides of the screens can be set to determine the frequency at which the rakes pass over the screen field. Under normal operating conditions the controller (be it a PLC or differential level controller) shall ensure that the screen is operated intermittently, based on timers set for raking and standing.

Table 2: Mechanically Cleaned Screens

Detail / Requirements	Unit	15mm Screens	6mm Screens	3mm Screens
Tag No.		1I-SC-01-M 1I-SC-02-M	1I-SC-03-M 1I-SC-04-M	1I-SC-05-M 1I-SC-06-M
No of screens		2	2	2

Detail / Requirements	Unit	15mm Screens	6mm Screens	3mm Screens
Spacing between bars or aperture size	mm	15	6	3
PDWF	MLD	100	100	100
Discharge level above channel invert	mm	4,050	4,050	4,050
Discharge level above top of channel	mm	1,800	1,800	1,800
Channel dimensions (W x D)	mm	1,200 x 1,700	1,200 x 1,800	1,500 x 1,950
Max depth of flow upstream of screen	mm	1,523	1,546	1,256
Max head differential across screen at PDWF	mm	75	434	544
Operating range (water flow)	m ³ /s	0 – 1.16	0 – 1.16	0 – 1.16
Operating range (screenings)	kg/h	6 - 150	6 - 150	6 - 75

The tenderer shall offer at least one alternative for each type of screen. The Bill of Quantities makes provision for the alternative screen offered and the tenderer shall insert the most expensive screen as his primary (priced item) but he shall indicate in his cover letter which screen is his preferred screen.

3.5 HAND-RAKED SCREENS

Refer to the Standard Specification on Manually Cleaned Screens.

Five hand-raked screens, complete with rakes, shall be supplied and installed at the Inlet Works as indicated on the drawings and in Table 3.

Table 3: Hand Raked Screens at the Inlet Works

Detail / Requirements	Unit	Bypass for the 15mm screens	Bypass for the 6mm screens	Bypass for the 3mm screens
Tag No		1I-SC-01-H 1I-SC-02-H	1I-SC-03-H	1I-SC-04-H 1I-SC-05-H
No of screens		2	1	2
Angle of inclination with the horizontal	deg	60	60	60
Spacing between bars or aperture size	mm	15	10	5
Screen bar dimensions	mm	50 x 10	50 x 10	40 x 5
Materials of manufacture		304 L stainless steel	304 L stainless steel	304 L stainless steel
Channel dimensions (W x D)	mm	1,200 x 1,700	1,200 x 1,700	1,550 x 1,180

The top section of the screen bars shall extend onto a horizontal platform. The screen shall be fixed to the concrete at the top and bottom by means of wedge anchors.

Three flat bars shall be welded at the back of the screen bars at the two ends and in the middle of the screen to ensure rigidity and proper spacing between the screen bars throughout the length of the screen.

An angle iron shall be welded to the bars where they bend and extend onto the platform which shall rest on the corner of the platform as illustrated on the drawings.

A detailed drawing of the screens and the rakes shall be submitted to the Engineer for approval prior to manufacturing.

3.6 VORTEX DEGRITTERS

Refer to the Standard Specification on Mechanical Degritter Systems.

Two vortex degritters shall be equipped by the Mechanical Contractor.

The Mechanical Contractor shall check and confirm the civil design of the vortex degritter structures to match the equipment he is offering.

Wash water and/or service water for the vortex degritters shall be obtained from the wash water and/or service water systems. The Contractor shall include in his pricing for all pipework, valves, fittings, instruments and other components required from the connection to the water reticulation system to the connection at the water supply point.

The Mechanical Contractor shall design, supply, deliver, install, test and commission the air supply system required for the removal of grit from the vortex degritters. The schematic representation on the P&ID drawing (PK278-01-PRC-DRG-1000-1009) may be used as the basis for such design but is not prescriptive and is not necessarily complete.

The system shall include a minimum of two compressors (1I-BL-01-GV & 1I-BL-02-GV) arranged in a duty and standby configuration, with a minimum of two air receivers (1I-TK-01-TK & 1I-TK-02-TK), and all necessary pipework, valves, fittings, instruments and other components required to establish a fully functional air supply system. Pipework shall be arranged in such a manner that any compressor can provide air to any air receiver, and the necessary valves shall be provided to ensure that the system remains operational if any one compressor or any one air receiver should be unavailable.

The Contractor shall be responsible for the detail design of the system and equipment selection to provide for the required degritting function. The scope of supply shall include pipework, valves, paddle system with drive and controls and all other components to establish an effective and efficient and fully functional vortex degritter system.

If the Contractor's design at the Inlet Works requires an air supply in locations other than the vortex degritters then this shall be allowed for in the design of the air supply system.

3.7 SCREENINGS WASH COMPACTORS

Refer to the Standard Specification on Screenings Handling Equipment.

Six screenings wash compactors shall be provided in accordance with the Standard Specifications on Screenings Handling Equipment. One compactor shall be provided for each of the 15mm screens (1I-A-01-M & 1I-A-02-M), the 6mm screens (1I-A-03-M & 1I-A-04-M) and the 3mm screens (1I-A-07-M & 1I-A-08-M).

The wash compactors shall receive the screenings via a screenings launder and shall discharge the washed and compacted screenings to a trolley mounted 6m³ standard waste skip. A separate screenings skip and trolley system shall be provided for each pair of wash compactors (1I-TK-01-SK, 1I-TK-02-SK & 1I-TK-04-SK).

Each screenings skip trolley system shall be rail mounted and shall be equipped with a cable and electric capstan winch (1I-M-01-W, 1I-M-02-W & 1I-M-04-W) for moving the trolley with skip in and out of the enclosure for the wash compactor and skip, to and from a location where the skip can be delivered and/or collected by a truck.

The screenings skip and trolley systems shall be designed by the Contractor and submitted to the Engineer for approval before any materials are ordered or manufacturing commences. The scope of supply shall include the dolly, i.e. frame with wheels to support the skip, the rails on which the dolly shall run, and the capstan winch and cable, and all other components required to provide a fully functional system.

Each wash compactor shall be sized to handle the grit load of the two vortex degritters.

The enclosure and the odour control of the enclosure shall be provided by others.

3.8 GRIT CLASSIFIERS

Refer to the Standard Specification on Mechanical Degritter Systems.

Two grit classifiers (1I-A-05-M & 1I-A-06-M) shall be supplied and installed in accordance with the requirements of the Standard Specification on Mechanical Degritter Systems.

The grit classifiers shall receive the grit directly from the airlift pumps that will pump the grit out of the vortex degritters and shall discharge the classified grit to a trolley mounted standard 6m³ waste skip.

The grit skip and trolley system (1I-TK-03-SK) shall be rail mounted and shall be equipped with a cable and electric capstan winch (1I-M-03-W) for moving the trolley with skip in and out of the enclosure for the grit classifier and bin, to and from a location where the skip can be delivered and/or collected by a truck.

The grit skip and trolley system shall be designed by the Contractor and submitted to the Engineer for approval before any materials are ordered or manufacturing commences. The scope of supply shall include the dolly, i.e. frame with wheels to support the skip, the rails on which the dolly shall run, and the capstan winch and cable, and all other components required to provide a fully functional system.

Each grit classifier shall be sized to handle the grit load of the two vortex degritters.

The enclosure and the odour control of the enclosure shall be provided by others.

3.9 INLET WORKS WASH WATER SYSTEM

To provide wash water and launder motive power the Mechanical Contractor shall design, supply, deliver, install, test and commission a wash water system suitably sized for all the wash water requirements at the inlet works. The schematic representations on the P&ID drawings may be used as the basis for such design but are not prescriptive and are not necessarily complete.

The water draw-off point for the wash water system shall be the flow dividing structure just before the primary settling tanks. The reticulation pipework shall form part of the Civil Contractor's scope of supply and the Mechanical Contractor shall connect to this reticulation system. All necessary pipework and fittings to connect to the wash water reticulation system shall be included in the mechanical scope of supply.

Two wash water pumps (1I-P-01-CF & 1I-P-02-CF) shall be installed on a slab adjacent to the primary flow dividing structure that will be provided by the Civil Contractor. The pumps shall be arranged in a duty and standby configuration.

The size of the slab shall be determined by the Mechanical Contractor to accommodate the equipment specified below. The mechanical / civil interface shall be 1m beyond the edge of the slab.

3.10 SCREENINGS AND GRIT HYDRO CONVEYORS

Refer to the Standard Specification on Mechanical Degritter Systems and the Standard Specification on Screenings Handling Equipment.

The Mechanical Contractor shall design, supply, deliver, install, test and commission three screenings hydro conveyor systems at the inlet works, one for the two 15mm screens, one for the 6mm screens and one for the 3mm screens. In addition, the Contractor shall design, supply, deliver, install, test and commission one grit hydro conveyor system to serve the vortex degritters. Each hydro conveyor shall be able to discharge to any one or both of the wash compactors or grit classifiers associated with the system.

The hydro conveyor for each set of screens shall collect the screenings from both screens and shall deposit the screenings into the selected wash compactor for each set of screens.

The hydro conveyor for the vortex degritters shall collect the grit from both degritters and shall deposit the grit into the selected grit classifier.

Each hydro conveyor shall have as few direction changes as possible and where a direction change is unavoidable this shall be to the approval of the Engineer.

Each hydro-conveyor shall be complete with all required pipework, valves and other flow control devices to ensure a fully functional unit.

The schematic representations on the P&ID drawings may be used as the basis for the Contractor's design but are not prescriptive and are not necessarily complete.

3.11 INLET WORKS PIPEWORK

Refer to the Standard Specification on Pipework.

All pipework in the inlet works specified in the following paragraphs shall be grade 304 L stainless steel including all appurtenant equipment such as supports, valves, etc.

Service water shall be sourced from the service water system. Wash water shall be sourced from the wash water system.

3.11.1 Return Water Pipework for the Wash Compactors and Grit Classifiers

The Mechanical Contractor shall design, supply, deliver, install, test and commission the pipework to return the overflow water from the screen wash compactors and the grit classifier to the inlet channel.

The scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional pipework system.

3.11.2 Service Water Pipework for the Vortex Degritters

The Mechanical Contractor shall design, supply, deliver, install, test and commission the service water pipework from the civil interface point up to and including the connection at the degritters.

The scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional pipework system. The system shall include isolating valves, a pilot operated flow control valve and a solenoid operated on/off control valve.

3.11.3 Service Water Pipework for the Screens

Should spray bars or clean water wash water be required for the 15mm and/or 6mm and/or 3mm screens then the Mechanical Contractor shall design, supply, deliver, install, test and commission the service water pipework from the civil interface point up to and including the connection to supply service water to the screens.

The scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional pipework system. The system shall include a manual globe valve for controlling the water flow and a solenoid valve to open a close the water when required.

3.11.4 Wash Water Pipework for the Hydro Conveyors

The Mechanical Contractor shall design, supply, deliver, install, test and commission the wash water pipework from the civil interface point up to and including the connection at the hydro conveyors.

The system shall provide motive water to the hydro conveyors and the scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional pipework system. The system shall include a globe or similar manual valve to manually set the flow rate required and a solenoid valve to open and close the water supply as required.

3.11.5 Wash Water Pipework for the Screenings Wash Compactors and Grit Classifiers

The Mechanical Contractor shall design, supply, deliver, install, test and commission the wash water pipework from the civil / mechanical interface point up to and including the connection at the wash compactors and grit classifiers.

The scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional pipework system, and the system shall include a globe or similar manual valve to manually set the flow rate required and a solenoid valve to open and close the water supply as required.

3.11.6 Service Water Pipework for the Grit Classifier

Should spray bars or clean water be required for the grit classifiers then the Mechanical Contractor shall design, supply, deliver, install, test and commission the service water pipework from the civil / mechanical interface point up to and including the connection to supply wash water to the grit classifiers.

The scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional pipework system. The system shall include a manual globe valve for controlling the water flow and a solenoid valve to open and close the water when required.

4. PRIMARY SETTLING

4.1 GENERAL REQUIREMENTS

Refer to PK278-01-PRC-DRG-1000-2001, -2002, -2003 & -2004.

Refer to the Standard Specification on Mechanically Scraped Settling Tanks.

The primary settling process area consists of the following:

- i. Flow division.
- ii. Primary settling tanks that can be used as elutriation tanks or primary settling tanks.
- iii. Primary sludge pump stations.
- iv. Scum pump station.

In the elutriation mode the primary settling tank contents will be recirculated through the settling tank using the primary sludge pumps. Alternatively, the same pumps will be used to pump the primary sludge to the anaerobic sludge treatment plant area.

4.2 PRIMARY FLOW DIVISION

Flow division is achieved by means of a hydraulic flow division structure. The structure is designed to ultimately divide the flow into 5 equal portions. At this stage only 2 outlets of the flow dividing structure will be equipped.

The Mechanical Contractor shall supply and install the following equipment associated with the hydraulic flow dividing structure:

4.2.1 Wall-Mounted Sluice Gates

Refer to the Standard Specification on Flow Control Valves and Sluice Gates.

Two wall mounted sluice gates shall be supplied and installed. The purpose of the sluice gates is to be able to isolate any of the downstream process streams. The wall mounted sluice gates shall be installed in the flow dividing structure on the downstream side of the weir utilised for the flow division. Further information is presented in Table 4.

Table 4: Wall Mounted Sluice Gates at PST Flow Divider

Detail / Requirements	Unit	Channel 1	Channel 2
Tag No		1I-SG-30-H	1I-SG-31-H
Number of gates	No	1	1
Width x height or dia of opening	mm	2,150 x 750	2,150 x 750
Max head when gate is closed	mm	650	650
Max unbalanced head against which gate will operate	mm	650	650
Height of operator's platform above top of wall	mm	0	0
Height of handwheel above operator's platform	mm	1,100	1,100
Height of gate	mm	900	900
Gate travel	mm	850	850
Wall mounting		downstream	downstream

4.2.2 Fixed Weir Plates

Refer to the Standard Specification on Baffles, Weirs and Other Specially Fabricated Devices.

Two adjustable fixed weir plates (1I-W-01-WP & 1I-W-02-WP) shall be supplied and installed at the flow dividing structure. The two weir plates shall be installed at exactly the same height and shall be levelled to within 1mm.

The width of the opening is 1,000mm. The top of the weir plate shall protrude approximately 100mm above the concrete invert of the opening. In total the plate shall be at least 1,300 x 350mm and shall be height adjustable by 100mm.

The weir plates shall be manufactured from 304 L stainless steel and shall be fastened to the concrete wall by means of suitable stainless steel anchors.

The fastening of the weir plates shall be in accordance with the Standard Specification on Installation, Erection and Fixing of Equipment to Concrete Structures.

The weir plates shall be properly sealed at the bottom and the top of the weir plates as indicated on the drawings.

4.2.3 Flow Dividing Structure Overflow

The overflow weir to the balancing tank is a concrete broad crested overflow weir and is measured under the civil work.

4.3 PRIMARY SETTLING TANKS

Refer to the Standard Specification on Mechanically Scraped Settling Tanks.

Two 25m diameter conical bottom, mechanically scraped, primary settling tanks shall be equipped with mechanical equipment as detailed in the drawings and in accordance with the Standard Specification on Mechanically Scraped Settling Tanks and the requirements in this part of the Detail Specification.

The settling tank bridges (1I-RB-01-M & 1I-RB-02-M) shall be manufactured from mild steel suitably protected against corrosion in accordance with the Standard Specification on Corrosion Protection and the Standard Specification on Mechanically Scraped Settling Tanks.

All the fabricated settling tank equipment as specified in the Standard Specification on Mechanically Scraped Settling Tanks, with the exception of the bridge floor grating, access ladder and hand railing, shall be manufactured from 304L stainless steel.

The bridge floor grating, access ladder and hand railing shall be manufactured from mild steel and shall be hot dip galvanised in accordance with the Standard Specification on Corrosion Protection.

The bridge drive shall be fitted with a torque limit switch that shall trip the drive unit if the torque on the motor exceeds a preset limit. Provision shall be made for this switch on the slip rings if required.

The tank shall be fitted with scum removal equipment as detailed in the Standard Specification on Mechanically Scraped Settling Tanks.

The Contractor shall submit detail drawings of his mechanical equipment to be supplied to the Engineer for approval within the period for submission of information as detailed in Section 2 of the Detail Specification.

4.4 PRIMARY SLUDGE PUMP STATIONS

4.4.1 General Requirements

Two primary sludge pump stations shall be equipped, with a pump station dedicated to each one of the primary settling tanks.

Each pump station shall have a dual function, the first being to recirculate sludge over each primary settling tank (converting the tank into an elutriation tank), and the second to extract elutriate / primary sludge to the sludge handling process area of the plant by pumping directly into an anaerobic digester or the thick sludge sump.

The individually selected function for either of the pump stations shall be selected from the SCADA system in the central control room.

4.4.2 Primary Sludge Pumps

Refer to the Standard Specification on Dry Well Pumps.

Each primary sludge pump station shall be equipped with two dry-well self-priming pumps (1I-P-03-CF, 1I-P-04-CF, 1I-P-05-CF & 1I-P-06-CF) with the suction manifold directly connected to the primary settling tank underflow pipe. The pumps shall be able to pump to the thick sludge sump or to the primary flow dividing structure. The pumps shall be arranged in a duty/standby configuration.

The system curves for the pumps are given in Data Sheet AT1:CP:02.

The duty point flow rates are:

- i. Elutriation mode: 15 l/s
- ii. Primary sludge to thick sludge sump: 23 l/s
- iii. Primary sludge to anaerobic digesters: 23 l/s

To achieve the desired flow rates the primary sludge pumps shall be equipped with variable speed drives.

4.4.3 Primary Sludge Pump Station Pipework

Refer to the Standard Specification on Pipework.

The primary sludge pumps shall be installed on a slab between the two PSTs and the balancing tank, that will be provided by the Civil Contractor.

The size of the slab shall be determined by the Mechanical Contractor to accommodate the specified equipment below. The mechanical / civil interface shall be 1m beyond the edge of the slab.

All pipework, valves, fittings, specials and instruments (with the exception of the two magnetic flow meters, the two pressure transducers for the pressure sustaining function and the total suspended solids (TSS) probe) shown between the mechanical / civil interface points upstream and downstream of the pump station shall be deemed included in the pipework measured for the primary sludge pump station and shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

4.5 SCUM PUMP STATION

4.5.1 General Requirements

Refer to the Standard Specification on Dry Well Pumps, the Standard Specification on Surface-Mounted Mechanical Mixers and Aerators and the Standard Specification on Pipework.

The scum pump station shall be equipped with two dry-well self-priming pumps (1I-P-07-CF & 1I-P-08-CF) arranged in a duty and standby configuration and two vertical shaft mechanical mixers (1I-MX-01-A & 1I-MX-02-A).

The direction of rotation of the mixers shall be selected by the Contractor, and approved by the Engineer, to achieve an effective mixing flow pattern. The drive units selected shall allow the direction of rotation of the mixers to be reversed individually, whenever desired.

All pipework, valves, fittings, specials and instruments (with the exception of the two pressure transducers) shown between the mechanical / civil interface points upstream and downstream of the pump station shall be deemed included in the pipework measured for the scum pump station and shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

5. BALANCING TANK

Refer to PK278-01-PRC-DRG-1000-3001.

5.1 GENERAL REQUIREMENTS

The purpose of the balancing tank is to balance or equalise the daily flow to the biological reactor into a near constant flow, thereby optimising the performance of the process.

The following equipment shall be supplied, delivered, installed, tested and commissioned by the Mechanical Contractor to achieve the flow balancing:

- i. Mixers with speed control to prevent the settling of solids in the balancing tank.
- ii. A pinch valve to regulate the outflow from the balancing tank with the necessary isolating valves.
- iii. Hoisting frames with mechanical hoists.

5.2 MECHANICAL MIXERS

Refer to the Standard Specification on Surface-Mounted Mechanical Mixers and Aerators.

Nine surface mounted mechanical mixers (1P-MX-01-A through 1P-MX-09-A) shall be supplied, delivered, installed, tested and commissioned on the mixer bridges on the Balancing tank.

The mixers shall be equipped with variable speed drives. The speed of the mixers shall be controlled by the level in the balancing tank to maintain the required mixing energy per volume. The actual control and the level measuring instruments will be provided by the Electrical Contractor. The Mechanical Contractor shall provide the Electrical Contractor with the required speed / level curve applicable to the mixers. The

Mechanical Contractor shall also determine the minimum submergence level of the mixers to determine the level at which the mixers shall be switched off.

Not all mixers shall rotate in the same direction. The direction of rotation of any particular mixer shall be selected by the Contractor, and approved by the Engineer, to achieve an effective mixing flow pattern. The drive units selected shall allow the direction of rotation of all mixers to be reversed individually, whenever desired.

The required mixer duty (mixing energy in W/m^3) and mixing compartment volume is specified in the technical data sheets.

5.3 PINCH VALVE CHAMBER AND PIPEWORK

Refer to the Standard Specification on Flow Control Valves and Sluice Gates and the Standard Specification on Pipework.

Two pinch valves (1P-CV-01-PV & 1P-CV-02-PV) shall be provided on the downstream side of the balancing tank to sustain the pressure on the delivery side of the primary sludge pumps should this fall too low when the pumps are operated in the elutriation mode. The pinch valve shall be manually adjusted and set during commissioning after which the hand wheel of the valve shall be removed to avoid tampering with the valve setting.

All pipework, valves, fittings, specials and instruments (with the exception of the two magnetic flow meters) shown between the mechanical / civil interface points upstream and downstream of the pinch valve chamber shall be deemed included in the pipework measured for the pinch valve chamber and shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

The electrical actuator installed as part of the pinch valve shall be a modulating actuator.

5.4 HOISTING FRAMES

Refer to the Standard Specification on Hoisting Equipment.

Two fixed hoisting frames (1P-LE-01-CB & 1P-LE-02-CB) shall be provided on the balancing tank to facilitate removal of mixers for maintenance, repair or replacement.

The hoisting frames shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

Each hoisting frame shall be equipped with a manual crawl and chain hoist as per the requirements of the Standard Specification on Hoisting Equipment. The maximum lifting distance and safe working load shall be selected to suit the Contractor's hoisting frame and the mixers provided.

6. BIOLOGICAL REACTOR

Refer to PK278-01-PRC-DRG-1000-4001, -4002, -4003, -4004, -4006, -4007, -4008 & -4009.

6.1 GENERAL REQUIREMENTS

The biological reactor is sub-divided into 12 basins. The first 7 basins of the biological reactor are anaerobic / anoxic zones, depending on the recirculation selected. The remaining 5 zones of the biological reactor are aerobic zones. Waste activated sludge (WAS) is drawn off to a WAS draw-off box equipped with two centrifugal pumps.

The following equipment shall be supplied, delivered, installed, tested and commissioned by the Mechanical Contractor:

- i. 14 mechanical mixers – 2 in each of the anaerobic / anoxic zones.
- ii. 24 sludge valves.

- iii. 29 channel-mounted sluice gates.
- iv. 6 A-recycle axial flow pumps complete with flap valves.
- v. 3 R-recycle axial flow pumps complete with flap valves.
- vi. 2 waste activated sludge pumps and associated pipework.
- vii. 5 A-frame hoisting frames with crawl hoists.
- viii. Fine bubble aeration system, complete with blowers and pipework for 5 aerobic zones.

6.2 MECHANICAL MIXERS

Fourteen fixed speed mechanical mixers (1P-MX-10-A through 1P-MX-23-A) shall be installed on the bridges provided on the anaerobic and anoxic zones of the biological reactor.

The required mixing energy and mixing compartment volumes are specified in Technical Data Sheet AT1:MX:01.

Not all mixers shall rotate in the same direction. The direction of rotation of any particular mixer shall be selected by the Contractor, and approved by the Engineer, to achieve an effective mixing flow pattern. The drive units selected shall allow the direction of rotation of all mixers to be reversed individually, whenever desired.

6.3 SLUDGE VALVES

Twenty-four sludge valves (1P-V-01-PL through 1P-V-24-PL) shall be installed in the recycle channels in the biological reactor as indicated on the drawings. The sludge valves shall be bottom mounted inside the channels. Additional information is presented in Table 5.

Table 5: Biological Reactor Sludge Valves

Detail / Requirements	Unit	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Tag No.		1P-V-01-PL 1P-V-02-PL	1P-V-03-PL 1P-V-04-PL	1P-V-09-PL 1P-V-10-PL	1P-V-15-PL 1P-V-16-PL	1P-V-23-PL 1P-V-24-PL	1P-V-17-PL 1P-V-18-PL
Diameter	mm	450	450	450	450	450	450
Tag No.		1P-V-05-PL 1P-V-06-PL	1P-V-07-PL 1P-V-08-PL	1P-V-11-PL 1P-V-12-PL	1P-V-13-PL 1P-V-14-PL	1P-V-21-PL 1P-V-22-PL	1P-V-19-PL 1P-V-20-PL
Diameter	mm	650	650	650	650	650	650
Material of manufacture	mm	304 L Stainless Steel	304 L Stainless Steel	304 L Stainless Steel	304 L Stainless Steel	304 L Stainless Steel	304 L Stainless Steel
Mounting	mm	Channel bottom	Channel bottom	Channel bottom	Channel bottom	Channel bottom	Channel bottom
Height of operator's platform above channel invert	mm	1,150	1,150	1,150	1,150	1,150	1,150
Height of handwheel above operator's platform	mm	900	900	900	900	900	900

The channels are covered by grating provided under the Civil Contract. The valve headstock shall be mounted on the grating. The cover tube over the rising spindle shall be of clear UV-stabilised plastic.

The installation of the sludge valves shall be in accordance with the Standard Specification on Installation, Erection and Fixing of Equipment to Concrete Structures.

6.4 CHANNEL MOUNTED SLUICE GATES

Twenty-nine channel-mounted sluice gates shall be supplied and installed. The purpose of the sluice gates is to allow reactor basins to be isolated while maintaining the aeration system, to withdraw waste activated sludge (WAS) from the reactor and to control the outflow from the reactor. Details of the sluice gates is provided in Table 6.

Table 6: Biological Reactor Bypass Channel-Mounted Sluice Gates

Detail / Requirements	Unit	Biological Reactor Bypass Channels	
Tag No	-	1P-SG-31-H and 1P-SG-32-H	1P-SG-01-H through 1P-SG-26-H and 1P-SG-30-H
Number of gates	No	2	27
Width x height or dia of opening	mm	800 x 2,170	1,500 x 2,170
Max head when gate is closed	mm	1,200	1,200
Max unbalanced head against which gate will operate	mm	1,200	1,200
Height of operator's platform above channel invert	mm	2,170	2,170
Height of handwheel above operator's platform	mm	1,100	1,100
Height of gate	mm	1,500	1,500
Gate travel	mm	1,300	1,300

The installation of the sluice gates shall be in accordance with the Standard Specification on Installation, Erection and Fixing of Equipment to Concrete Structures.

6.5 A-RECYCLE AND R-RECYCLE AXIAL FLOW PUMPS COMPLETE WITH CHANNEL FLAP VALVES

Refer to the Standard Specification on Propeller Pumps.

Nine propeller pumps of the type specifically developed for the recirculation of mixed liquor within the reactor of an activated sludge treatment plant shall be supplied, delivered, installed, tested and commissioned in the positions as indicated on the drawings.

The scope of supply for each pump shall include a flap valve to be mounted on the side wall of the recycle channel, suitable for an opening of 650 x 450mm.

The pumps shall be suited to pumping large volumes of liquid at low heads without the risk of clogging. The pumps shall be of a cantilever design with no underwater bearings. All moving parts shall be adequately enclosed in accordance with the provisions of the Occupational Health and Safety Act, Act 85 of 1993. The propeller shall have a swept-back blade to reduce the risk of fouling.

The propeller shall draw liquid from the applicable compartment through a throat pipe fitted with a bell mouth on both ends. The discharge shall be collected in a chamber above the propeller. Flow accumulating in the chamber of the A-recycle pumps will be channelled to the required point of re-entry to the reactor. Flow accumulation in the chambers of the R-recycle pumps shall flow through an opening provided into the anaerobic zone of the bioreactor.

The propeller pumps shall be V-belt driven. The number and type of V-belts used, the pulley sizes, the distance between the motor drive end bearing and drive pulley centre lines and the V-belt tension shall be selected so that the maximum radial load on the electric motor bearings, as well as the centre line distance between the driven pulley and pump shaft drive end bearing does not exceed 50% of the maximum

allowable radial load, as specified by the motor manufacturer and the pump shaft drive end bearing manufacturer.

The shaft, propeller, throat pipe and safety enclosure shall be fabricated from grade 304 L stainless steel. The length of the shaft, position of the chamber and position of the drive shall be customized to suit the dimensions of the structure where the pump is to be installed.

The pump propeller shall be positioned sufficiently below the water surface of the compartment that it is pumping from to minimize aeration due to high upflow velocities through the throat into the upper chamber.

The pulley drive safety enclosure shall be fitted with V-belt inspection openings covered with expanded metal mesh.

The Tenderer shall submit a detailed calculation sheet with his covering letter detailing all the parameters mentioned above and the calculated maximum radial load on the motor bearing and pump shaft bearings for each size of propeller pump.

The structures on which the pumps will be installed as detailed on the drawings shall be supplied by others. Any specific civil requirements and alterations required to the civil structures to fit the equipment offered shall be submitted to the Engineer within the period for submission of information as detailed in Section 2 of the Detail Specification. Should the Contractor fail to do so any modifications to the structures required at a later stage shall be for the Contractor's account.

Any grouting up of the pump baseplate and/or throat shall be done by the Mechanical Contractor and payment for grouting shall be included in the rates for the installation of the pumps.

The pumps shall be supplied complete with a standard electric motor, frame, throat pipe, safety enclosures, holding-down bolts, flap valves (where required), corrosion protection, documentation (including pump curves, operating and maintenance manuals, and spares lists) and all other items of equipment required to render a complete working and maintainable system.

The electric motors for the recycle pumps shall be supplied with a heater and over temperature cut-out switch.

The A- and R-recycle pumps shall comply with the requirements stipulated below:

Table 7: Biological Reactor Mixed Liquor Recycle Pumps

Detail / Requirements	Unit	A-recycle Pumps	R-recycle Pumps
Tag No		1P-P-01-AX 1P-P-02-AX 1P-P-03-AX 1P-P-04-AX 1P-P-05-AX 1P-P-06-AX	1P-P-07-AX 1P-P-08-AX 1P-P-09-AX
Number of pumps	No	6	3
Pumped medium	-	Activated sludge	Activated sludge
Solids content of pumped medium	%	0.6	0.6
Duty point of the pumps	m ³ /s @ m	0.2315 @ 0.7	0.2315 @ 0.7
Flap valves required		1P-SG-01-FG 1P-SG-02-FG 1P-SG-03-FG 1P-SG-04-FG 1P-SG-05-FG 1P-SG-06-FG	1P-SG-07-FG 1P-SG-08-FG 1P-SG-09-FG

Dimensions of wall openings		650 x 450	650 x 450

6.6 HOISTING FRAMES

Refer to PK278-01-PRC-DRG-1000-4008 & -4009.

Refer to the Standard Specification on Hoisting Equipment.

Five fixed A-frame hoisting frames shall be provided on the biological reactor to facilitate removal of recycle pumps for maintenance, repair or replacement.

- i. Hoisting frame 1P-LE-03-CB shall serve A-recycle pumps 01 and 02.
- ii. Hoisting frame 1P-LE-04-CB shall serve A-recycle pumps 03, 04, 05 and 06.
- iii. Hoisting frame 1P-LE-05-CB shall serve R-recycle pumps 07.
- iv. Hoisting frame 1P-LE-06-CB shall serve R-recycle pumps 08.
- v. Hoisting frame 1P-LE-07-CB shall serve R-recycle pumps 09.

The hoisting frames shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

Each hoisting frame shall be equipped with a manual crawl and chain hoist as per the requirements of the Standard Specification on Hoisting Equipment. The maximum lifting distance and safe working load shall be selected to suit the Contractor's hoisting frame and the recycle pumps provided.

6.7 WAS PUMPS AND PIPEWORK

Refer to the Standard Specification on Dry Well Pumps and the Standard Specification on Pipework.

Two VSD driven, self-priming, non-contact impeller centrifugal waste activated sludge (WAS) pumps (1P-P-01-CF & 1P-P-02-CF) shall be installed in a duty and standby configuration. The duty and system curves are given in Datasheet AT1:CP:03.

The WAS pumps shall be installed on a slab, adjacent to the WAS draw-off box, which will be provided by the Civil Contractor.

The size of the slab shall be determined by the Mechanical Contractor to accommodate the specified equipment below. The Mechanical / Civil interface shall be 1m beyond the edge of the slab.

All pipework, valves, fittings, specials and instruments (with the exception of the magnetic flow meter) shown between the mechanical / civil interface points upstream and downstream of the WAS pumps shall be deemed included in the pipework measured for the WAS pumps and shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

6.8 FINE BUBBLE AERATION SYSTEM COMPLETE WITH BLOWERS AND PIPEWORK FOR 5 AEROBIC ZONES (CONTRACTOR'S DESIGN)

Refer to PK278-01-PRC-DRG-1000-4011, -4012, 4013, -4014, -4015 & -4016.

Refer to the Standard Specification on Diffused Aeration Equipment.

The fine bubble aeration system for the 5 aerobic zones in the bioreactor shall be designed, supplied, delivered, installed, tested and commissioned by the Contractor in accordance with the Standard Specification on Diffused Aeration Equipment and subject to the following requirements and information:

- i. The blower building/s shall be sized by the Contractor. The position of the blower building/s shall be on the platform between the biological reactor and the secondary settling tanks. The Contractor may opt for single or multiple blower buildings. The outer wall of the blower building closest to the biological reactor shall be at least 3m from the outer wall of the reactor. There is a 2m wide (outside

dimensions) bypass channel before the outer structural wall of the aeration basin is reached. The maximum depth of the blower buildings shall not be more than 7m (outer dimensions.) The Contractor shall optimise the positions of the blower buildings to reduce the aeration pipe lengths.

- ii. The scope of supply shall include all blowers, air pipes including manifolds, feeder pipes, down pipes, valves, fittings, headers and laterals to render a complete and functioning aeration system in the five aeration basins.
- iii. The Tenderer shall provide at least two offers for the aeration system in their tender with the most expensive offer being carried forward to the total tender amount. The Tenderer shall however indicate in his tender cover letter which aeration system is his preferred system. Both alternatives shall comply with all the requirements as listed here. Should the Tenderer wish to offer an alternative which does not fully comply with the requirements as listed here, he shall do so in his tender cover letter providing full technical details in order that this alternative can be fully evaluated.
- iv. The aeration system shall comply with the following general requirements:
 - a) The total actual O_2 requirement (all 5 basins combined) is 17,000kg O_2 /day
 - b) All 5 basins are equal in size with the following internal dimensions: 15,690 x 27,080 x 6,400mm deep.
 - c) The operating mixed liquor depth is 5m.
 - d) The ambient air temperature range is between 0°C and 40°C.
 - e) The maximum air bubble size shall be 2mm.
 - f) The minimum mixing capacity per basin shall be the greater of $20m^3/1000m^3$ or $0,85m^3/h$ or $27m^3/(day.m^2)$.
- v. The required O_2 requirement for the 5 individual aeration zones is given below.
 - a) Reactor Basin 8: 4,320 kg O_2 /day
 - b) Reactor Basin 9: 2,770 kg O_2 /day
 - c) Reactor Basin 10: 1,630 kg O_2 /day
 - d) Reactor Basin 11: 1,140 kg O_2 /day
 - e) Reactor Basin 12: 1,140 kg O_2 /day
- vi. The aeration system shall be a complete and functional system and shall include an acid injection system for cleaning the diffusers.

6.9 BLOWERS FOR THE AERATION BASINS (CONTRACTOR'S DESIGN)

Refer to PK278-01-PRC-DRG-1000-4011, -4012, -4013, -4014, -4015 & -4016.

Refer to the Standard Specification on Compressors and Blowers.

6.9.1 General Requirements

The blowers shall be positive displacement blowers, preferably of the Roots type.

Blowers that can be serviced by local agents in Polokwane shall be preferred.

Blowers shall be dedicated to individual aeration basins.

The airflow to each aeration basin shall be controlled by varying the speed of the blowers. Control valves to control the airflow to the aeration zone will not be allowed.

6.9.2 Blowers for Basin 8

Three blowers (1P-BL-01-PD, 1P-BL-02-PD & 1P-BL-03-PD) shall be provided in a two duty and one standby configuration.

The required airflow requirements shall be determined by the Contractor's design.

The blower manifold for Basin 8 shall be coupled via an isolating valve with the blower manifold for Basin 9. This is to make additional aeration capacity available during the isolation of either Basin 8 or 9.

6.9.3 Blowers for Basin 9

Three blowers (1P-BL-04-PD, 1P-BL-05-PD & 1P-BL-06-PD) shall be provided in a two duty and one standby configuration.

The required airflow requirements shall be determined by the Contractor's design.

The blower manifold for Basin 9 shall be coupled via an isolating valve with the blower manifold for Basin 8. This is to make additional aeration capacity available during the isolation of either Basin 8 or 9.

6.9.4 Blowers for Basin 10

Three blowers (1P-BL-07-PD, 1P-BL-08-PD & 1P-BL-09-PD) shall be provided in a two duty and one standby configuration.

The required airflow requirements shall be determined by the Contractor's design.

6.9.5 Blowers for Basin 11

Two blowers (1P-BL-10-PD & 1P-BL-11-PD) shall be provided in a one duty and one standby configuration.

The required airflow requirements shall be determined by the Contractor's design.

6.9.6 Blowers for Basin 12

Two blowers (1P-BL-12-PD & 1P-BL-13-PD) shall be provided in a one duty and one standby configuration.

The required airflow requirements shall be determined by the Contractor's design.

6.9.7 Standby Blowers for Basins 10, 11 and 12

Two standby blowers (1P-BL-14-PD & 1P-BL-15-PD) shall be provided in a one duty and one standby configuration. The delivery pipework of these blowers shall be connected, via isolating valves, to the aeration grids for Basins 10, 11 and 12 to provide standby aeration capacity when this is required due to maintenance activities.

The required airflow requirements shall be determined by the Contractor's design.

6.9.8 Aeration Pipework

All pipework, valves, fittings, specials and instruments associated with the fine bubble diffused aeration system shall be deemed included in the scope of supply for the aeration system and shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

6.10 ACID INJECTION SYSTEM FOR DIFFUSER CLEANING (CONTRACTOR'S DESIGN)

6.10.1 General Requirements

The aeration system for the bioreactor shall include a system capable of injecting formic acid (methanoic acid, HCOOH) or acetic acid (ethanoic acid, CH_3COOH) to address carbonaceous and/or organic deposits and scaling in the aeration system.

The acid injection system shall comply in general with the requirements of the Standard Specification on Chemical Dosing Plant and shall comprise of the following:

- i. Chemical dosing pump.

- ii. Compressor.
- iii. Ultrasonic atomizer.
- iv. Acid tank.
- v. Pipework, valves and fittings.
- vi. All other components to provide a complete and fully functional acid injection system.

Both the formic or acetic acid dosed will be 85% in solution and all chemical dosing equipment associated with the injection of acid shall be manufactured from materials that are resistant to this concentration of these acids.

The acid injection system shall be designed, supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

6.10.2 Chemical Dosing Pump

Chemical dosing pumps shall comply with the requirements of the Standard Specification on Chemical Dosing Plant and the Standard Specification on Dry-Well Pumps.

The chemical dosing pump shall be adjustable within a range of dosing rates and shall dose the acid into the down leg of each aeration grid that forms part of the fine bubble diffused aeration system.

The amount of acid to be dosed is related to the number of diffusers that are installed on the aeration grid that is to be treated. The Contractor shall ensure that the dosing pump can be adjusted between 0 and 100 ml/diffuser, in steps of 5 ml/diffuser or less.

6.10.3 Compressor

Compressors shall comply with the requirements of the Standard Specification on Compressors and Blowers.

The compressor shall be sized to allow for an adjustable airflow rate between 0 and 5 times the acid dosing rate.

6.10.4 Ultrasonic Atomizer

The acid dosing pipework and the air pipework shall both terminate at and connect to the atomizer. The atomizer shall be a permanently mounted atomizer on each down leg of each aeration grid, or it shall be possible to connect to a special connection point on each down leg with a man-portable acid and air dosing unit. In such a case the connection point on the down legs shall be included in the scope of supply for the acid dosing system.

6.10.5 Acid Tank

The acid tank shall be manufactured from a material suitable to withstand the corrosive nature of the acid to be dosed. The tank shall be equipped with a tray or bund to collect spillages and leakages.

6.10.6 Pipework, Valves and Fittings

The acid dosing system shall be installed complete with all pipework, valves, fittings, couplings, connections and other components required to establish a fully functional acid injection system.

6.10.7 Safety Signage

The acid injection system shall be delivered complete with all necessary safety signage and documentation.

7. SECONDARY SETTLING

Refer to PK278-01-PRC-DRG-1000-5001, -5002, -5003 & -5004.

7.1 GENERAL REQUIREMENTS

The secondary settling process area consists of the following:

- i. Flow division.
- ii. Secondary settling tanks.
- iii. Return activated sludge (RAS) pump station.
- iv. Flow measurement in the outlet channel to the ponds.

7.2 FLOW DIVISION

7.2.1 General Requirements

Flow division is achieved by means of a hydraulic flow division structure. The structure is designed to divide the flow into 2 equal portions.

The Mechanical Contractor shall supply, deliver, install, test and commission channel-mounted sluice gates and fixed weir plates in the flow division structure.

7.2.2 Channel-Mounted Sluice Gates

Refer to the Standard Specification on Flow Control Valves and Sluice Gates.

Two channel-mounted sluice gates (1P-SG-35-H & 1P-SG-36-H) are required. The purpose of the sluice gates is to isolate any one of the downstream process streams. The sluice gates shall be installed in the flow dividing structure on the downstream side of the weir utilised for the flow division. Further information is provided in Table 8.

Table 8: Channel- Mounted Sluice Gates at SST Flow Divider

Detail / Requirements	Unit	Channel 1	Channel 2
Tag No		1P-SG-35-H	1P-SG-36-H
Number of gates	No	1	1
Channel dimensions (W x D) at gate position	mm	1,100 x 1,200	1,100 x 1,200
Max head when gate is closed	mm	300	300
Max unbalanced head against which gate will operate	mm	300	300
Height of operator's platform above channel invert	mm	1,200	1,200
Height of handwheel above operator's platform	mm	1,100	1,100
Height of gate	mm	750	750
Gate travel	mm	750	750
Wall mounting		downstream	downstream

7.2.3 Fixed Weir Plates

Refer to the Standard Specification on Baffles, Weirs and Other Specially Fabricated Devices.

Two adjustable fixed weir plates (1P-W-01-WP & 1P-W-02-WP) shall be supplied and installed at the flow dividing structure.

The width of the opening is 1,000mm. The top of the weir plate shall protrude approximately 100mm above the concrete invert of the opening. In total the plate shall be at least 1,300 x 350mm and shall be height adjustable by 100mm.

The two weir plates shall be installed at exactly the same height and shall be levelled to within 1mm.

The weir plates shall be manufactured from 304 L stainless steel and shall be fastened to the concrete wall by means of suitable stainless steel anchors.

The fastening of the weir plates shall be in accordance with the Standard Specification on Installation, Erection and Fixing of Equipment to Concrete Structures.

The weir plates shall be properly sealed at the bottom and the top of the weir plates as indicated on the drawings.

7.3 SECONDARY SETTLING TANKS

Two 30m diameter conical bottom, mechanically scraped, secondary settling tank shall be equipped with mechanical equipment as detailed in the drawings and in accordance with the Standard Specification on Mechanically Scraped Settling Tanks and the requirements in this part of the specification.

The settling tank bridges (1P-RB-01-M & 1P-RB-02-M) shall be manufactured from mild steel suitably protected against corrosion in accordance with the Standard Specification on Corrosion Protection and the Standard Specification on Mechanically Scraped Settling Tanks.

All the fabricated settling tank equipment as specified in the Standard Specification on Mechanically Scraped Settling Tanks, with the exception of the bridge floor grating, access ladder and hand railing, shall be manufactured from 304L stainless steel.

The bridge floor grating, access ladder and hand railing shall be manufactured from mild steel and be hot dip galvanised in accordance with the Standard Specification on Corrosion Protection.

The bridge drive shall be fitted with torque limit switch that shall trip the drive unit if the torque on the motor exceeds a pre-set limit. Provision shall be made for this switch on the slip rings if required.

The tank shall not be fitted with scum removal equipment as detailed in the Standard Specification on Mechanically Scraped Settling Tanks.

The Contractor shall submit detail drawings of his mechanical equipment to be supplied to the Engineer for approval within the period for submission of information as detailed in Section 2 of the Detail Specification.

7.4 RETURN ACTIVATED SLUDGE (RAS) PUMP STATION

7.4.1 General Requirements

Equipment for the RAS pump station shall be supplied, delivered, installed, tested and commissioned by the Mechanical Contractor.

7.4.2 RAS Pumps

The RAS Pump Station shall be equipped with six pumps (1P-P-03-CF through 1P-P-08-CF), of which one set of three will be dedicated to each of the two secondary settling tanks. The suction manifold for each set of three pumps shall be directly connected to the underflow pipe of the applicable secondary settling tank. Each set of three pumps shall be arranged in a two duty and one standby configuration.

The system curves for the pumps are given in Technical Data Sheet AT1:CP:04.

To achieve the desired flow rates the RAS pumps shall be equipped with variable speed drives.

7.4.3 RAS Pump Station Pipework

The RAS pumps shall be installed on a slab located southwest of the settling tanks between the two SSTs. The two sets of RAS pumps shall share a common slab that will be provided by the Civil Contractor.

The size of the slab shall be determined by the Mechanical Contractor to accommodate the specified equipment. The mechanical / civil interface shall be 1m beyond the edge of the slab.

All pipework, valves, fitting, specials and instruments, with the exception of the two magnetic flow meters and the twelve pressure transducers for the pressure sustaining function, shown between the Civil / Mechanical interface points upstream and downstream of the RAS Pump Station shall be deemed included in the pipework measured for the RAS pump station.

7.5 PARSHALL FLUME

Refer to the Standard Specification on Parshall Flumes.

A standard Parshall flume with throat dimension 305mm shall be installed in the outlet channel as indicated on the drawings.

8. SLUDGE THICKENING AND DEWATERING

Refer to PK278-01-PRC-DRG-1000-7001, -7002, -7003 & -7004.

8.1 GENERAL REQUIREMENTS

The Mechanical Contractor shall design, supply, deliver, install, test and commission, giving a 12 month guarantee, mechanical equipment and systems for the sludge thickening and dewatering systems. The schematic representations on the P&ID drawings may be used as the basis for such designs but are not prescriptive and are not necessarily complete.

The Mechanical Contractor shall submit details of his sludge thickening and dewatering systems design, his building layout and related requirements to the Engineer for approval within 14 days after award of the Contract.

All pipework, valves and fittings required shall be included in the scope of supply.

The sludge to be dewatered can be either:

- i. Undigested waste activated sludge (WAS).
- ii. Anaerobically digested WAS.
- iii. Anaerobically digested primary sludge (PS).
- iv. An anaerobically digested mixture of PS and WAS.

The equipment and systems shall include the following:

- i. WAS thickening.
- ii. Thick sludge sump and thick sludge pumps.
- iii. Digested sludge day tank and pumps.
- iv. Sludge dewatering presses.
- v. Filtrate precipitation.
- vi. Ferric chloride dosing.
- vii. Polyelectrolyte dosing.
- viii. Pneumatic valve actuator air supply.
- ix. All necessary flow control valves and equipment.

The proposed design provides for the following:

- i. The dewatering plant shall be designed for a single 8 hour shift operation. In the proposed concept this was interpreted as 6 working hours – using 1 hour for set-up and one hour for cleaning and shut down at the end of the shift.

- ii. To be able to directly discharge the thickened WAS into a belt press (if WAS is wasted from the aerobic zone) or to divert the thickened WAS to the thick sludge sump (if WAS is wasted from the anaerobic zone) for further processing in the anaerobic digesters.
- iii. In the proposed concept four linear screens and four belt filter presses would be required.
- iv. The Contractor is at liberty to optimise this concept.

8.2 WAS THICKENING (CONTRACTOR'S DESIGN)

Refer to Refer to PK278-01-PRC-DRG-1000-6001.

Refer to the Standard Specification on Linear Screens and Belt Filter Presses.

The contractor shall be responsible for the design, supply, delivery, testing and commissioning of the WAS thickening system.

The concept design for the WAS thickening system comprises two elevated flow division tanks that divide the sludge between four linear screens (2R-F-01-LS, 2R-F-02-LS, 2R-F-03-LS & 2R-F-04-LS). The elevated tanks will respectively receive WAS from the WAS pumps at the bioreactor and digested WAS from the digested sludge day tank. Each feed stream will be dosed with polyelectrolyte via an ejector/injector at the entry to each tank.

The total load for WAS thickening is (6 hour operation):

- i. Flow rate: 217 m³/h.
- ii. Suspended solids loading: 1,084 kg/h.
- iii. Minimum guaranteed dry solids in linear screen discharge shall be 5%.

Thickened WAS shall be transferred from the linear screens to belt filter presses for further dewatering. The transfer from the linear screens to the belt presses shall be such as to not destroy any flocks in order to minimise the usage of polyelectrolyte. A facility to bypass the belt filter presses and discharge the thickened WAS directly to the thick sludge sump shall be provided.

The underflow from the linear screens shall be discharged to the filtrate precipitation tank for further treatment.

The flow division between multiple linear screens shall be actively controlled.

All provisions to supply service water and instrument air supply for operation of the linear screens and pneumatic operating and actuating systems shall be included in the scope of supply.

8.3 THICK SLUDGE SUMP AND PUMP STATION

Refer to Refer to PK278-01-PRC-DRG-1000-6003.

8.3.1 Thick Sludge Sump

The thick sludge sump shall receive thickened WAS from the linear screens as well as primary sludge from the primary settling tanks. In addition, it receives scum from the scum pump station, which will first be concentrated in a scum/water separator (2R-SC-01-SD) upstream of the thick sludge sump. Underflow from the scum/water separator as well as overflow from the thick sludge sump will be directed to the Inlet Works.

The Mechanical Contractor shall supply, deliver, install, test and commission two vertical shaft mechanical mixers (2R-MX-01-A & 2R-MX-02-A) in the thick sludge sump.

The mixers shall be equipped with variable speed drives that will allow mixer speed to be varied based on the level in the thick sludge sump to maintain a constant mixing energy per volume until the minimum level

is reached after which the mixers will be shut down. The mixers shall be selected to allow for a mixing velocity gradient between 80/s and 100/s.

The required mixing energy and mixing compartment volume are specified in Technical Data Sheet AT1:MX:05.

8.3.2 Thick Sludge Pumps

The Mechanical Contractor shall supply, deliver, install, test and commission two progressing cavity sludge pumps (2R-P-01-CF & 2R-P-02-CF) in the thick sludge pump station. The pumps shall pump to the anaerobic sludge digesters.

The thick sludge pumps shall be installed on a slab adjacent to the Thick Sludge Sump. The slab will be provided by the Civil Contractor.

The size of the slab shall be determined by the Mechanical Contractor to accommodate the specified equipment below. The Mechanical / Civil interface on the outlet of the pump station and for the single service water connection shall be 1m beyond the edge of the slab.

The suction manifold of the thick sludge pumps shall be directly connected to the outlet puddle flanges in the thick sludge sump. The pumps shall be arranged in a duty and standby configuration.

The pumps shall be fitted with integral dry-run protection and over pressure protection on the outlet of the pump. Both these protections shall prevent the pump from further operation until manually reset.

Provision shall also be made for connecting service water to the inlet of the pump to be able to flush the pump and pipeline for maintenance or when the system will be out of operation for prolonged periods. This will be a manual intervention.

The system curves and duty points for the pumps are given in Technical Data Sheet AT1:CP:05.

8.3.3 Thick Sludge Pump Station Pipework

Refer to PK278-01-PRC-DRG-1000-6003.

All pipework, valves, fitting, specials and instruments, with the exception of the magnetic flow meter and the total suspended solids (TSS) transducers shown between the thick sludge sump and the civil / mechanical interface at the anaerobic digesters shall be deemed included in the pipework measured for the thick sludge sump and pump station.

All pipework and fittings shall be 304 L stainless steel.

8.4 DIGESTED SLUDGE DAY TANK AND PUMPS

Refer to PK278-01-PRC-DRG-1000-6006.

8.4.1 Digested Sludge Day Tank

The Digested Sludge Day Tank receives digested sludge from the anaerobic digesters and precipitate from the filtrate precipitation tank, from where it is pumped to the sludge dewatering plant.

The Mechanical Contractor shall supply, deliver, install, test and commission four surface-mounted mechanical mixers (2R-MX-03-A, 2R-MX-04-A, 2R-MX-05-A & 2R-MX-06-A) on the bridges on the digested sludge day tank as indicated on the drawings.

The mixers shall be equipped with variable speed drives to allow the mixing intensity to be varied based on the level in the digested sludge day tank to maintain a constant mixing energy per volume until the minimum level is reached after which the mixers will be shut down. The mixers shall be selected to allow for a mixing velocity gradient between 80/s and 100/s.

The required mixing energy and mixing compartment volume are specified in **Technical Data Sheet AT1:MX:04**.

Overflow from the digested sludge day tank shall be directed to the primary flow divider upstream of the primary settling tanks.

8.4.2 Digested Sludge Day Tank Pumps

The Mechanical Contractor shall supply, deliver, install, test and commission two progressing cavity sludge pumps (2R-P-03-CF & 2R-P-04-CF) in the digested sludge pump station at the digested sludge day tank. The pumps shall be arranged in a duty and standby configuration.

The digested sludge day tank pumps shall be installed on a slab adjacent to the digested sludge day tank. The slab will be provided by the Civil Contractor. The size of the slab shall be determined by the Mechanical Contractor to accommodate the specified equipment below. The Mechanical / Civil interface on the outlet of the pump station and for the single service water connection shall be 1m beyond the edge of the slab.

The suction pipe of each pump shall be a surface pipe with a bell mouth in the digested sludge day tank.

The pumps shall be fitted with integral dry-run protection and over-pressure protection on the outlet of the pump. Both these protections shall prevent the pump from further operation until it has been manually reset.

Provision shall be made for connecting service water to the inlet of each pump to be able to flush the pump and pipeline for maintenance or when the system will be out of operation for prolonged periods. This will be a manual intervention.

The system curves and duty points for the pumps are given in Technical Data Sheet AT1:CP:05.

8.4.3 Digested Sludge Day Tank Pipework

All pipework, valves, fitting, specials and instruments (with the exception of the magnetic flow meter and the total suspended solids (TSS) transducers) shown between the Digested Sludge Day Tank and the Civil / Mechanical interface at the Sludge Dewatering Plant shall be deemed included in the pipework measured for the Digested Sludge Day Tank.

All pipework and fittings shall be stainless steel.

8.5 SLUDGE DEWATERING PRESSES (CONTRACTOR'S DESIGN)

Refer to PK278-01-PRC-DRG-1000-7001, -7002, -7003 & -7004.

Refer to the Standard Specification on Linear Screens and Belt Filter Presses.

The Mechanical Contractor shall supply, deliver, install, test and commission four sludge dewatering belt filter presses (2R-F-01-BP, 2R-F-02-BP, 2R-F-03-BP & 2R-F-04-BP) in the sludge dewatering building.

The maximum load for sludge dewatering is (6 hour operation):

- i. Flow rate: $74 + 7,4 \text{ m}^3/\text{h}$ (digested liquor + thickened WAS).
- ii. Suspended solids loading: $500 + 1,084 \text{ kg/h}$ (digested liquor + thickened WAS).
- iii. Minimum guaranteed dry solids in belt press discharge: 22% and 20% dry solids content (digested liquor and thickened WAS, respectively).

The proposed design links the output of the WAS thickening linear screens to the input of the belt presses. Should the Contractor's design use a different approach for this, his offer must include for all equipment to make this possible. The transfer of sludge from the linear screens to the belt presses shall be such as to not destroy any flocs in order to minimise the usage of polyelectrolyte.

Should the belt presses be used for drying digested sludge, the flow division between multiple belt presses shall be actively controlled. The solids cake from the belt press must be discharged 2m away from the building and the discharge point must be at least 2m above ground level. Each belt press shall have its own discharge point.

8.6 FILTRATE PRECIPITATION

Refer to PK278-01-PRC-DRG-1000-7007.

The filtrate from the linear screens and belt presses shall be discharged to the filtrate precipitation tank where ferric chloride shall be dosed. The clear overflow from the precipitation tank shall be discharged to the Inlet Works. The underflow of the precipitation tanks shall be discharged to the digested sludge day tank.

All pipework, valves, fitting, specials and instruments between the filtrate precipitation tank and the civil / mechanical interface at the Inlet Works shall be deemed included in the pipework measured for the filtrate precipitation tank.

8.7. FERRIC CHLORIDE DOSING

8.7.1 General Requirements

Refer to PK278-01-PRC-DRG-1000-7006 & -7007.

The Mechanical Contractor shall design, supply, deliver, install, test and commission, giving a 12 month guarantee, a ferric chloride storage, make-up and dosing system. The schematic representation on the P&ID drawings may be used as the basis for such design but are not prescriptive and are not necessarily complete.

Detailed layout drawings and accompanying technical details of the components of the proposed system shall be submitted to the Engineer for approval prior to ordering the materials. The design and installation of the ferric chloride dosing system shall comply with the Standard Specification on Chemical Dosing Plant, all relevant safety, municipal, environmental and other regulations.

8.7.2 Ferric Chloride Storage Tank

The system shall be designed to accept a 43% ferric chloride solution via road tanker.

The storage tank capacity shall be sufficient to provide for 8 days capacity at the highest dosing rate required.

The storage tank shall be adequately bunded, so that the bund can retain the full volume of the storage tank. Drainage pipework, complete with isolating valves and fittings, to drain the bund to the Inlet Works shall be designed, supplied, delivered, installed, tested and commissioned as part of the scope of supply.

8.7.3 Ferric Chloride Dosing Pumps

Two positive displacement-type ferric chloride dosing pumps (2R-P-01-DP & 2R-P-02-DP) shall be installed in a duty and standby configuration, allowing duty rotation, to pump ferric chloride from the ferric chloride storage or make-up tanks to the ferric chloride dosing point at the filtrate precipitation tank. The pumps shall be complete with pressure gauges and all installation ancillaries.

The pumps shall be suitable to pump ferric chloride at a concentration of 43% by weight.

The system shall provide for ferric chloride dosing to the filtrate precipitation tank, via an ejector/injector where the 43% ferric chloride solution shall be combined with a suitable quantity of service water to reduce the concentration to 11%.

All pipework, valves, fitting, specials and instruments (with the exception of the magnetic flow meter) between the ferric chloride storage tank and the ejector/injector, as well as between the connection with

the service water reticulation system and the filtrate precipitation tank, shall be deemed included in the pipework measured for the ferric chloride dosing system.

8.7.5 Ferric Chloride Dosing Pipework

The scope of supply shall include all pipework, valves, fittings, supports and all other components to provide a fully functional ferric chloride dosing system. This shall include the necessary pipework to connect to the service water supply as well as the ejector/injector and any special fittings required at the dosing point to achieve an adequate degree of mixing.

8.8 POLYELECTROLYTE PREPARATION AND DOSING SYSTEMS

Refer to PK278-01-PRC-DRG-1000-7008, -7009, -7010, -7011 & -7012.

8.8.1 General Requirements

The Contractor shall design, supply, install, test and commission two polyelectrolyte make-up, storage, mixing and dosing systems to dose polyelectrolyte into the elevated flow division tanks at the linear screens.

The schematic representations on the P&ID drawings may be used as the basis for such design but are not prescriptive and are not necessarily complete.

The most suitable polymer dosing system selection, and the actual size, type and pressure rating of pipe work, valves, fittings and specials shall be determined by the Contractor and submitted to the Engineer with the proposed system layout, detailed construction drawings and equipment selection for approval prior to ordering material or commencing fabrication.

The equipment shall comply with all the relevant standard specifications including the Standard Specification on Chemical Dosing Plant.

Each system shall include the following components:

- i. One polyelectrolyte storage hopper with capacity to hold 100kg of dry polyelectrolyte granules and feed the polyelectrolyte screw feeder into make-up tank described below.
- ii. One polyelectrolyte screw feeder with a feed capacity of 5kg/h. The screw feeder shall be driven through a gearbox by a helix-type electric motor and shall be used to feed polyelectrolyte from the hopper to the make-up tank.
- iii. Three polymer reaction vessels, of which two will be used for polyelectrolyte make up and stock and the third as storage. The make-up vessels are to come complete with all pipe couplings, drain pipework and relevant isolating valves, and shall be used to prepare a batch of polyelectrolyte mixture and hold it for some time, before the mixture is transferred to the storage tank using the transfer pumps described below.
- iv. All pipework, valves, fitting, specials and instruments to provide service water from the service water reticulation system and for the drainage of spillages and overflows to an appropriate discharge point.
- v. The polymer reaction vessels shall be equipped with vertical shaft mechanical mixers to effectively mix the contents of the vessels. The mixing energy per mixer shall be at least 8W/m^3 .
- vi. A hoist for lifting the polymer bags or containers shall be provided. The hoist shall lift the bags or containers from a delivery truck to the storage area, and from the storage area to the level of the loading hopper of the make-up equipment. Maximum lifting distance, operator level and SWL to be determined by the Contractor based on his design. The hoist shall include the beams, gantry and electrically controlled travelling chain hoist with appropriate SWL rating.
- vii. Two progressing cavity polyelectrolyte transfer pumps to be installed in a duty and standby

configuration with duty rotation, to transfer polyelectrolyte from the make-up tank to the stock tank.

The pumps shall comply with the following specifications.

Model:	Shall be a currently catalogued, locally supported brand product
Duty flow:	2 m ³ /h
Duty head:	5 m (to be confirmed by the Contractor)
Motor size:	To be confirmed by the Contractor
Solids handling:	±10 mm
Other:	Pressure relief valves to suit applications

8.8.2 Polyelectrolyte Dosing Pumps for the Linear Screens

Refer to PK278-01-PRC-DRG-1000-7008, -7009, -7010, -7011 & -7012.

The Contractor shall supply, deliver, install, test and commission two sets of two progressing cavity polyelectrolyte dosing pumps (2R-P-01-PC, 2R-P-02-PC, 2R-P-03-PC & 2R-P-04-PC) to dose polyelectrolyte from any of the stock tanks to each of the ejectors/injectors (2R-E-01-IJ & 2R-E-02-IJ) at the elevated flow division tanks preceding the linear screens. The pumps shall be equipped with variable speed drives and shall be installed in a duty and standby configuration with duty rotation.

The dosing pumps shall comply with the following specifications:

Model:	Shall be a currently catalogued, locally supported brand product
Duty flow:	To be confirmed by the Contractor
Duty head:	To be confirmed by the Contractor
Motor size:	To be confirmed by the Contractor
Solids handling:	±10 mm
Other:	Pressure relief valves to suit applications

All pipework and valves shall be stainless steel and shall be rated for the appropriate operating pressure, with a minimum of a 16 bar rating.

All the necessary non return valves, ball valves, pipework and all other components required to establish a fully functional and efficiently operating polyelectrolyte dosing system from (and including) the polymer bag handling system up to each dosing point shall be included.

8.9 PNEUMATIC VALVE ACTUATOR AIR SUPPLY

Refer to PK278-01-PRC-DRG-1000-7005.

Several modulating and open/close valves are required in the dewatering process area.

The proposed design allows for pneumatic actuators. For this reason, an air supply system producing instrument air quality is required. The Mechanical Contractor shall determine the quantity of instrument quality air required as the base sizing of the plant.

The Mechanical Contractor shall design, manufacture, supply, deliver, test and commission the required instrument air quality supply system. The system shall be adequately sized to provide at least 20% spare capacity.

The schematic representations on the P&ID drawings may be used as the basis for such design but are not prescriptive and are not necessarily complete.

All pipework, valves, fitting, specials and instruments between the air supply system and the individual air supply locations shall be deemed included in the scope of supply.

9. DIGESTER MIXING SYSTEM

Refer to PK278-01-PRC-DRG-1000-6004 & -6005.

The Mechanical Contractor shall design, supply, deliver, install, test and commission, giving a 12 month guarantee, all mechanical equipment required for the anaerobic digester, pumped mixing system as described below.

The mixing system shall consist of recycling chopper pumps to macerate the sludge solids and pump the sludge back to the digester through an engineered arrangement of floor-mounted nozzles. The complete system shall be designed and installed by a specialist as a turnkey solution.

A detailed layout of the proposed system and technical details of all equipment involved shall be submitted with the tender. The system shall include at least the following components:

- i. Two centrifugal chopper pumps to be installed in a duty and standby configuration to serve the digester. These pumps shall be Vaughan or similar approved centrifugal chopper pumps, and the mixing system shall be the Vaughan Rotamix system or similar approved. The pump speed shall not exceed 1,500 rpm.
- ii. There shall be a suitable arrangement of at least 4 nozzles to aid the mixing of the pumped sludge mixture.
- iii. The Mechanical Contractor shall submit a computational fluid dynamic (CFD) analysis performed by the system manufacturer of the digester mixing system as part of the tender. The CFD analysis shall accurately model the flow in the digester.
- iv. Suitable pipework and valves shall be provided to connect the chopper pumps to and from the digester. Suction pipework and valves are expected to be 450mm NB and suitably rated for the applicable working pressure. Discharge pipe work and valves are expected to be 400mm NB and shall also be suitably pressure-rated. The pipework shall be 304 L stainless steel or mild steel suitably corrosion protected to suit the working environment.
- v. All pipework, valves, fitting, specials and instruments required to establish a fully functional and efficient digester mixing system shall be deemed included in the scope of supply for the digester mixing system.
- vi. Pipework and valves shall comply with the Standard Specification on Pipework and the Standard Specification on Flow Control Valves and Sluice Gates, respectively.
- vii. The pumps, electric motors and couplings shall comply with the Standard Specification on Dry Well Pumps, the Standard Specification on Electric Motors and the Standard Specification on Power Transmission Couplings. They shall be locally available and catalogued brand products with readily available spares and backup service.
- viii. The minimum mixing energy imparted to the digester contents shall not be less than 6W/m^3 and shall be supported by the CFD results.

10. METHANE GAS EXTRACTION PIPEWORK AND FLARE

Refer to PK278-01-PRC-DRG-1000-6004 & -6005.

The Mechanical Contractor shall design, supply, deliver, install, test and commission, giving a 12 month guarantee, all mechanical equipment required for the methane gas extraction and flaring system, complete with safety valves and extras, for the anaerobic digesters as described below.

Pipework and valves shall be designed to facilitate the removal of methane gas from the anaerobic digester and deliver it to the gas flare. All pipework, valves, fitting, specials and instruments required to establish a fully functional and efficient methane gas collection and flaring system shall be deemed included in the scope of supply for the system.

Flame arrestors of aluminium construction to inhibit flame propagation in the digester gas piping system shall be provided after the gas extraction from the digester. The pipework shall be designed to prevent the methane gas from flowing back to the anaerobic digesters.

The expected methane gas production from each digester is 2,000m³/day at 20°C. The maximum expected total gas production is 3,500m³/day per digester.

The Mechanical Contractor shall prepare a P&ID, general arrangement drawings and structural drawings and submit these to the Engineer for approval within 4 weeks after the award of the Contract. The complete equipment list shall be determined by the Contractor's design, but is expected to include the following:

- i. One or more automatic condensate drain assemblies expected to be made up of pipework, valves and other ancillaries and consumables.
- ii. Support columns, steelwork, fasteners and ancillaries.
- iii. All the required flame traps and ancillaries.
- iv. All the required seals, fasteners and ancillaries.
- v. Any other additional equipment or sub-assemblies required.

The Mechanical Contractor shall provide with his tender a complete description of the proposed gas flare system, as well as schedules of the materials to be used in the construction and corrosion protection of the structural steel work associated with the gas flare.

The Contractor shall supply a list of at least 5 installations with contactable references where his proposed system has been successfully installed.

11. CHLORINATION EQUIPMENT

Refer to PK278-01-PRC-DRG-1000-8001 & -8002.

11.1 GENERAL REQUIREMENTS

The Contractor shall design, supply, deliver, install, test and commission a gas chlorination system, based on the use of 1-tonne chlorine tanks, as detailed below and in accordance with the Standard Specification on Gas Chlorination Equipment where applicable to this installation. The schematic representations on the P&ID drawings may be used as the basis for such design but are not prescriptive and are not necessarily complete.

The Contractor shall be responsible to provide all components required to establish a fully functional chlorination system that meets the disinfection requirements of the treatment plant.

The chlorination system will mainly consist of a duty and standby automatic chlorinator, vacuum regulator, vacuum changeover unit, chlorine injector and the necessary pipework, valves and fittings, up to and including the diffuser at the dosing point, associated with a gas chlorination installation.

The motive water required to induce chlorine gas via the injector shall be obtained from the central service water system through a pilot operated flow control valve.

11.2 PROCESS DESIGN DATA

11.2.1 Basic Design Data

The basic design data given below is for the current plant being built under this Contract. The ultimate design provides for double the flow given below, and the chlorination system shall be designed in such a manner that it can easily be extended to allow for the final plant flow rate.

Peak chlorine dosing rate:	10 mg/l
Average chlorine dosing rate:	3 to 5 mg/l
Peak design flow:	40 MI/day
Average design flow:	20 MI/day

11.2.2 Operating Performance

The equipment specified in this project specification shall have an operating life of 15 years and shall have an operational availability of at least 95% during its operating life.

11.2.3 Mechanical Requirements

All standards for chlorine to meet national and international specifications for installation and safety (SANS 50937 and 10298). All items, safety items and signage to be incorporated shall comply with safety standards and specifications.

The chlorine tank banks shall be housed in the high-pressure room. The chlorine tanks will be supplied by the Employer.

There shall be two banks of chlorine tanks operating in a duty/standby operation configuration with automatic changeover, with each bank having five one-tonne chlorine tanks. There shall be a further 6 cradles – 5 for storage of spare tanks and 1 as an exchange cradle.

Each on-line chlorine tank shall be connected to the high-pressure manifold with a pigtail tube. The flexible copper tubes shall be nickel-plated. In addition to the tank shut-off valve and a manual manifold shut-off valve, an electric safety shut-off valve shall be provided.

Tanks shall be set for gas abstraction, and each bank shall have a maximum chlorine gas withdrawal requirement of at least 10kg/h.

The tanks connected to the two banks as well as the tanks in storage shall be positioned on support cradles fitted with rollers for rotation. One tank in each bank shall be installed on a support cradle fitted with two bearing swivel points on the one side and a 2-tonne load cell on the other side. The load cell display units shall be installed in the chlorinator room.

A lifting beam to be used in conjunction with an electrically powered chain hoist unit (0R-LE-01-DC), specially designed for the handling of 1-tonne chlorine tanks, shall be included in the scope of supply. Maximum lifting distance, operator level and SWL are to be determined by the Contractor based on his design. The hoist shall include the beams, gantry and electrically controlled travelling chain hoist with appropriate SWL rating.

11.3 HIGH PRESSURE AREA (CHLORINE TANK SIDE)

The Contractor shall supply and install two high pressure manifolds complete with valves and fittings with each manifold allowing for the connection of five 1-tonne chlorine tanks as indicated on PK278-01-PRC-DRG-1000-8001.

The manifolds shall be fitted with two catch pots one on each tank bank and the catch pots shall be fitted with self-regulating heating tape connected to a permanent 240V (max 20A) power supply. The minimum catchpot capacity shall be 4 litres.

A manual isolating/header valve and an electric safety shut-off valve, flexible connection and auxiliary valve shall be supplied to connect the tanks to the manifold. All valves and fittings shall be suitable for use in chlorine installations.

The two high-pressure banks shall each be connected to a suitably sized vacuum regulator and to an automatic vacuum change over unit (0R-CV-01-CV). The change over unit shall automatically change to the standby bank in the event of the pressure in the duty bank dropping to below the minimum pressure as set on the automatic change over unit.

The horizontal sections of the high-pressure manifolds shall have a gradual downwards slope from the vacuum regulating valve. The vacuum regulating valve shall be installed on the highest point.

A fluoroplastic filter capable of removing impurities greater than 25 microns shall be installed in the vacuum regulator inlet.

The high pressure manifold shall also be fitted with all required minor equipment, such as pressure indicators as shown on PK278-01-PRC-DRG-1000-8001, but which is not specifically mentioned in the Detail Specification.

The high pressure manifold shall be suitably corrosion protected for the chlorine environment.

The vacuum regulating valve vent pipes shall be routed to the outside of the building.

The proposed layout of the equipment, manifold and tank positions shall be submitted to the Engineer for approval.

Piping shall be 25 mm ND Schedule 80 seamless piping. All pipework and fittings shall be rated for at least 2MPa. Valves shall be high pressure flanged to SANS 1123 Table 16. Flanges to SANS 1123 Table 16 shall be welded to steel piping.

Piping shall be supported before and after all fittings, bends and valves.

Piping shall be wall mounted at least 1m above floor level.

11.4 CHLORINATORS AND EJECTORS/INJECTORS

Two 0 to 10kg/h automatic chlorinators (0R-CL-01-CL & 0R-CL-02-CL) and injectors (0R-E-01-IJ & 0R-E-02-IJ) shall be supplied and installed in the configuration as detailed on PK278-01-PRC-DRG-1000-8002.

The automatic chlorinators shall be fitted with a manual chlorine flow meter suitable to measure a dosing rate of up to 10kg/h.

The automatic chlorinators shall be switchable between manual control and automatic control (4-20mA) mode. In the manual mode the chlorine dosing rate shall be manually adjusted while in the automatic mode the dosing flow rate shall be adjusted by means of a 4-20mA signal from the control system.

All equipment shall be mounted on frames supporting PVC backboards and no equipment shall be mounted directly on the walls.

Vacuum shall be created by a fixed-throat venturi/ejector system connected directly to the chlorine solution diffuser. A dual high pressure/low-pressure check valve system shall prevent water from entering the gas system. The ejector assembly shall be capable of withstanding water pressure up to 20bar.

Two ejectors shall be installed, each ejector connected and dedicated to a chlorinator. The ejector and chlorinator combinations shall operate in a duty standby configuration.

Each of the ejectors shall have a maximum chlorine dosing capacity of at least 10kg/h.

An isolating ball valve shall be provided upstream and downstream of each ejector.

The ejectors and isolating valve manifold shall be neatly installed inside the low pressure chlorinator room on frames supporting PVC backboards and no equipment shall be mounted directly on the walls.

11.5 LOW PRESSURE CHLORINE PIPING

The delivery section of the water manifold from the wash water supply point to the dosing point shall be suitably sized class 16 uPVC pipework, valves and fittings. The pipe work shall be routed from the service water supply point, through the low pressure chlorine room to the effluent into the contact channel. Where the pipe work crosses walls or structures it shall be suitably supported from the concrete structure.

All valves shall be double union type ball valves with Viton O-rings.

uPVC piping shall be supported before and after all fittings (including bends and valves) and at intervals of not more than 0,6m.

All uPVC piping and fittings outside the chlorine building shall be painted with a suitable UV resistant paint.

The chlorine solution dosing manifold (diffuser) shall be installed at the inlet of the chlorine contact channel (situated approximately 350m from the chlorine building at maturation pond overflow weir 5) and shall be positioned 300mm above the channel invert level and shall span the full width of the inlet channel. The diffuser shall be suitably supported on both ends. The dosing manifold shall have holes over the full width of the inlet channel facing the flow to disperse the solution into the water flow.

The dosing manifold shall be easily removable for inspection and cleaning purposes.

11.6 GAS LEAK DETECTION SYSTEM

One dual channel gas detector, capable of detecting chlorine gas at levels below 0,5ppm, shall be supplied, delivered, installed, tested and commissioned in the high pressure room and in the low-pressure room.

The dual channel gas detectors shall have at least two adjustable threshold levels for each channel.

It shall be possible to install the sensors up to at least 300m from the gas detector controller/alarm module.

The sensor response time shall be undetectably small and the recovery of the sensor shall be immediate once the presence of the chlorine has been cleared.

The controller/alarm module shall be housed in an IP55 enclosure and shall have the following minimum features:

- i. A multiline display with at least 16 characters per line. The screen shall be back lit for easy reading in low light areas.
- ii. An internal alarm horn with a minimum output of 95dB.
- iii. A time and date stamped alarm log with capacity for at least 256 event entries. It shall be possible to view and scroll through the alarm log on the internal multi line display. The alarm log shall be available to the plant SCADA system.
- iv. Sensor life and calibration timers/reminders.
- v. A 4-20mA gas level monitor output per channel.
- vi. Password protection for all parameter settings.
- vii. Two level alarm settings for Warning and Danger gas levels for each channel.
- viii. Individual, real-time display of each monitored channel.

11.7 ELECTRICALLY OPERATED SAFETY SHUT-OFF SYSTEM

An emergency tank valve shut off system shall be provided to close the tank valves on all tanks on the duty and standby bank to instantly stop the flow of chlorine gas at the tank if triggered by either:

- i. A chlorine leak alarm.
- ii. A manual shut down request from the emergency shut down button.

When a signal is given to the controller from a gas detector or panic button, the system shall rapidly shut the valve to the torque value recommended by the tank supplier.

The following are the minimum features required:

- i. Must be economical and easy to use.
- ii. Close the valve in less than 3 seconds.
- iii. Shut down via gas leak detector or panic button/emergency shut down button.
- iv. Must preferably be electrically (DC) operated with a minimum of 8 hour back-up reserve. During times when normal AC power is available the batteries shall be charged by means of an intelligent battery charger.

11.8 CHLORINE SCRUBBER

The Contractor shall design, supply, deliver, install, test and commission a complete Chlorine Gas Scrubber System, including scrubber vessel, media, blower, blower control and starter panel, and appropriate connections for external ductwork. The chlorine scrubber system shall be capable of treating the contents of one full 1-tonne chlorine tank in the event of a leak in accordance with a dry system design.

The scrubber shall be capable containing a leak rate of 42kg/h and shall collect leakage from both the high and low pressure rooms without the possibility of a leak in one of the rooms causing contamination of the other room.

The system manufacturer shall have a minimum of five (5) years' experience in the design, fabrication and installation, testing and commissioning of chlorine gas scrubber systems.

The tenderer shall supply a list of at least five (5) contactable references with his tender of similar sized systems installed by him.

The Emergency Chlorine Gas Scrubber (ECGS) shall be configured to allow discrete sampling of the entire height/length of the media column/bed to determine the extent of spent media, and to allow replacement of the spent media without removing and replacing the entire media column/bed.

The ECGS shall be designed and verified by testing, to assure that the discharge air contains less than 1ppm Cl₂.

If discrete media beds are used, each media bed shall be contained between separate corrosion resistant support grids and perforated sheet material.

The blower (0R-BL-01-CF) shall be externally mounted, belt driven with backward inclined blades, sized to deliver the required airflow while adsorbing chlorine at the design absorption rate. The blower must be located to cause air (gas) to be drawn through the scrubber, thus maintaining the scrubber internal atmosphere at a slight vacuum.

The ECGS system shall contain enough media to safely scrub an over-filled 1-tonne chlorine tank.

11.9 SAFETY EQUIPMENT

11.9.1 General Requirements

The following safety equipment shall be provided as part of the scope of supply for the chlorination system:

Two (2) self-contained BA Sets and 3 x gas masks with and a basic First Aid kit for chlorine gas related incidents

Six spare respirator (gas mask) cartridges of the disposable type.

Two pairs of chlorobutyl-proof or PVC rubber gloves.

Two pairs of gas tight chemical safety goggles.

An emergency first-aid kit containing at least the following:

- i. Propan gel (2-off).
- ii. Vitamin E cream (2-off).
- iii. Resuscitube non-return valve (10-off).
- iv. A complete set of instructions and an inventory.

A Safety Repair "Kit B" for repairing minor leaks on 1-tonne chlorine tanks.

11.9.2 Storage Cabinet

A storage cabinet, large enough and with an adequate number of suitably spaced shelves to house the abovementioned safety equipment without stacking individual items on top of each other shall be installed against the wall, on the outside of the chlorine building, next to the entrance.

The cabinet shall be lockable. The key to the cabinet lock shall be housed in a sealed waterproof key box with a breakable but replaceable glass, installed adjacent to the emergency cabinet. Two spare glass panes shall be provided and stored with the rest of the safety equipment inside the cabinet.

The emergency cabinet shall be manufactured from mild steel and shall be suitably corrosion protected. The emergency cabinet shall be painted in compliance with SABS 0140. The cabinet shall be airtight with replaceable rubber seals on the door edges to prevent the ingress of moisture and dust.

11.10 SAFETY SHOWER AND EYEBATH

A safety shower and eyewash basin connected to a permanent potable water supply shall be installed near the entrance of the high-pressure chlorine room. The safety shower and eyewash shall comply with the requirements as detailed in the Standard Specification on Chemical Dosing Plant.

11.11 SAFETY SIGNAGE

The following safety signage suitable for outside installation and a corrosive atmosphere shall be supplied and installed.

A chlorine safety and information notice detailing safety precautions, handling and usage guidelines and emergency procedures as supplied by NCP shall be supplied and installed inside and outside of the chlorination building in positions that will be indicated on site by the Engineer.

A warning sign saying "CHLORINE GAS" shall be installed outside the entrance to warn passers-by of the chlorine hazard.

Signage indicating the positions of the gas masks and safety equipment shall be installed in the positions as agreed on site with the Engineer.

The cost of the required safety signage shall be included in the tendered rate for the gas chlorination system.

12. SERVICE WATER SYSTEM

Refer to PK278-01-PRC-DRG-1000-8003.

12.1 GENERAL REQUIREMENTS

The service water pumps shall abstract water from Pond 2 and a purpose-made abstraction structure will be provided under the civil scope of work. The abstraction structure will have three channels. Each channel will be 1m wide and will be 1,5m deep with the water level 1,2m above the channel floor. Each channel can be isolated from the pond by means of a wall mounted sluice gate to be supplied under this Contract.

The channels shall be equipped with hand-raked screens as described below.

12.2 SERVICE WATER ABSTRACTION SLUICE GATES

Three sluice gates to isolate the below water level entry into the service water abstraction channel shall be supplied and installed. Further information is presented in Table 9.

Table 9: Wall Mounted Sluice Gates for the Service Water Abstraction Channel

Detail / Requirements	Unit	Channel 1	Channel 2	Channel 3
Tag No		01-MP-01-SG-01	01-MP-01-SG-02	01-MP-01-SG-03
Number of gates	No	1	1	1
Width x height or dia of opening	mm	750 x 750	750 x 750	750 x 750
Max head when gate is closed	mm	1,200	1,200	1,200
Max unbalanced head against which gate will operate	mm	1,200	1,200	1,200
Height of operator's platform above wall	mm	50	50	50
Height of handwheel above operator's platform	mm	1,100	1,100	1,100
Height of gate	mm	800	800	800
Gate travel	mm	750	750	750
Wall mounting		downstream	downstream	downstream

12.3 SERVICE WATER ABSTRACTION CHANNEL HAND RAKED SCREENS

Three hand-raked screens shall be supplied and installed, one each in each of the service water abstraction channels.

The hand-raked screens shall be manufactured from 304 L stainless steel in accordance with the Standard Specification on Manually Cleaned Screens.

The angle of inclination of the screen shall be 60° in the positions as indicated on the drawings.

The gap between the screen bars shall be 20 mm.

The screen bars shall be 50 mm x 10 mm flat bars.

The top section of the screen bars shall extend onto the horizontal platform as shown on the drawing. The screen will be fixed to the concrete at the top and bottom by means of wedge anchors.

Three flat bars shall be welded at the back of the screen bars at the two ends and in the middle of the screen to ensure rigidity and proper spacing between the screen bars throughout the length of the screen.

An angle iron shall be welded to the bars where they bend and extend onto the platform which shall rest on the corner of the platform as illustrated on the drawings.

Two appropriate rakes shall be provided for each screen.

Detail of the screens is given in Table 10.

Table 10: Hand Raked Screens in the Service Water Abstraction Channels

Detail / Requirements	Unit	Channel 1	Channel 2	Channel 3
Tag No		01-SW-01-SC-01	01-SW-01-SC-02	01-SW-01-SC-03
Number of screens	No	1	1	1
Spacing between bars or aperture size	mm	20	20	20
Channel width x depth	mm	1,000 x 1,500	1,000 x 1,500	1,000 x 1,500

A detailed drawing of the screens and the rakes shall be submitted to the Engineer for approval prior to manufacturing.

12.4 SERVICE WATER PUMPS

The Service Water Pump Station shall be equipped with five dry-well self-priming pumps (00-01-01-CF, 00-01-02-CF, 00-01-03-CF, 00-01-04-CF & 00-01-05-CF).

The suction for each pump shall be by means of a dedicated suction pipe complete with bell mouth fitting to extract water directly from the service water abstraction channels. The bell mouth suction and the suction pipe form part of the suction pipework scope of supply to be supplied by the Mechanical Contractor.

The pumps shall be arranged in a three duty, two standby configuration.

The system curves for the pumps are given in Technical Data Sheet AT1:CP:07.

To achieve the desired flow rates the service water pumps shall be equipped with variable speed drives.

12.5 SERVICE WATER PUMP STATION PIPEWORK

The service water pump station will be located on the northern side of the chlorination building. The Mechanical Contractor shall advise on the required size of building and shall provide a layout drawing. The building will be constructed by the Civil Contractor.

The Mechanical Contractor shall be responsible for the pipework from the suction bell mouth to the Mechanical / Civil interface point which shall be 1m beyond the building.

All pipework, valves, fitting, specials and instruments (with the exception of the magnetic flow meter), including surge protection measures, from the abstraction point to the connection with the service water reticulation system shall be deemed included in the pipework measured for the Service Water Pump Station.

13. POTABLE WATER SYSTEM

The sustainability and quality and quantity of potable water from the boreholes is currently under investigation.

The final number of boreholes and the required treatment is as yet unknown. For this reason, a provisional sum is provided to cover the potential expenses in establishing a potable water supply on site.

The Engineer shall provide the necessary details applicable to the potable water system once the sustainability and quality and quantity of potable water from the boreholes has been established.

14. SUBSOIL DRAINAGE SYSTEM

Six submersible centrifugal subsoil drainage pumps shall be supplied, delivered, installed, tested and commissioned at the subsoil drainage pump stations. The pumps shall be supplied complete with duckfoot bend, guide rails and lifting chain. The pumps shall pump drainage water from the balancing tank, the primary settling tanks and the secondary settling tanks, and this water may be expected to contain a small amount of solids.

The pumps shall be installed in pairs at the locations indicated and shall operate on a duty and standby basis with duty rotation.

The duty points for the subsoil drainage pumps are presented in Table 16.

Table 16: Submersible Subsoil Drainage Pumps

Detail / Requirements	Unit	Balancing Tank	Primary Settling	Secondary Settling
Tag No				
Number of pumps	No	2	2	2
Duty point	l/s @ m	6.9 @ 2	2.8 @ 6	2.8 @ 8

15 DEWATERED SLUDGE HANDLING

15.1 GENERAL REQUIREMENTS

Four types of wastewater sludge will be treated at the sludge dewatering facility.

- Primary sludge from the PSTs. The sludge will be anaerobically digested prior to being dewatered.
- Waste activated sludge (WAS) from the anaerobic zone. The WAS will be treated with a metallic salt to chemically bind the phosphorus and then treated with a coagulant prior to thickening. The thickened anaerobic sludge will be anaerobically digested prior to dewatering.
- Waste activated sludge from the aerobic zone. The WAS will be treated with a coagulant and directly thickened and dewatered.
- Dewatered WAS deposited by truck on the drying beds at a minimum solids concentration of 30%. This sludge originates from the Old Polokwane Wastewater Treatment Works.

All of the sludges will be dewatered by the belt presses and will be discharged onto a dewatered sludge cake collection area.

The dewatered sludge cake will be collected on a daily basis and will be spread evenly onto a solar drying pad for further drying. Once the sludge has been sufficiently dried, the dried sludge will be collected and removed from the solar pad.

The dewatered sludge from the aerobic zone will not be fully stabilized and thus can be further dried on the solar pads or preferably be mixed with the solar dried sludges and be stockpiled to be stabilized during the compost process.

It is estimated that a total 1 – 2 tons of dewatered sludge cake will be produced per hour. This will equate to between 5 and 10 m³/hour depending on the type of sludge that have been dewatered. The total operational time of the dewatering facility will be 8 hours /day thus producing 40 to 80 m³/day.

In order to accomplish the handling of the dewatered sludge cake the following equipment, will be the minimum requirement:

- Articulated wheel loader.
- Dewatered sludge spreader.
- Tractor to pull the dewatered sludge spreader.
- Dried sludge turner.
- Hydraulic tip trailer (optional).

15.2 ARTICULATED WHEEL LOADER

The articulated wheel loader will be required for the loading of the dewatered sludge spreader as well as to scrape the dried sludge together and remove the dried sludge to a designated storage area.

The articulated wheel loader shall comply with the requirements in Table 11.

Table 11: Articulated Wheel Loader

Description	Minimum Requirement	Maximum Requirement
Fully enclosed ROPS cab	yes	yes
Back-up alarm and flashing light	yes	yes
Variable Shift Control System	yes	yes
Traction Control System	yes	yes
Travel light system	yes	yes
Suspension seat with seat belts	yes	yes
Mono lever loader control	yes	yes
Wet disc parking brake	yes	yes
Maintenance free wet disc service brake	yes	yes
Power train under-guard (bonnet)	yes	yes
Hydraulic oil cooler	yes	yes
Automatic bucket positioner	yes	yes
Transmission	hydrostatic, automatic	hydrostatic, automatic
Torque proportioning differentials	yes	yes
Overrun protection system	yes	yes
Air intake extension pipe with pre-cleaner	yes	yes
Boom and bucket controls with PPC	yes	yes
Poor fuel arrangement (contamination)	yes	yes
Engine type	direct injection diesel	direct injection turbo-charged diesel
Flywheel power	55 kW @ 2,000 rpm	80 kW@ 2,000 rpm
Maximum torque	420 Nm @ 1,300 rpm	420 Nm @ 1,300 rpm
Bucket capacity	1 m3	1.5 m3
Reversible bucket cutting edge	yes	yes
Bucket tip height	2.5 m	2.5 m
Tyre size	16/70 x 20	17,5 x 25 – (L4)
Operating weight		4 600 kg
Minimum Spares Required		
Spare wheel	one, if front and rear wheels are the same size, else one of each size	
Reversible cutting edge	two, contact details of supplier to be submitted with tender	

15.3 DEWATERED SLUDGE SPREADER

The dewatered sludge spreader is required for the spreading of dewatered wastewater sludge with a minimum of 20% dry solids (5 m³/dry ton). The dewatered sludge will be spread onto a concrete base solar pad for further drying.

The dewatered sludge spreader will be required to spread the dewatered sludge evenly in bands equal to the width of the dewatered sludge spreader to prevent overspreading the solar pad.

The dewatered sludge spreader shall comply with the requirements in Table 12 below.

Table 12: Dewatered Sludge Spreader

Description	Minimum Requirement	Maximum Requirement
Loading capacity	9,500 kg	9,500 kg
Load box	4,300 mm	4,900 mm
Load box	700 mm	760 mm
Load box	1,650 mm	1,650 mm
Load box	1,435 mm	1,640 mm
Overall length	6,300 mm	6,900 mm
Overall tread width	2,590 mm	2,590 mm
Spreaders / beaters	1	1
No. paddles / spreader	12	12
Type drive to dewatered sludge spreader hydraulic drive	Tractor PTO 540 / 1,000 rpm	Tractor PTO 540 / 1,000 rpm
Method of conveying dewatered sludge	Chain, full box width	Chain, full box width
Type chain	Pintle or T-bar	Pintle or T-bar
Slats per apron	16	19
Operating weight with maximum load	11,500 kg	13,750 kg
Tractor Requirements 4 WD - PTO	60	72
Construction Materials		
Load box sides and front	Carbon steel	
Floor	Polycarbon on carbon steel supports	
Chassis and drawbar	Carbon steel	
Corrosion protection	Painted to manufacturer's standards	
Number of axles	2	2
Minimum Spares Required		
Spare wheel	One	
Beaters, chain and paddles	To be delivered to site from supplier within 145 days of order – written guarantee to be submitted with tender	

15.4 TRACTOR

The purpose of the tractor is to draw the Dewatered Sludge Spreader and to assist with the spreading of the dewatered sludge onto the solar pad.

The tractor shall comply with the requirements in Table 13 below.

Table 13: Tractor

Description	Minimum Requirement	Maximum Requirement
ROPS canopy	yes	yes
Rated power according to ISO TR 14396 @ 2,000/25/EC	58.8 kW	72 kW
Synchro shuttle transmission	yes	yes
4-wheel drive	yes	yes
Main oil pump flow range (standard / max)	40.1 / 51.7	40.1 / 51.7
Minimum number of remote hydraulic valves	3	3
Minimum lift capacity at ball ends with arms horizontal	3,500 kg	3,500 kg
Tractor power take-off rpm at 540 / 1000 rpm	2,200 / 2,381	2,200 / 2,381
Tractor power take-off	mechanical	mechanical
Minimum Spares Required		
Spare wheel	one, if front and rear wheels are the same size, else one of each size	
PTO shaft	two	
Top linkage	one	

15.5 DRIED SLUDGE TURNER

The dewatered sludge will be spread onto the solar pad with the dewatered sludge spreader. The dewatered sludge will be spread to a layer thickness of between 75mm and 150mm.

An implement, attachable to the tractor, to turn the sludge around to speed-up the drying process is required.

The dried sludge turner that shall be attachable to the tractor shall comply with the requirements in Table 14.

Table 14: Dried Sludge Turner

Description	Minimum Requirement	Maximum Requirement
Working width	1,800 mm	2,300 mm
Width of unit, inclusive of depth control wheels	2,170 mm	2,760 mm
Tractor power requirement	45 kW	72 kW
Minimum PTO shaft speed required	540 rpm	540 rpm
Drive gearbox protection	Friction slip clutch	
Working depth control type (front and rear)	Adjustable wheels	
Type of blades	“L’ type blades	
Minimum Spares Required		
Working depth control wheels	2	
PTO shaft	2	
Blades	One full set of “L ” type blades, complete with fasteners	

15.6 HYDRAULIC TIP TRAILER

At the Employer's discretion a hydraulically operated tip trailer, suitable to be drawn by the tractor specified above, may be ordered for transporting dried sludge away from the solar pad for disposal.

The hydraulic tip trailer shall comply with the requirements in Table 15.

Table 15: Hydraulic Tip Trailer

Description	Minimum Requirement	Maximum Requirement
Loading capacity	4 m3 / 6,000 kg	6 m3 / 9,000 kg
Load box	3,130 mm	3,130 mm
Load box	700 mm	1,000 mm
Load box	1,950 mm	1,950 mm
Load box	1,500 mm	1,800 mm
Overall length	4,500 mm	4,500 mm
Overall tread width	2,400 mm	2,400 mm
Number of axles	1	1
Hydraulic oil supply	Tractor system	Tractor system
Landing leg	Heavy duty landing leg	Heavy duty landing leg
Construction Materials		
Load box	Minimum 3mm carbon steel supported with 76 x 38mm cold rolled carbon steel channel as supports	
Chassis and drawbar	Minimum 180 x 70mm cold rolled carbon steel channel	
Corrosion protection	Painted to manufacturer's standards	
Minimum Spares Required		
Spare wheel	One	

15.7 Legal Requirements

All self-driven equipment and trailers not fitted with braking systems shall be made road worthy according to Road Traffic Regulations. All equipment shall be registered for 1 year in the name of the Employer when delivered to site.

All documentation and warranties and guarantees shall be transferred to the Employer.

15.8 OPERATOR TRAINING

All equipment supplied under this section requires operator training. The original distributor / manufacturer shall arrange the training of the operators. The cost of such training shall be included in the tendered rates.

The training schedule must be submitted to the Engineer within 14 days after the Engineer has approved the equipment as offered by the Contactor.

16. MEASUREMENT AND PAYMENT

Item	Description	Unit
B16.1	Design, supply and delivery of anaerobic digestion and pump mixing equipment	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights (if applicable), pre-delivery testing and test certificates where needed, transport for delivery to site and off-loading including all handling of all the equipment, together with all associated accessories as specified and consumables as may be needed, and all other costs associated with the design and supply of the mechanical equipment for anaerobic digestion of sludge, including Vaughan tank mixing assemblies and CFD analysis, Vaughan mixing chopper pumps, sludge distribution box and associated pipework, sludge heating pipework (if applicable), gas domes, valves, and all other necessary ancillaries to ensure a complete anaerobic digestion and mixing system ready for installation.

Item	Description	Unit
B16.2	Installation, testing and commissioning of anaerobic digestion and pump mixing equipment	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for site handling and positioning and adjusting of equipment including the fastening of all equipment in their designated positions, supply of all necessary drawings, testing and commission, including full compensation for the following:

- i. Coupling of all required pipe fittings and appurtenant equipment including all required gaskets, nuts, bolts and washers.
- ii. All required installation materials, labour and consumables to render a complete and efficient working equipment installation.

No taking-over certificate (or partial taking-over certificate) will be issued for the installation unless the required operating and maintenance manuals have been submitted to, and accepted by, the Engineer.

Item	Description	Unit
B16.3	Design, supply and delivery of anaerobic digester gas flare system	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights (if applicable), pre-delivery testing and test certificates where needed, transport for delivery to site and off-loading including all handling of all the equipment, together with all associated accessories as specified and consumables as may be needed, and all other costs associated with the design and supply of the mechanical equipment for anaerobic digestion gas flare, gas domes, valves, and all other necessary ancillaries to ensure a complete anaerobic digestion flare system ready for installation.

Item	Description	Unit
B16.4	Installation, testing and commissioning of anaerobic digester gas flare system	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for site handling and positioning and adjusting of equipment including the fastening of all equipment in their designated positions, supply of all necessary drawings, testing and commission, including full compensation for the following:

- i. Coupling of all required pipe fittings and appurtenant equipment including all required gaskets, nuts, bolts and washers
- ii. All required installation materials, labour and consumables to render a complete and efficient working equipment installation.

No taking-over certificate (or partial taking-over certificate) will be issued for the installation unless the required operating and maintenance manuals have been submitted to, and accepted by, the Engineer.

Item	Description	Unit
B16.5	Design, supply and delivery of an instrument air supply system	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights (if applicable), pre-delivery testing and test certificates where needed, transport for delivery to site and off-loading including all handling of all the equipment, together with all associated accessories as specified and consumables as may be needed, and all other costs associated with the design and supply of the instrument air supply system and all other necessary ancillaries to ensure a complete instrument air supply system ready for installation.

Item	Description	Unit
B16.6	Installation, testing and commissioning of instrument air supply system	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the site handling and positioning of the equipment and adjusting of equipment including all fastening of all the equipment in their designated positions, supply of all necessary drawings, testing and commission, including full compensation for the following:

- i. Coupling of all required pipe fittings and appurtenant equipment including all required gaskets, nuts, bolts and washers.
- ii. All required installation materials, labour and consumables to render a complete and efficient working equipment installation.

No taking-over certificate (or partial taking-over certificate) will be issued for the installation unless the required operating and maintenance manuals have been submitted to, and accepted by, the Engineer.

Item	Description	Unit
B16.7	Design, supply and delivery of ferric chloride dosing system	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights if applicable, pre-delivery testing and test certificates where needed, transport for delivery to site and off-loading including all handling of all the equipment, together with all associated accessories as specified and consumables as may be needed, and all other costs associated with the design and supply of the ferric chloride dosing system and all other necessary ancillaries to ensure a complete ferric chloride dosing system ready for installation.

Item	Description	Unit
B16.8	Installation, testing and commissioning of ferric chloride dosing system	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the site handling and positioning of the equipment and adjusting of equipment including all fastening of all the equipment in their designated positions, supply of all necessary drawings, testing and commission, including full compensation for the following:

- i. Coupling of all required pipe fittings and appurtenant equipment including all required gaskets, nuts, bolts and washers

- ii. All required installation materials, labour and consumables to render a complete and efficient working equipment installation.

No taking-over certificate (or partial taking-over certificate) will be issued for the installation unless the required operating and maintenance manuals have been submitted to, and accepted by, the Engineer.

Item	Description	Unit
B16.9	Provisional Sum for.....	Prov Sum

The unit of measurement shall be a provisional sum.

Separate items will be scheduled for different items that may be procured via a provisional sum.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The provisional sum shall provide for the acquisition, at the sole discretion of the Employer, of the item / system identified. The provisional sum does not include provision for overhead charges, profit and handling by the Contractor, which shall be measured separately under payment item B16.10 below. Payment shall be effected on actual invoiced amounts.

Item	Description	Unit
B16.10	% profit on provisional sum	%

The unit of measurement shall be the percentage tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of the items procured under item B16.9 above.

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C3.3.7 PARTICULAR SPECIFICATIONS – ELECTRICAL, CONTROL AND INSTRUMENTATION

Particular Specifications: Electrical, Control and Instrumentation

The Particular Specification is set out in Three parts. The purpose of each of the Three parts is as follows:

- Part A : Description of Works for a general overview of the project and a description of the site conditions. This part of the specification also includes descriptions of items, which form the basis for payment for this contract.
- Part B : This part of the specification provides standard specifications for the equipment and services required for this project. The standard specifications detail the requirements to be complied with and the inspections and testing to be done in order to verify compliance with these specifications. Where each standard specification details the items which form the basis for payment, is not applicable to this contract.
- Part C : This part of the specification provides the detail of the equipment and services required for this project.

Parts A, B and C of this Electrical, Control and Instrumentation Specification constitute the Employer's Requirements with respect to the Electrical, Control and Instrumentation Works.

The standard specifications (Part B) cover the general, administrative, legal and organisational requirements and general technical requirements relating to the quality of Materials, construction, testing, commissioning and maintenance of the construction applicable to this contract.

In particular refer to Clause C3.1.5 for the site climatic conditions.

Part A: Description of Works

1.1 INTRODUCTION

This Particular specification covers the design, supply, delivery, installation, testing and guarantee of the electrical, control and instrumentation installations for the new Polokwane Regional Wastewater Treatment Works (PRWWTW). This Chapter is applicable to both the Permanent Works and Temporary Works

1.2 PROJECT DESCRIPTION

The development of the Polokwane Regional Waste Water Treatment Works (PRWWTW) is to be separated into four phases, of which this Contract includes the design, supply, delivery, installation, and testing of the electrical and control and instrumentation installations of Phase 1A. Phases 1B, 2, 3 and 4 of the PRWWTW are planned to be tendered as separate Contracts in future years as the need for expansion arises.

The PRWWTW will be situated on the Polokwane's Doornbult site, will have an initial capacity of 20MI/day (with an ultimate capacity when fully developed of 100MI/day) and will consist of (Refer to the Process Flow Diagram – Liquid Plant Drawing PK278-01-PRC-DRG-1000-0005):

- An Inlet Works with mechanical raked screens and degritting equipment
 - Primary Settling with mechanically raked settling tanks
 - Flow balancing with mechanical mixers
 - Biological reactor with mechanical mixers and fine bubble aeration
 - Secondary settling with mechanically raked settling tanks
 - Maturation and Chlorine dosing
 - Sludge handling facilities (refer Drawing PK278-01-PRC-DRG-1000-0006) consisting in main of:
 - Linear screens
- Anaerobic Digestors with jet pump mixing
- Mechanical belt filter presses
- Chemical dosing (Ferric chloride and Poly Electrolite
- Gas flaring

The detail of the process is detailed in:

- Inlet Works - Drawings PK278-01-PRC-DRG-1000-1001 to -1010,
- Primary Settling - Drawings PK278-01-PRC-DRG-1000-2001 to -2004,
- Flow Balancing - Drawings PK278-01-PRC-DRG-1000-3001
- Biological Reactor - Drawings PK278-01-PRC-DRG-1000-4001 to -4016
- Secondary Settling - Drawings PK278-01-PRC-DRG-1000-5001 to -5004
- Sludge Handling - Drawings PK278-01-PRC-DRG-1000-6001 to -6006
- Sludge dewatering - Drawings PK278-01-PRC-DRG-1000-7001 to -7012
- Chlorination -- Drawings PK278-01-PRC-DRG-1000-8001 to -8002
- Plant Service Water - Drawings PK278-01-PRC-DRG-1000-8003

1.4 SCOPE OF ELECTRICAL CONTROL & INSTRUMENTATION WORKS

The Electrical Control & Instrumentation (EC&I) works will be let as a subcontractor of the Mechanical Works Contract, and the basis of the sub-contract will be a Contractor Design and Build contract.

The scope of work to be designed and implemented by the Sub-Contractor shall include all required designs and implementation from the MV Utility Supply point to render a complete EC&I installation for the PRWWTW.

The Scope of Work shall at minimum (but not be limited to) include the following to provide a fully operational WWTW in conjunction with the Mechanical and Civil works making up the WWTW:

- A Medium Voltage (MV) Ring network that is expandable to include for the future phase 1B and subsequent phases. The Contractor shall indicate in his design how the future phases can be incorporated.
- The MV ring shall supply power to the following load centres:
 - Inlet Works
 - Primary sedimentation and Flow Balancing
 - Biological Reactor and Secondary Sedimentation
 - Maturation, Chlorination and Site Water services
 - Sludge Treatment Facility
- LV Installation including Motor Control Centres (MCCs) at each load centre and associated LV Cable work.
- Emergency Back-up Power facilities, which shall include a central generator facility and the required control to power all drives at the Inlet Works, 50% of the balancing tank mixers and the chlorination facilities in addition to any facilities that the mechanical contractor identifies as requiring emergency power. All devices identified as requiring an Uninterruptible Power Supply (UPS) shall be supplied from the Emergency Back-up power facility.
- UPS systems shall be provided for all control systems and critical instrumentation.
- A distributed control system consisting of either distributed Programmable Logic Controllers (PLCs) or a central PLC with Remote Input/Output (RIO) facilities at the different load centres.
- A SCADA system in the Central Control Room.
- Access Control incorporating a CCTV system

1.5 MEASUREMENT AND PAYMENT

The payment for the electrical subcontract shall be as follows (Please note that retention will be retained on all payments as detailed in the retention clauses of the contract):

SANS1200A Clause 8.4.5 (as amended) shall apply.

1.5.1 DESIGN FEE: The Design fee shall be tendered as a SUM.

60% of the design fee shall be payable once the Engineer has approved the design

20% of the design fee once the construction work has progressed to 50% of the construction value.

20% of the design fee on completion of the commissioning of the plant.

1.1.2 CONSTRUCTION COST: **The Construction/implementation cost shall be tendered as Sums for the following:**

- a. MV equipment and Transformers/Minisubs
- b. MCC's and Local Control Stations
- c. Emergency Back-up Power system
- d. Control system including PLC equipment and SCADA complete with all Software and Hardware
- e. UPS Systems

- f. MV Cable installation
- g. LV Cable installation
- h. Control and Instrumentation Installation
- i. Access Control System.

Payment for the construction work shall follow the following Milestones:

- j. For items 2.a. to 2.e. above: 80% on the successful completion of the Factory Acceptance Tests (FAT) and delivery to site of the equipment.
- k. For items 2.a. to 2.e. above: 10% on the successful installation certified by the Engineer.
- l. For items 2.a. to 2.e. above: 10% on the successful commissioning of the complete plant.
- m. For items 2.f. to 2.i. above: 80% on the successful installation completion certified by the Engineer.
- n. For items 2f. to 2.i. above: 10% on the successful installation completion of all equipment certified ready for commissioning by the Engineer.
- o. For items 2.f. to 2.i. above: 10% on the passing of the Tests on Completion.

Part B: Standard Specifications

CONTENTS

SECTION 1:	CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS.....	797
1.1	SCOPE	797
1.2	RELEVANT ACTS, REGULATIONS AND STANDARDS.....	797
1.3	RESPONSIBLE PERSON	797
1.4	SAFETY	797
1.5	QUALITY	797
1.6	QUALITY ASSURANCE	798
1.7	APPROVAL OF DRAWINGS, MATERIAL AND EQUIPMENT.....	798
1.8	CONSTRUCTION PROGRAMME.....	800
1.9	SETTING OUT OF WORKS	800
1.10	CONTRACTOR'S SITE REPRESENTATIVE	800
1.11	SITE MEETINGS	800
1.12	SUB-CONTRACTORS	801
1.13	HANDLING AND STORAGE OF EQUIPMENT.....	801
1.14	FACTORY TESTING AND INSPECTION	802
1.15	INSPECTIONS	802
1.16	SITE TESTING AND COMMISSIONING.....	802
1.17	HANDING OVER	803
1.18	"AS-BUILT" DRAWINGS	803
1.19	OPERATING AND MAINTENANCE MANUALS	803
1.20	SPARES	805
1.21	MEASUREMENT AND PAYMENT	806

SECTION 1: CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS

1.1 SCOPE

This standard specification covers the general, administrative, legal and organisational requirements as well as general technical requirements relating to quality of materials, installation, testing, commissioning and maintenance of the installation applicable to this contract.

1.2 RELEVANT ACTS, REGULATIONS AND STANDARDS

The whole of the installation shall comply, and the work shall be executed in accordance with the latest edition of the following:

- (a) The Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act or the Factories Machinery and Building Works Act of 1941, whichever is applicable and their respective Regulations,
- (b) The Code of Practice for the Wiring of Premises SABS 0142, with the latest amendments, issued by the South African Bureau of Standards,
- (c) The regulations and bylaws of the local supply authorities,
- (d) The applicable regulations of the relevant telecommunication authority,
- (e) The local Fire Department Regulations; and
- (f) The relevant SABS, BS and IEC and ISO supporting specifications referred to in the standard specifications.

1.3 RESPONSIBLE PERSON

The Contractor shall, before establishing on site, appoint and submit to the Engineer in writing the name(s) of the person(s) who is/are the responsible person(s) in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act within 14 days from being appointed.

1.4 SAFETY

- (a) From date of site handover to the Contractor until the completed work is handed back to the Employer, the Contractor shall be responsible for maintaining safe working conditions on site. As the "owner" of the site, the Contractor shall bear all responsibilities in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act or Factories, Machinery and Buildings Work Act, whichever is applicable.
- (b) The Contractor shall be responsible for supplying and installing the required safety signs as determined by the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act or Factories, Machinery and Building Works Act, whichever is applicable, both during the construction phase and for the completed works.
- (c) All safety signs shall comply with the requirements of the latest edition of SABS 1186 as applicable.

1.5 QUALITY

- (a) Material and equipment

All material and equipment shall conform in respect of quality, manufacture, tests and performance, with the relevant requirements of the South African Bureau of Standards or where no such standards exist, with the relevant current specification of the British Standards Institution and/or relevant IEC and/or ISO publications.

All material and equipment shall be suitable for the conditions on site. These conditions shall include weather conditions as well as conditions under which materials are installed, stored and used. Should the materials not be suitable for use under temporary site conditions then the Contractor shall at his own cost provide suitable protection until these unfavourable site conditions cease to exist.

The Contractor shall, where requested to do so, submit samples of equipment and material to the Engineer for approval prior to installation. The Engineer may retain these samples until the contract is completed after which they will be returned.

(b) Proprietary materials

Where proprietary materials are specified it is to indicate the quality or type of materials or articles required, and where the terms "or other approved" or "or approved equivalent" are used in connection with proprietary materials or articles, it is to be understood that the approval shall be at the sole discretion of the Engineer after the appropriate samples have been submitted to the Engineer for his evaluation.

(c) Voltage rating of appliances and equipment

The voltage rating of all appliances and equipment to be installed shall be in accordance with the nominal supply voltage of the supply authority except where otherwise laid down in the detail specification.

1.6 QUALITY ASSURANCE

The Contractor shall implement a quality assurance system to ensure adequate control of the total construction process including those off-site activities that impact on quality of the final constructed product. Before commencing with any procurement or construction work, the Contractor shall furnish the Engineer with details of the quality management system.

The Contractor shall before commencing with the project nominate to the Engineer for written acceptance thereof the names of the management representative and the quality auditor complete with CVs to demonstrate their experience in quality management.

1.7 APPROVAL OF DRAWINGS, MATERIAL AND EQUIPMENT

(a) Engineer's drawings and specifications

The drawings prepared by the Engineer show general layout of all equipment and systems, complete with schematic arrangements. These, together with the specification, give sufficient information to enable the Contractor to estimate the cost and to determine how the system must be installed, tested, inspected, operated, serviced and maintained.

These drawings are not dimensioned installation drawings and cannot be used as construction/shop drawings. Location dimensions shown are only indicative of the routes and zones in which the service shall be installed.

(b) Contractor's drawings

(i) Preparation of drawings

Three paper print drawings of all equipment to be manufactured shall be submitted to the Engineer for approval. These drawings shall indicate all equipment, distribution systems, instrumentation positions and access requirements.

The Contractor may, if he so desires, purchase copies of the Engineer's drawings on 0,08 mm thick polyester film for modifications and updating if required. These drawings shall be retitled in accordance with the Contractor's system and shall thereafter be submitted as Contractor drawings. No portion of the Contractor's work shall be commenced until the drawings have been approved by the Engineer.

'As-built' drawings on 0,08 mm thick polyester film shall be furnished on completion. These shall comprise the drawings as specified above, embodying all modifications made during construction, and further system diagrams indicating the intended functioning, capacity data and control functioning of all systems. (The works shall not be certified as complete unless these drawings and the specified operating and maintenance manuals have been submitted.)

(ii) Submission of drawings`

Submission for approval will consist of the following activities executed by the Contractor and other parties involved: -

The Contractor shall review, stamp, date and sign to signify his approval and submit in the manner required by the Engineer and with reasonable promptness and in orderly sequence so as to cause no delay in the work, all Contractor drawings and samples required by the contract documents or subsequently by the Engineer. Contractor drawings shall be properly identified.

At the time of submission, the Contractor shall inform the Engineer in writing of any deviation in the Contractor drawings or samples from the requirements of the contract documents.

Three copies of the drawings shall be submitted to the Engineer for approval.

By submitting drawings and samples, the Contractor signifies that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, or will do so, and that he has checked and co-ordinated each Contractor's drawing and sample with the requirements of the works and of the contract documents.

The Engineer will review and approve construction drawings and samples with reasonable promptness (but within 21 days) so as to cause no delay, but only for conformance with the design concept of the works and with the information given in the contract documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.

The Contractor shall make any corrections required by the Engineer and shall re-submit the required number of corrected copies of Contractor drawings or new samples until approved. When re-submitting drawings, the Contractor shall specifically direct the Engineer's attention (in writing) on revisions other than corrections required by the Engineer on previous submissions.

No portion of the contract works requiring a Contractor drawing or sample submission shall be commenced until the submission has been approved.

(c) Samples of material and equipment

The Contractor shall, prior to placing orders, submit samples of all material and equipment to the Engineer for approval.

For large equipment such as high voltage switchgear, transformers, standby generators, pumps, compressors and lifts, catalogues and brochures shall be submitted for approval.

Equipment and material shall only be approved in writing by the Engineer, and the Contractor is responsible for obtaining such approval prior to commencing with the installation.

(d) Compliance with national and international standards

For all material and equipment that are required to conform to any national or international specification or publication, the Contractor shall submit a certificate to the Engineer, issued by an accredited testing laboratory clearly stating that the material and/or equipment complies with the required specification or publication.

1.8 CONSTRUCTION PROGRAMME

The Contractor shall submit his programme of work to the Engineer not later than 14 days after the Contractor has been notified of the acceptance of his tender. If necessary, the Engineer may instruct the Contractor to adjust his programme to suit other activities.

The programme shall not be in the form of a bar chart only but shall be based on a network technique and shall show clearly the anticipated quantities of work to be performed each week, together with the manner in which the listed plant is to be used, as well as the cash flow for the various sections of work.

If, during the progress of the work, the quantities of work performed per week fall below those shown on the programme, or if the sequence of operations is altered, or if the programme is deviated from in any other way, the Contractor shall, within two days after being notified by the Engineer, submit a revised programme.

If the programme has to be revised by reason of the Contractor falling behind his programme, he shall produce a revised programme showing how he intends to regain lost time in order to ensure completion of the works within the time for completion as defined in the General Conditions of Contract or any granted extension of time. Any proposal to increase the tempo of work must be accompanied by positive steps to increase production by providing more labour and plant on site, or by using the available labour and plant in a more efficient manner.

Failure on the part of the Contractor to submit or to work according to the programme or revised programmes shall be sufficient reason for the Engineer to take steps as provided for in the General Conditions of Contract.

The approval by the Engineer of any programme shall have no contractual significance other than that the Engineer will be satisfied if the work is carried out according to such programme and that the Contractor undertakes to carry out the work in accordance with the programme. It shall not limit the right of the Engineer to instruct the Contractor to vary the programme should circumstances make this necessary.

1.9 SETTING OUT OF WORKS

The Contractor shall arrange for the setting out of the works by a qualified professional land surveyor.

1.10 CONTRACTOR'S SITE REPRESENTATIVE

In terms of the General Conditions of Contract, the Contractor shall advise the Engineer in writing of the name of the person the Contractor intends using to supervise the carrying out of the works on site. The Contractor shall furthermore submit the qualifications and details of the experience of the person the Contractor intends using on site. The Engineer reserves the right to accept or reject the employment of the proposed representative of the Contractor on site. Such representative shall have full powers to act on behalf of the Contractor.

The approved representative on site shall be on site at all times while the Contractor is established on site and shall not be removed from the site and replaced by any other person without the prior approval of the Engineer. The Engineer reserves the right to stop all work on site in the event of the site representative not being on site at all times or if the approved site representative is removed from site without the Engineer's approval, until this condition is complied with.

Both the Contractor and the Contractor's representative on site shall sign a declaration that they are conversant with the requirements of the contract document and that they are aware of the details of the contract. No excuses will be accepted for material or work, which does not comply with the specification.

1.11 SITE MEETINGS

The Contractor or his authorised representative shall attend all meetings held on the site with representatives of the main Contractor and professional team at dates and times to be determined by

the Engineer. Such meetings will be held to evaluate the progress of the contract and to discuss matters pertaining to the contract which any of the parties represented may wish to raise. It is not the intention of such meetings to discuss matters concerning the normal day-to-day running of the contract.

1.12 SUB-CONTRACTORS

The appointment of Sub-Contractors shall be subject to the approval of the Engineer and/or the Employer. Proposed Sub-Contractors shall first be introduced to the Employer or his duly authorised deputy before he (the Sub-Contractor) commences work. The Sub-Contractor shall have a thorough knowledge of the work to be carried out under his portion of the contract. The Employer will make payments in favour of the Contractor alone. The Contractor shall mutually arrange payments between himself and the Sub-Contractor.

The responsibility for communication remains the responsibility of the main Contractor.

1.13 HANDLING AND STORAGE OF EQUIPMENT

Payment items have been provided for the storage of equipment either on site or at a location determined by the Engineer. These items will only be applicable if the Engineer has confirmed in writing that the equipment is ready to be installed, but that the other work on site has not advanced sufficiently to enable the equipment to be installed.

Facilities for extended storage at site for plant may not always be available and the Contractor shall therefore make his own arrangements for any off-site storage which may be required for plant which become available before installation thereof can be commenced.

The equipment stored on site shall be adequately protected and insured against damage resulting from weather, vandalism, theft, etc. This also applies to tools and equipment required for installation.

The Engineer reserves the sole authority to determine when equipment is damaged and what remedial actions, if any, are required. If the damage is extensive, the equipment shall be rejected and removed from site. Previous payments can then be revoked until the Contractor has replaced all such equipment.

The Contractor shall be responsible for the necessary maintenance of the equipment during the period of storage e.g. the maintenance of breathers, rotation of gearboxes, etc. All equipment shall, where necessary, be protected against the elements and corrosion.

Payment under this item will be according to the volume of the equipment and shall be determined by measuring the largest dimensions of the width, depth and length, including the packing material, of the packed equipment.

Should the Contractor claim payment of a portion of the value of some or all of the plant and equipment held in off-site stores, the items concerned must be clearly marked: 'The property of (name of the Employer)' and a certificate to this effect shall accompany his claim detailing the items and serial numbers included in his claim as well as the street address of the store where the plant is held. In addition, a certificate must also be furnished by the company with whom the plant and equipment has been insured in terms of the requirements of the general conditions of contract, in which it is certified that the plant and equipment for which the Contractor is claiming payment is fully covered by the insurance policy concerned while the plant and equipment is stored away from the site (street address of store to be stated).

The tendered rate shall include for double handling of the equipment, all packing material, insurance, maintenance, repair work where such repair work is not claimed from the insurance, storage costs, corrosion protection, administrative costs, additional transport, etc.

The volume of the equipment and the duration of storage (in months) shall be agreed on in writing by the Engineer and the Contractor before payment for storage will be made.

1.14 FACTORY TESTING AND INSPECTION

- (a) The Engineer reserves the right to visit and enter the manufacturer's works during the design and manufacturing stages for the purposes of interim and final inspections and for progress information acquisition. Where the Contractor makes use of third parties for the manufacturing and/or procurement of equipment, the Contractor shall ensure that this requirement is agreed with the third party.
- (b) The Engineer reserves the right to be present at all or any tests (or, at the Engineer's discretion repeats of such tests) conducted on the equipment.
- (c) One calendar weeks' notice of pending tests shall be given to the Engineer in writing.
- (d) Three copies of all test records are to be submitted to the Engineer for approval.

1.15 INSPECTIONS

The Contractor shall give the Engineer at least 24 hours' notice in writing to inspect, measure, test or commission any section of the works. In the event of the Contractor requesting the Engineer to inspect, measure, test or commission any sections of the works where the Contractor has not completed such sections of the works and is not ready for the Engineer to inspect, measure, test or commission the sections of the works or where the testing of the works fails due to the neglect of the Contractor to test such sections of the works prior to notifying the Engineer to witness the tests, the Contractor shall pay the Engineer per hour for his travelling time and time spent on site or in the factory re-imburse the Engineer for all other costs incurred in travelling to and from site in accordance with the Association of Consulting Engineer's recommended time and cost tariffs.

The Contractor shall furthermore be liable for the Engineer's costs as specified above for all inspections, measurements, tests and commissioning that the Engineer has to undertake after the expiry of the completion period allowed for in this contract and where no extension of time has been granted.

1.16 SITE TESTING AND COMMISSIONING

- (a) The Contractor shall be responsible for commissioning all sections of the works and shall perform all of the tasks set out below and as detailed in the relevant standard and detail specifications.
 - (i) Prior to any tests and commissioning, all sections of the works shall be carefully inspected by a responsible representative of the Contractor to ensure that all construction and installation work has been properly completed.
 - (ii) Prior notice of and proper arrangements for the commissioning shall be made with the Employer, Engineer, supply authority, and all Contractors and suppliers of equipment, which will be affected by the commissioning operation.
 - (iii) If plant and equipment which has been supplied by others has to be commissioned, the supplier's specific permission thereto, together with any specific requirements relating to commissioning shall be obtained prior to commissioning and the Contractor shall arrange that the commissioning shall be attended by a representative of the equipment supplier.
- (b) Commissioning and testing on site shall be carried out by experienced personnel under the manufacturer's supervision and shall be the Contractor's responsibility.
- (c) All equipment necessary for the purpose of the tests must be provided by the Contractor and remains the property of the Contractor.
- (d) All tests and checks to be carried out shall be approved by the Engineer prior to the commencement thereof.
- (e) All tests and checks are to be recorded in writing and records sent to the Engineer.
- (f) Commissioning

- (i) Carry out all necessary adjustments to ensure correct operation of the equipment, mechanisms and interlocks.
- (ii) Adjust all the protective devices to the settings required.
- (iii) Operate all circuits and check that all interlocks and controls operate correctly. Check that all meters are reading correctly.
- (iv) Instruct the client's staff in the operation and servicing of the equipment.
- (v) Hand over all loose items together with lists of such items and obtain receipt from client's representative.
- (vi) Clean all equipment and thoroughly clean plant rooms and leave in neat and tidy condition.

1.17 HANDING OVER

The handing over of completed sections of the works to the Employer and the energising/putting into operation of the completed sections of the works will only take place once the following documents and drawings have been submitted to the Engineer:

- a certificate of compliance in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act or Factories, Machinery and Building Works Act, whichever is applicable
- a certificate issued by the Contractor that the installation complies with the contract and specifications
- a certificate of acceptance which shall be specified and signed by the Employer after the inspection, acceptance and approval of the completed sections of the works has taken place
- "As-built" drawings of the installation on 0,08 mm thick polyester film
- written application to energise the completed sections of the works.

The Contractor shall be responsible for timeously arranging for all tests and inspections with the Employer and Engineer, submitting the necessary documents and drawings to the Engineer and applying for the energising of the completed sections of the works.

1.18 "AS-BUILT" DRAWINGS

On completion of the contract, all drawings required for the manuals shall be prepared and included in the manuals as specified. In addition, a set of drawings on 0,08 mm thick polyester film shall be handed to the Engineer to form the "as-built" records.

1.19 OPERATING AND MAINTENANCE MANUALS

1.19.1 Submission of Manuals

- (a) A complete set of Provisional Operation and Maintenance manuals shall be handed over to the Engineer at least one month before any commissioning tests commence. The manuals will be checked by the Engineer and returned to the Contractor with comments. The Contractor shall make the necessary changes and amendments to the manuals to incorporate the Engineer's comments in the manuals.
- (b) Portions of the information required in terms of this section may only be omitted with approval of the Engineer.
- (c) After the Operation and Maintenance manuals have been approved by the Engineer, four sets of the manuals shall be provided by the Contractor for distribution by the Engineer.

1.19.2 Format of the Manuals

- (a) Physical appearance

- (i) Manuals shall be bound in hard cover lever-arch files with plastic coatings. The files shall be clearly labelled on the outer front cover and on the edge with the following information:
 - The Contractor's name (logo optional)
 - The project title
 - The title "Operation and Maintenance Manuals"
 - The month and year during which the manuals are finally handed over to the Employer.
- (ii) Pamphlets and bound leaflets/booklets from suppliers shall be placed in plastic sachets, especially if they are of non-standard size.
- (iii) Large format drawings shall be folded and placed in plastic sachets such that they can be easily removed.
- (iv) The sections of the manuals described below shall be clearly partitioned.
- (v) Systems and/or functional units on the site shall be treated as units in the manuals, even if different types of equipment occur on such units. Cross-referencing may be used.

(b) Contents

The manual shall contain the following:

- (i) Title page.
- (ii) Contents list.
- (iii) List of drawings and appendices.
- (iv) Plant description

This section shall give a brief, but detailed overview of the complete plant covered by this manual including all systems and/or functional units.

- (v) Maintenance and lubrication schedule (summary)

This maintenance schedule shall be in a table format and shall include a summary of all the maintenance actions required of all the different systems and/or functional units covered by this manual to give a single summary of all maintenance actions required for the complete plant.

The schedule shall indicate daily, weekly, fortnightly, monthly and yearly maintenance actions. A lubrication schedule summary shall also be included under this section.

- (vi) The main body of the manual shall be divided into sections, if necessary, with each section covering a system and/or functional unit. Each of these sections shall contain the following information in the sequence given below:

- (1) Plant Description

This section shall give a brief but detailed description of the system and/or functional unit in general.

- (2) Maintenance and Lubrication Schedule

This maintenance schedule shall be in a table format and shall contain all the maintenance actions required for all the mechanical equipment supplied. The schedule shall indicate daily, weekly, fortnightly, monthly and yearly maintenance actions. A fully detailed lubrication schedule shall also be included under this section.

- (3) Mechanical Flow Diagrams (MFD's) / Single line diagram

Mechanical flow diagrams (for mechanical systems) or single line diagrams (for electrical systems) of the system and or functional unit shall be included in the Operation and Maintenance Manuals for easy reference by the plant operators.

(4) Operating Instructions

The operating instructions shall be a step-by-step description of the "manual" start-up and shutdown procedure for every piece of equipment and/or process supplied with references to the MFD's.

For automatic operation the operators shall be referred to the automatic control manual (if applicable).

(5) Fault Finding

A fault-finding table indicating the possible causes of failure and rectification procedures for all the equipment supplied shall be included in the Operation and Maintenance Manuals.

(6) Equipment Data Sheets

A data sheet shall be drawn up for every piece of equipment and/or machine supplied containing the following information:

- Equipment tag number
- Equipment description
- Supplier details
- Model/make
- Ordering details
- Details of fixed components
- Details of lubrication
- Maintenance references (refer to Supplier Technical Manuals)

(7) Equipment Technical Manuals

For each piece of equipment and/or machine supplied the following shall be included in this section of the Operation and Maintenance Manuals:

- The suppliers Manual of Operation and Maintenance Instructions
- Parts lists and data sheets including all characteristic curves for machines installed indicating the operation point
- Calibration charts
- Test certificates for hydraulic pressure tests, flame proof grading, materials, non-destructive examinations, coating and lining details, etc
- Prints of applicable drawings

(8) "As-built" drawings

Folded A3 size "as-built" drawings of the plant and/or areas thereof shall be included in the manual where applicable.

1.20 SPARES

One month before commissioning and handover of a system or functional unit, the Contractor shall submit a detail priced list of recommended spares and consumables required for the system. The list shall indicate which spares are consumable spares and which are strategic spares together with an expected monthly consumption.

1.21 MEASUREMENT AND PAYMENT

	Item	Unit
1.21.1	Provide and maintain a quality system	Sum
	The unit of measurement shall be a lump sum.	
	SANS1200A Clause 8.4.5 (as amended) shall apply.	
	The quoted lump sum shall include full compensation for the development and maintenance of a documented system consisting of procedures, instructions, standard forms and to ensure that the specified SABS ISO 9001 elements are controlled. This item shall include implementing and/or training of staff in the requirements of the system to ensure that it is entrenched and being worked to. This item shall further include the auditing of all aspects of the system by a suitably experienced quality auditor to verify the successful entrenchment of the system.	
	Item	Unit
1.21.2	Setting out of works	Lump sum
	The unit of measurement shall be a lump sum.	
	The lump sum tendered shall include full compensation for a qualified professional land surveyor to set out the works and to provide the Engineer with a drawing of the installation drawn in ink on 0,08 mm thick polyester film.	
	Item	Unit
1.21.3	Storage of equipment where storage space is provided by:	
1.21.3.1	The Contractor	m ³ /month
1.21.3.2	The Employer	m ³ /month
	The unit of measurement shall be the cubic metre - month.	
	The tendered rate for sub-item 1.21.3.1 shall include full compensation for all double handling of the equipment, all packing material, insurance, maintenance, repair work where such repair work is not claimed from the insurance, storage costs, corrosion protection, administrative costs, additional transport, etc of the equipment as specified.	
	The tendered rate for sub-item 1.21.3.2 shall include full compensation for all the obligations as described for sub-item 1.21.3.1 except that storage for the equipment will be supplied free of charge by the Employer.	
	Item	Unit
1.21.4	Test and commission the installation	Sum
	The unit of measurement shall be a lump sum.	
	SANS1200A Clause 8.4.5 (as amended) shall apply.	
	The lump sum tendered shall include full compensation to test and commission the complete installation as specified.	
	Item	Unit
1.21.5	Provide "as-built" drawings	Sum
	The unit of measurement shall be a lump sum.	
	SANS1200A Clause 8.4.5 (as amended) shall apply.	

The lump sum tendered shall include full compensation to provide the "as-built" drawings of the installation, drawn up in ink on copies of the contract drawings on 0,08 mm thick polyester film by a qualified draughtsman.

Item	Unit

1.21.6	Provide manuals for the installation	Sum

The unit of measurement shall be a lump sum.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The lump sum tendered shall include full compensation for the compilation of the draft manuals, submitting these to the Engineer for approval, incorporating and comments and modification requested by the Engineer or Employer until the manuals are approved by the Engineer. The tendered rate shall further include full compensation for providing 4 complete sets of approved manuals complete with complete sets of as-built drawings.

Item	Unit

1.21.7	Maintenance spares	Prov sum

The unit of measurement shall be a provisional sum.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The provisional sum shall provide for the acquisition at the sole discretion of the Employer of maintenance spares. The provisional sum does not include provision for profit and handling by the Contractor, which shall be measured separately under payment item 1.21.8 below. Payment shall be affected on actual invoiced amounts.

Item	Unit

1.21.8	Charges and profit on maintenance spares	%

The unit of measurement shall be the % tendered of the actual amount spent.

SANS1200A Clause 8.4.5 (as amended) shall apply.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of maintenance spares ordered under item 1.21.7 above.

Item	Unit

1.21.9	Contract administration and general requirements	Lump sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the contract administration and general requirements as set out in this section of the standard specification but excluding the as-built drawings, manuals and testing and commissioning for which separate items have been scheduled.

Payment for the lump sum tendered will be made in three instalments, as follows:

2. The first instalment, 10 percent of the lump sum, will be paid after the Contractor has made a substantial start with construction and procurement in accordance with the approved programme.
3. The second instalment, 40 percent of the lump sum, will be paid when the value of work completed reaches one half of the contract price, excluding contingencies and escalation.
4. The third and final instalment, 50 percent of the lump sum, will be paid when the works have been completed, all "as-built" documentation and manuals have been submitted, and the site has been cleared to the satisfaction of the Engineer.

CONTENTS

_Toc212543296

SECTION 2: CONTRACTOR'S ESTABLISHMENT ON SITE	808
2.1 SCOPE	808
2.2 GENERAL REQUIREMENTS	808
2.3 NOTICES, SIGNS AND ADVERTISEMENTS	808
2.4 MEASUREMENT AND PAYMENT	809

SECTION 2: CONTRACTOR'S ESTABLISHMENT ON SITE

2.1 SCOPE

This specification covers all work and costs involved in the establishment of the Contractor's organisation, camp and plant on the site and the removal thereof after completion of the contract. Payment for the Contractor's general obligations, liabilities and risks not covered elsewhere is also provided for in this section.

2.2 GENERAL REQUIREMENTS

(a) Camps, personnel and plant

The Contractor shall establish his construction camp, including all accommodation, maintenance and testing facilities necessary for his personnel, plant, stores, process control etc. on the site.

Accommodation must comply in all respects with the requirements of the authorities who shall have free access at all times for inspection purposes.

The Contractor shall also move all necessary personnel and plant to the site preparatory to starting work, and from the site after completion of the work, leaving the camp clean, tidy and free from obstructions. All buildings as well as the whole camp area and fencing shall be maintained during the contract.

The Contractor shall provide and maintain suitable facilities within his office complex for the holding of site meetings.

The positioning of the camp on the site shall be subject to the approval of the Engineer.

(b) Legal relations and responsibility to the public

The Contractor shall take steps necessary to comply with the terms of the General Conditions of contract, particularly in respect of the insurance, guarantees and indemnities required and shall comply with all regulations of statutory authorities.

2.3 NOTICES, SIGNS AND ADVERTISEMENTS

The Contractor shall not erect any notices, signs or advertisements on or near the site without the written approval of the Engineer.

As part of his general obligations, the Contractor shall erect the official nameboard(s), the details of which are shown on the drawings. The nameboard(s) shall be erected in the position(s) indicated by the Engineer.

All signboards, notices, the official nameboard(s) and advertisements shall be removed by the Contractor on completion of the works or by the end of the maintenance period, as may be directed by the Engineer.

2.4 MEASUREMENT AND PAYMENT

The measurement and payment clauses of SANS1200A shall be applicable to the measurement and payment items below. The content provided below should thus be read as particular clauses to the associated SANS1200A measurement and payment clauses.

2.4.1 PRELIMINARY AND GENERAL

The measurement and payment items in this section are provided to enable separation of the preliminary and general charges associated with the electrical Works from the remainder of the preliminary and general charges in this Contract, to facilitate payment commensurate with the timing of effort associated with the electrical Works.

It is envisaged that these charges would be those associated with any electrical Subcontractor appointed by the Contractor or to any electrical contractor forming part of the Joint Venture contracted for the electrical Works.

These measurement and payment items are applicable to the Construction Period only. Separate measurement and payment items for the Commissioning Period and Defects Notification Period are provided in the Particular Specification on Testing and Commissioning in Part C3.3.6 of the Contract.

2.4.2 FIXED-CHARGE ITEMS:

Item	Unit
Contractor's establishment on site	

2.4.2.1 Contractual Requirements (SANS1200A 8.3.1) Sum

The sum shall include full compensation for all fixed-charge requirements of this section of the Specification and all requirements of SANS1200 A (as amended) as applicable to the electrical Works.

Payment for the lump sum tendered will be made in three instalments, as follows:

- (i) The first instalment, 30% of the lump sum, will be paid after the Contractor has placed orders for manufacture of 50% of the electrical Plant by value.
- (ii) The second instalment, 50% of the lump sum, will be paid when the value of electrical work certified reaches 50% of the total tendered value of Part C [Electrical] of the BoQ.
- (iii) The third and final instalment, 20% of the lump sum, will be paid when the Taking-Over Certificate for Ready for Commissioning has been achieved.

Item	Unit
2.4.2.2 Other Fixed-Charge Obligations (SANS1200A 8.3.3)	Sum

The sum shall include full compensation for all fixed-charge requirements of this section of the Specification and all fixed-charge requirements of SANS1200 A (as amended) as applicable to the electrical Works, not already covered under Clause 1.5.1 above.

Payment for the lump sum tendered will be made in three instalments, as follows:

- (iv) The first instalment, 30% of the lump sum, will be paid after the Contractor has placed orders for manufacture of 50% of the electrical Plant by value.
- (v) The second instalment, 50% of the lump sum, will be paid when the value of electrical work certified reaches 50% of the total tendered value of Part C [Electrical] of the BoQ.
- (vi) The third and final instalment, 20% of the lump sum, will be paid when the Taking-Over Certificate for Ready for Commissioning has been achieved.

2.4.3 TIME RELATED ITEMS

Item	Unit

2.4.3.1 Contractual Requirements (SANS1200A 8.4.1) Sum

The sum shall include full compensation for all such requirements as related to the electrical Works, and all time-related charge requirements of this section of the Specification, as related to the electrical Works. The sum shall include provision of requisite arrangements and the installation of temporary power to the site as required.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the electrical Contractor has fully established on Site.

Item Unit

2.4.3.2 Supervision for Duration of Construction (SANS1200A 8.4.3) Sum

The sum shall include full compensation for all such requirements as related to the electrical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the electrical Contractor has fully established on Site.

Item Unit

2.4.3.3 Company and Head Office Overhead Costs for the Duration of the Contract
(SANS1200A 8.4.4) Sum

The sum shall include full compensation for all such requirements as related to the electrical Works. The sum shall include the Contractor's activities in setting up, implementing, maintaining, and adhering to the Quality Management and Compliance Verification Systems, both on-site and in-office.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the electrical Contractor has placed orders for manufacture of 50% of the electrical Plant by value.

Item Unit

2.4.3.4 Other Time-related Obligations (SANS1200A 8.4.5) Sum

The sum shall include full compensation for all such requirements as related to the electrical Works.

Payment for the lump sum tendered shall be made in accordance with the provisions of SANS1200A Clause 8.2.2, commencing once the electrical Contractor has fully established on Site.

	Item	Unit
2.4.4	Daywork	hrs
The Engineer may schedule and require unit rates for estimated numbers of hours of daywork for various classes of labour and an amount to cover materials or equipment, or both, likely to be ordered under daywork during the course of the contract. The unit rates for labour, equipment and materials shall cover overhead charges and profit, site supervision and site staff, insurances, holidays with pay and use and maintenance of tools and equipment. The rates for equipment shall cover the cost of operators, consumable stores, fuel, and maintenance. The rates or allowances shall cover travelling allowances or travelling costs (transport of men by Contractor's transport or transport hired or paid for by the Contractor), lodging allowances and any other emoluments and allowances payable to the workmen.		

CONTENTS

SECTION 3: GENERAL DESIGN	812
3.1 SCOPE	812
3.2 DESIGN	812
3.3 STANDARDS.....	813
3.4 QUALITY OF MATERIAL	813
3.5 INTERCHANGEABILITY	813
3.6 BOLTS AND NUTS.....	813
3.7 FIRE PRECAUTIONS.....	813
3.8 GALVANISING	814
3.9 WELDING	814
3.10 ELECTROMAGNETIC INTERFERENCE	814
3.11 LABELS AND NOTICES.....	814
3.12 CLEANING AND PAINTING.....	815
3.13 WATER AND DEBRIS ACCUMULATION	816
3.14 INSPECTION AND TESTS.....	816

SECTION 3: GENERAL DESIGN

3.1 SCOPE

This standard specification covers general design criteria and standards applicable to all sections of work. Should the requirements of this standard specification be in conflict with any other standard specification or the detail specification, the other standard specification or detail specification shall govern, and the Tenderer/Contractor shall seek information of such precedence from the Engineer.

3.2 DESIGN

- 3.2.1 The works shall be designed to facilitate easy accessibility, equipment replacement, maintenance, handling, inspection cleaning and repairs and to ensure satisfactory operation in which safety of plant, personnel and public and continuity of service is the first consideration.
- 3.2.2 All plant, equipment and apparatus shall operate satisfactory under the ambient and other conditions prevailing at the site.
- 3.2.3 All apparatus shall be designed to prevent the risk of accidental short circuits due to animals, birds, ants and vermin.
- 3.2.4 All moving, rubbing or wearing surfaces shall be machined or ground where they bear upon each other.
- 3.2.5 The plant and equipment shall be designed and constructed to keep maintenance costs and the number of persons employed for maintenance to a minimum.
- 3.2.6 All the equipment shall be to the approval of the Engineer and shall, unless otherwise specified, be suitably designed for operation on normal electrical supply systems, with voltage fluctuations of plus and minus 10% and under such sudden variations of load and voltage as may be met with under working conditions.
- 3.2.7 The design of equipment shall include as a major consideration the absolute safety of the general public, operating and maintenance personnel.

3.2.8 All dimensions, units and design parameters shall be in accordance with the international metric (SI) system.

3.3 STANDARDS

3.3.1 All electrical equipment shall be of approved manufacture, and its construction, design and testing shall be in accordance with the requirements of the most recent South African, British Standards or IEC publications including all amendments issued thereto up to the date of tender. The installation and equipment shall also comply with the relevant clauses of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993), and the regulations promulgated in terms of the Act, and with the Code of Practice for The Wiring of Premises, SABS 0142.

3.3.2 Notwithstanding reference in this specification to South African or British Standards and IEC or ISO recommendations the supplier may submit for approval material and designs conforming to other technically equivalent national standards, provided that the supplier supplies the Engineer with a translation of the standards into Afrikaans or English and satisfactory proof of actual compliance therewith.

3.4 QUALITY OF MATERIAL

All material shall be new and of a design and class suitable for working under the conditions specified, and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion, deterioration, or the setting up of undue stresses in any part such as to affect the efficiency and reliability of the plant and also without affecting the strength and suitability of the various parts for the duty which they have to perform.

3.5 INTERCHANGEABILITY

Corresponding parts throughout the works shall be made to such close tolerances that all similar components and spares shall be fully interchangeable without any further alterations or adjustments being necessary.

3.6 BOLTS AND NUTS

3.6.1 The threads of all bolts, nuts and studs shall be in accordance with SABS 135.

3.6.2 No brass bolt or stud shall have a diameter of less than 6 mm.

3.6.3 All nuts and studs shall be locked in position by lock washers and where necessary, lock nuts.

3.6.4 Each bolt shall protrude by at least one but not more than five threads through the nut with all washers in position.

3.6.5 All bolts, nuts and washers used outdoors shall be of approved materials and treated to prevent corrosion of the threads.

3.6.6 The Contractor shall provide special tools if any bolt, nut, screw or other fastener is used in a position, which is not accessible using conventional tools. This also applies where the size or shape of the fastener is not conventional.

3.7 FIRE PRECAUTIONS

All apparatus, connections and cabling shall be designed and arranged to minimise the risk of fire and any damage, which might be caused in the event of fire.

3.8 GALVANISING

- 3.8.1 Where galvanising is specified, or is a requirement of the design, such galvanising shall be performed by the hot-dip process to SABS 763.
- 3.8.2 For all parts, other than wires, the equivalent zinc coating thickness shall not be less than 455 g of zinc per square metre of surface area.
- 3.8.3 The galvanising must be clean, smooth, of uniform thickness, unblemished and free from defects.
- 3.8.4 The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.
- 3.8.5 All drilling, welding, cutting, sawing, punching, filing and bending shall be complete, and the metal shall be cleaned of any machining blemishes, millscale, rust and lubricants, before galvanising.
- 3.8.6 Galvanised areas must be kept free of lubricants. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.
- 3.8.7 Electrolytic deposition of zinc is not acceptable.
- 3.8.8 Where it is not practicable to coat the surface of metal by the hot-dip galvanising process, such equipment may be zinc-sprayed instead. The surface being zinc-sprayed shall be suitably prepared in accordance with the requirements of the process adopted and the rate of deposition of zinc shall not be less than 760 g per square metre of surface area. After zinc spraying the surface shall be painted with a suitable paint to render it completely impervious.

3.9 WELDING

- 3.9.1 All welding shall comply with the appropriate international standards such as BS 1856 (General specification) and BS 709 (methods of testing).
- 3.9.2 The welding shall be executed in accordance with modern accepted practice for welding and shall be sound, full strength and free from undercut and slag inclusions. Crater effects at the ends of weld runs shall be eliminated.
- 3.9.3 Intermittent welding and incomplete penetration butt-welding will not be accepted.
- 3.9.4 All fabricated items shall be stress relieved after welding.
- 3.9.5 The supplier shall well in advance of the commencement of fabrication, submit for approval details of proposed welding procedures.

3.10 ELECTROMAGNETIC INTERFERENCE

- 3.10.1 All equipment installed under this contract shall comply with the requirements of IEC 61000 Parts 1 to 6 ELECTROMAGNETIC COMPATIBILITY (EMC).
- 3.10.2 Any equipment found producing Electromagnetic interference subsequent to commissioning, shall be suppressed or replaced to the satisfaction of the Engineer without any cost to the Employer.

3.11 LABELS AND NOTICES

- 3.11.1 Identification labels must be attached to all equipment, motors, control gear and all panels and the equipment contained therein.

- 3.11.2 All labels and plates shall be of an approved non-corrosive material and shall be fixed with stainless steel or nickel-plated screws of ISO metric thread form.
- 3.11.3 Labels shall have a matt or satin finish to minimise reflection.
- 3.11.4 Labels shall have black lettering on a white background. Danger plates shall have white lettering on a red background.
- 3.11.5 Cables shall be labelled at both ends, at through joints and at regular intervals.
- 3.11.6 Cables shall be labelled on both sides of the place where the cable passes through a permanent obstruction.
- 3.11.7 For outdoor applications labels shall be of aluminium, with letters filled in black, lightly sanded with fine grit paper and clear lacquered.
- 3.11.8 All lettering shall be in uppercase letters except where standard abbreviations of units are used, e.g. kWh, kVA, etc.
- 3.11.9 The wording of labels and character height shall be to the approval of the Engineer.
- 3.11.10 All labels shall be in English. In addition to the English text, all Warning/Danger labels shall also be in Afrikaans and seTswana.

3.12 CLEANING AND PAINTING

- 3.12.1 The cleaning and painting of all exposed surfaces of all plant and accessories, unless otherwise specified or approved, shall be carried out as follows:
 - (a) Surface preparation

All metal work shall be thoroughly cleaned by blast cleaning or pickling so as to be free of all millscale, dirt, rust, welding slag and spatter, grease and all other contaminants and so as to present a dry, bright metallic finish.
 - (b) Priming

The metal work shall be primed with an approved primer which, for equipment intended for outdoor use, shall be red lead based and for indoor mounted equipment shall be phosphate based.
 - (c) Finishing

The primed surfaces shall be finished with a minimum of two coats of approved alkyd-based enamel of which each coat shall be of a different shade.
- 3.12.2 Epoxy powder coating will be considered as alternative, for indoor applications, subject to the approval of the application procedure by the Engineer.
- 3.12.3 Top and bottom plates of chassis compartments assemblies and chassis runners may be protected against corrosion in an alternative approved manner (e.g. by passivated cadmium plating) due to the likelihood of damage to paint work on removal and replacement.
- 3.12.4 All painting shall be spray applied using dry oil-free air.
- 3.12.5 The final paint thickness shall be not less than 0,1 mm as determined by a magnetic film thickness gauge.

3.13 WATER AND DEBRIS ACCUMULATION

All outdoor equipment must be designed so that water and debris will not readily accumulate to cause deterioration of equipment or an electrical discharge hazard. Where this cannot be avoided such places shall be easily accessible for cleaning.

3.14 INSPECTION AND TESTS

3.14.1 All equipment will be inspected and tested, both in the factory during manufacturing and on-site during installation. The tests required are prescribed in the standard and detail specification. The Engineer will do all inspections accompanied by the Contractor and the Contractor shall perform all tests with the Engineer as witness.

3.14.2 The Engineer will require seven (7) days notification to avail himself for any tests or inspection. The Contractor shall arrange for the maximum number of tests and inspections to be done on the same day.

3.14.3 The Contractor shall provide all testing facilities and instruments and all equipment and labour required for a test or inspection. All instruments shall be adequately scaled for the application. All testing facilities and instruments remain the property of the Contractor.

3.14.4 All instruments used shall have a valid test certificate issued by an accepted testing authority. The Engineer reserves the right to call for a calibration test on any instruments used during the test.

3.14.5 The Contractor shall record all results of the tests done on a test certificate, of which the Engineer must receive two (2) copies.

3.14.6 The Contractor shall ensure that the equipment is ready for testing or inspection and that the equipment conforms to the specifications before the Engineer is requested to witness tests or inspections. Should it be found that the equipment or contract works is not ready for testing/inspection, or does not conform to the specification, the Engineer reserves the right to charge the Contractor for any re-tests or subsequent costs.

CONTENTS

SECTION 4: TESTING AND COMMISSIONING	817
4.1 SCOPE	817
4.2 TESTING SEQUENCE	817
4.3 SITE TESTING OF EQUIPMENT PRIOR TO COMMISSIONING	817
4.4 COMMISSIONING	818
4.5 MEASUREMENT AND PAYMENT	819

SECTION 4: TESTING AND COMMISSIONING

4.1 SCOPE

This section covers the factory and on-site testing and commissioning requirements for all equipment supplied and installed under this contract. The procedures described are the minimum required, and additional tests/requirements are specified in the relevant standard and detail specifications.

4.2 TESTING SEQUENCE

The testing to be performed on site is divided into two sections as follows:

- (a) Before official commissioning commences the Contractor shall test his equipment as described below to ensure that the plant has been installed correctly.
- (b) After the Contractor has been satisfied that his equipment is in running order, the commissioning of the plant will commence as described below.

4.3 SITE TESTING OF EQUIPMENT PRIOR TO COMMISSIONING

- (a) The Contractor shall timeously inform the Engineer when he intends to perform his first tests and start-up of equipment in order to allow a representative of the Engineer to witness the tests.
- (b) Before starting up any section of the mechanical plant or filling tanks and sumps with liquid, the Contractor shall clean out the tanks, pipes, fittings, equipment or structures, and, if necessary, make arrangements with other Contractors to remove their building rubble from the structures, check that all safety devices and alarms have been set and activated, all nuts have been tightened correctly, that all the equipment is complete and ready for start-up, that the plant has been installed correctly, and that three copies of the operating manuals have been handed over to the Engineer.
- (c) Each section of the equipment shall be started up by the Contractor, who shall ensure that all oil fillings, lubrication, vibration monitoring, etc, have been correctly completed. In addition, he shall be responsible for the first re-filling of all the lubricating oils as well as for adjusting the plant to operate according to specification. Before any equipment is started or energised, the Contractor shall ensure that it is safe for personnel and equipment on site to do so. Allowance for these costs shall be made in his tendered rates and sums.
- (d) The Contractor shall conduct his own tests on the equipment and, only when he is satisfied that these tests meet the requirements of the specifications, shall he notify the Engineer that he is ready to conduct the official tests on completion. The Contractor shall not conduct an official test without the Engineer being present or his approval to do so. All equipment tested shall conform to the requirements specified.

4.4 COMMISSIONING

- (a) The Contractor shall be responsible for commissioning all sections of the works and shall perform all of the tasks set out below:
 - (i) Prior notice of and proper arrangements for the commissioning shall be made with the Employer, Engineer, supply authority, and all electrical Contractors and suppliers of equipment, which will be affected by the commissioning operation.
 - (ii) If plant and equipment, which has been supplied by others has to be commissioned, the supplier's specific permission thereto, together with any specific requirements relating to commissioning shall be obtained prior to commissioning.
 - (iii) All sections of the works shall be carefully inspected by a responsible representative of the Contractor to ensure that all construction and installation work has been properly completed.
- (b) Commissioning and testing on site shall be carried out by experienced personnel under the Contractor's supervision.
- (c) All pre-commissioning tests and checks shall be agreed with the Engineer prior to the commencement therewith.
- (d) When all the tests required before commissioning, or tests before tests on completion, have been completed and accepted by the Engineer, the commissioning may proceed. The commissioning period shall be undertaken over a trouble-free period of at least thirty consecutive calendar days. During this period the Contractor shall instruct the operating staff in the correct procedures of operating the plant under all circumstances of operation, including emergency conditions, the correct servicing of every part, the type of oil or grease to be used, and similar instructions. This shall be done by demonstration and confirmation in writing and operating manuals shall be referred to for this purpose.
- (e) At least four weeks before commissioning commences the Engineer will be requested to provide the Contractor with commissioning sheets for all the equipment installed by the Contractor. These forms shall be completed by the Contractor during the commissioning period and all items listed shall be entered. Final hand-over certificates will not be issued for equipment with incomplete commissioning reports. Information that is not available or applicable, or reasons for not performing certain tests shall be agreed with the Engineer.
- (f) The thirty-day commissioning period will commence with a day-one test and terminate with a day-thirty test in compliance with the commissioning report. Commissioning of the plant (which includes the thirty days between the day-one and day-thirty tests) shall include operating under conditions which shall adequately prove that all the specifications are met. All safety devices, stand-by plant, automatic controls and protection devices shall be adequately tested for reliability and correct functioning. The Contractor may be called upon to repeat testing during the maintenance period if the performance of any equipment supplied under this contract is suspected to be substandard by the Engineer. Such tests shall be for the Contractor's account and shall comply with the requirements specified. Copies of updated commissioning reports shall be provided to the Engineer within two days after a test has been performed.
- (g) After the Contractor has provided training to the Employer and provided all other contractual requirements have been met, the latter will sign the commissioning report.
- (h) Once a commissioning report is complete, the Engineer and the Contractor will sign and date the report, whereupon the Engineer will notify the Employer that maintenance for that particular piece of equipment from then on is the Employers responsibility in compliance with the general conditions of contract.
- (i) Programs for the day-one tests, day-thirty tests and instruction/training sessions with the client shall be prepared by the Contractor and provided to the Engineer no less than two weeks before the

commissioning period commences. Weekly updates to these schedules shall be provided by the Contractor for the duration of the commissioning period.

- (j) Note that if any equipment should fail during the 30-day commissioning period, the equipment shall be repaired or replaced by the Contractor, and testing and commissioning will commence from scratch.
- (k) During the thirty-day commissioning period, the Contractor shall be responsible for providing all labour and materials (including testing equipment) and shall carry out all the servicing and any adjustment of the plant required for ensuring that it operates as specified. Valid calibration certificates shall be available for all testing equipment on site during the commissioning period.
- (l) The Contractor shall conduct all the tests required to satisfy the Engineer that the plant is capable of performing in accordance with the specification and shall make allowance therefor in his tendered rates and prices. Any defects detected during the commissioning period shall be made good by and at the expense of the Contractor, including all additional costs incurred by the Employer and his representatives and the Engineer. These tests shall be conducted to certify that the plant, as installed, is operating in accordance with the specified requirements. Note that all equipment will be tested as part of a system, where appropriate, and will not be passed if all protection devices, interlocking with other equipment, etc, is not fully functional.

4.5 MEASUREMENT AND PAYMENT

All costs for equipment, labour and other expenses for the on-site testing and commissioning of equipment shall be included in the tendered rates for testing and commissioning as set out in the measurement and payment clauses of each piece of equipment and in the schedule of quantities. Any additional tests specified in the standard and detail specifications shall also be included in the tendered rates.

CONTENTS

SECTION 5: MOTOR CONTROL CENTRES (MCCS)	820
5.1 SCOPE	820
5.2 APPLICABLE STANDARDS	820
5.3 GENERAL REQUIREMENTS	820
5.4 CONSTRUCTION	821
5.5 COMPONENTS	821
5.6 CONTROL AND COMMUNICATION	822
5.7 LABELLING AND IDENTIFICATION	822
5.8 TESTING AND INSPECTION	822
5.9 DOCUMENTATION	822
5.10 SPARES AND WARRANTY	823
5.11 ACCEPTANCE	823

SECTION 5: MOTOR CONTROL CENTRES (MCCS)

5.1 SCOPE

This specification defines the minimum technical, construction, and performance requirements for Motor Control Centres (MCCs) to be designed, manufactured, tested, supplied, installed, and commissioned by the Contractor.

The MCCs shall provide safe, reliable, and maintainable power and control distribution for all plant motor and process control equipment as identified in the relevant P&IDs and Equipment Lists.

5.2 APPLICABLE STANDARDS

All MCCs and their components shall comply with the latest editions of the following standards (or equivalent):

- IEC 61439 series – Low-voltage switchgear and controlgear assemblies
- IEC 60947 series – Low-voltage switchgear and controlgear components
- IEC 61641 – Internal arc classification for LV assemblies
- IEC 60034 – Rotating electrical machines
- IEC 60529 / SANS 60529 – Degrees of protection (IP code)
- SANS 10142-1 – The wiring of premises (Low-voltage installations)
- SANS/IEC 60439 – Controlgear assemblies
- SANS 947 – Control circuit devices and switching elements
- ISO 12944 – Paint systems for steel structures
- SANS 1973 – Marking and identification

5.3 GENERAL REQUIREMENTS

All MCCs shall be factory-built, type-tested assemblies (TTA) in accordance with IEC 61439-1/2.

MCCs shall be designed for 400 V, 3-phase, 4-wire, 50 Hz systems with a neutral and earth bar.

The busbar system shall be rated for a minimum 50 kA for 1 second short-circuit withstand.

Form of separation shall be minimum Form 3b, unless otherwise specified.

The assembly shall incorporate measures to mitigate internal arcing faults and shall be type-tested to IEC 61641.

Each MCC shall be designed for front access operation and maintenance unless otherwise approved.

Each MCC shall be provided with a separate 230 V AC control supply, with optional 24 V DC auxiliary supply where required.

5.4 CONSTRUCTION

5.4.1 Enclosure

- Minimum ingress protection:
 - Indoor MCCs: IP54
 - Outdoor MCCs: IP65 (stainless steel or GRP enclosure)
- Fabricated from minimum 2 mm mild steel sheet, fully welded and powder-coated to ISO 12944 C3 standard (or C5 for corrosive zones).
- Doors shall be fitted with neoprene gaskets, three-point latching, and stainless-steel hinges.
- Enclosures shall be provided with drip shields where exposed to washdown or condensation.

5.4.2 Compartments and Segregation

- Minimum Form of Separation: Form 3b, with separate compartments for busbars, control wiring, and power components.
- Each functional unit shall be individually removable or withdrawable.
- Busbars shall be isolated from control wiring by metal or insulating barriers.

5.4.3 Busbar System

- Constructed from electrolytic copper, rated for 50°C maximum temperature rise.
- Phases and neutral shall be clearly colour-coded (R–Y–B–N).
- Each MCC shall include a full-length earth bar bonded to the enclosure frame and all doors.
- Vertical distribution busbars shall be fully shrouded and finger-safe (IP20 minimum).

5.4.4 Wiring and Terminations

- Control wiring: minimum 1.5 mm² stranded copper, 600/1000 V rated, PVC or XLPE insulated.
- Power wiring: as per SANS 10142-1 and equipment rating.
- All wiring shall be numbered, ferruled, and neatly loomed.
- Incoming and outgoing cable terminations shall be located in dedicated cable compartments with gland plates.
- Gland plates shall be removable, drilled on site, and earthed via copper earth studs.

5.5 COMPONENTS

5.5.1 Circuit Breakers and Switchgear

- MCCBs shall comply with IEC 60947-2, rated for the maximum system fault level.
- Isolators shall comply with IEC 60947-3, with visible break and lockable handles.
- All circuit breakers shall have adjustable thermal and magnetic protection.
- Incoming and outgoing feeders shall be provided with phase indication lamps and control fuses.

5.5.2 Contactors and Overload Relays

- Contactors shall comply with IEC 60947-4-1, AC-3 duty rated for motor starting.
- Overload relays shall be bimetallic or electronic, manually resettable, and coordinated to provide Type 2 protection.
- Each starter shall be provided with a manual/auto selector, start/stop pushbuttons, and run/fault indication.

5.5.3 Soft Starters and VSDs

- Where applicable, soft starters and VSDs shall comply with IEC 60947-4-2 and IEC 61800-3 respectively.
- Units shall be housed in segregated ventilated compartments.
- Harmonic mitigation and EMC compliance shall be as per Section 6.3 of this specification.

5.5.4 Control Circuit Components

- Control relays: plug-in, DIN-rail mounted, with LED indication and retaining clips.
- Terminal blocks: cage-clamp or screw-type, 2.5 mm² minimum, colour-coded.
- Control fuses: DIN-mounted, 10 x 38 mm type, with LED blown-fuse indication.
- Pilot lights and pushbuttons: 22 mm modular type, IP65 minimum, colour-coded to IEC standards (Red–Stop/Fault, Green–Run, Amber–Trip).

5.5.5 Instrumentation and Metering

- Each MCC shall include:
 - Digital multifunction meter on incomer for V, A, PF, kW, kWh.
 - Phase-failure relay.
 - Control voltage monitor.
- Metering shall be Modbus TCP or RTU capable for integration into SCADA.

5.6 CONTROL AND COMMUNICATION

- Each MCC shall include an industrial-grade Ethernet switch for network communication.
- Fieldbus protocol shall be as per the plant PLC system (e.g. Modbus TCP/IP, Profinet, or Ethernet/IP).
- Each motor starter or drive shall provide status, fault, and running feedback to the PLC/SCADA system.
- Provision shall be made for remote start/stop and speed control where applicable.

5.7 LABELLING AND IDENTIFICATION

- All components, terminals, and cables shall be clearly labelled using printed PVC or engraved phenolic labels.
- Labels shall correspond to the tag numbers on the approved P&IDs and MCC schedules.
- Main equipment labels shall include the feeder name, circuit number, and rating.

5.8 TESTING AND INSPECTION

5.8.1 Factory Tests:

- Routine dielectric, insulation resistance, and functional testing per IEC 61439.
- Verification of protection relay settings and control logic.
- Inspection for workmanship, wiring, and completeness.

5.8.2 Site Tests:

- Insulation resistance ($\geq 1 \text{ M}\Omega$ at 500 V DC).
- Functional tests of all feeders, controls, and interlocks.
- Verification of PLC/SCADA communication and alarms.
- Arc flash detection and tripping tests where applicable.

5.9 DOCUMENTATION

- The Contractor shall submit the following:

- General arrangement drawings.
- Single line diagrams and schematic wiring diagrams.
- MCC schedules with load data, feeder details, and control supply information.
- Type test certificates and manufacturer's datasheets.
- Operation and maintenance manuals.
- Factory and site test reports.

5.10 SPARES AND WARRANTY

- A complete set of spare control fuses, contactors, relays, and indicating lamps shall be provided for each MCC.
- Drives and protection relays shall have parameter backup files.
- All assemblies and components shall carry a minimum 24-month warranty from the date of commissioning.

5.11 ACCEPTANCE

Final acceptance shall be subject to:

- Approval of all design documentation.
- Successful completion of all factory and site acceptance tests.
- Compliance with this specification and all referenced standards.

Part C: Detail Specifications

CONTENTS

SECTION 1: DETAIL SPECIFICATION	824
1.1 SCOPE	824
1.2 GENERAL INFORMATION AND INSTRUCTIONS	825
1.3 GENERAL DESIGN REQUIREMENTS	826
1.4 PLANT LOADS	827
1.5 MV INSTALLATION	827
1.6 LV INSTALLATION	827
1.7 EMERGENCY BACKUP POWER FACILITIES	833
1.8 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS FOR CONTROL AND INSTRUMENTATION	837
1.9 DISTRIBUTED CONTROL SYSTEM (DCS)	840
1.10 CONTROL SYSTEM ARCHITECTURE NARRATIVE	844
1.11 ACCESS CONTROL AND CCTV SYSTEM	847

SECTION 1: DETAIL SPECIFICATION

1.1 SCOPE

This part of the specification provides the detail of the Electrical Control and Instrumentation (EC&I) equipment and services that must be designed and supplied for this project.

The work to be carried out under this Contract consists mainly of the following:

- The EC&I design for the Polokwane RWWTW to render a complete and operating WWTW in conjunction with the Mechanical and Civil works for the project
- Design, supply, delivery, installation, testing and commissioning of an Intake substation and MV ring supplying the load centres on site including the required MV cable work
- Design, supply, delivery, installation, testing and commissioning of MCCs to power the mechanical equipment in the respective load centres together with the required Start/Stop/Isolation stations and LV cable installation.
- Design, supply, delivery, installation, testing and commissioning of a centralised emergency power generation facility that together with the control system will power all drives that require emergency power.
- Design, supply, installation, testing and commissioning of a plant control system consisting of a PLC and distributed Remote I/O or a distributed PLC network which will be used to control and interlock where necessary to provide the desired control as detailed in the P&ID and plant control philosophy including the required control and instrumentation cable installation.
- Design, supply, installation, testing and commissioning of a plant SCADA system.
- Design, supply, delivery, installation, testing and commissioning of plant access control system incorporating the CCTV at critical locations.
- Design, supply, delivery, installation, testing and commissioning of mechanical equipment for one secondary settling tank.
- Supply, delivery, installation, testing and commissioning of various submersible pumping installations.

1.2 GENERAL INFORMATION AND INSTRUCTIONS

1.2.1 The Contractor shall make every attempt to ensure that his installation conforms to the layout indicated on each drawing and process flow diagram. These drawings and flow diagrams are however only schematic and do not necessarily show all minor equipment and fittings.

1.2.2 Any deviation from the general layout indicated shall be detailed in a covering letter.

1.2.3 All equipment shall be labelled in accordance with the Standard Specification on General Design and to the approval of the Engineer.

1.2.4 The Contractor shall submit all the relevant detail of all the mechanical and electrical equipment supplied under this contract, including all civil requirements and modifications to structures, to the Engineer for approval within six (6) weeks from tender award to enable the finalisation of the Motor and Equipment Schedule (MES) and construction drawings. Any revisions to the information shall be finalised in the two weeks following the six weeks in which the information must be submitted.

1.2.5 The Contractor shall be responsible to provide cabler sizes to the mechanical contractor in good time so that the mechanical contractor can order the required motors with terminal boxes to suite the cables required.

1.2.6 Bolts, Nuts and Washers

Bolts, nuts and washers in their respective sizes shall comply in all respects with SABS 136 – 1972 for ISO metric precision hexagon head bolts, screws and nuts.

They shall be the sizes shown on the drawings, or as approved, and be of grade 4.6 unless otherwise indicated.

The bolts and nuts shall be fitted with a flat washer under the bolt head and a further flat washer under the nut. Bolt lengths shall be such that when in position and fitted with one washer under both nut and head, not less than 3 mm or more than 6 mm of thread protrudes from the nuts.

Bolts, nuts and washers for stainless steel or 3CR12 shall be of grade 304 stainless steel.

Bolts, nuts and washers for structural mild steel/mild steel shall be of mild steel and shall be hot dip galvanised to SABS 763 – 1988 and once fitted in place shall be given two thorough coats of epoxy tar to give a dry film thickness of not less than 200 micrometers.

For stainless steel or 3CR12 connections to mild steel, grade 304 stainless steel nuts, bolts and washers shall be used.

Anchor bolts shall be installed in accordance with BS 5080: Part I: 1974 and the type of fixing bolt the Contractor proposes to use shall be approved by the Engineer.

All anchor and other fixing bolts to be cast into, grouted into or fixed into concrete, shall be made from stainless steel.

The threads of all bolts shall be coated with Nickel Anti-Seize compound or a similar approved release paste prior to fastening. The release paste shall be water resistant with no more than 40 % petroleum oil and meet Mil Spec. A.907D.

1.2.7 Structural Steelwork

(a) All structural steelwork, materials, welding and workmanship will confirm to the Standard Specification for structural metalwork.

(b) Connections shall be designed to transmit the loadings specified, but where a connection is detailed on the drawing it shall be adhered to.

- (c) All welded joints shall be fully continuous on all sides to prevent access of moisture. Welding shall be carried out in such a sequence as to minimise distortion.
- (d) Splicing of the members will not be permitted without prior consent of the Engineer.
- (e) Samples of welding may be required by the Engineer for testing purposes. The Contractor will make allowance in his tender for the cost of providing such samples.
- (f) Material or workmanship rejected by the Engineer's appointed inspector will be remedied immediately or removed from site by the Contractor at his own cost.

1.2.8 Hot Dip Galvanised Coatings

Items to be hot dip galvanised shall be hot dip galvanised in accordance with the requirements of SABS 763 – 1988. The galvanising shall be of the "heavy duty" class.

All welded articles shall be seal welded before galvanising.

The Contractor shall handle, store and install all hot dip galvanised items with great care to avoid damage to their protective coatings. Should any damage be caused to the protective coatings the Contractor shall remedy such damage at his own expense in the following manner.

- (a) Remove oil, grease and debris with clean solvent.
- (b) Rub surface down with abrasive paper.
- (c) Remove debris with clean solvent.
- (d) Apply well-mixed two pack zinc rich primer complying with SABS 926 to give a minimum dry thickness of 100 micrometers.

1.3 GENERAL DESIGN REQUIREMENTS

The basis of the design shall be to ensure the minimisation of life cycle costs.

1.3.1 Fault level coordination.

The designer shall obtain the maximum future and existing fault level at the supply point to the plant.

The designer shall provide a full plant wide fault calculation and specify the minimum fault level for all components in the plant.

As part of the design document submitted to the Engineer for approval shall be a design file indicating the calculations and final equipment fault withstand levels selected.

1.3.2 Arc Flash Protection and Arc Flash Mitigation

As part of the design documentation submitted to the Engineer for approval shall be documentation to demonstrate that the total electrical installation complies with the minimum requirements as set out in IEC 61850 and shall include an arc flash coordination study and an Arc Flash Risk Assessment.

1.3.3 Building Requirements

Where additional buildings are required not already included in the Civil design, the tenderer shall clearly indicate the size and requirements of the building required with his tender. Please also refer to paragraph 2.4 above.

1.3.4 Mechanical Design

Portions of the Mechanical installation is "Designed by the Mechanical Contractor". Throughout the project the EC&I Sub-Contractor shall closely work with the Mechanical Contractor and shall update the P&IDs and Schedules provided to ensure a compatible and complete electrical design and implementation.

1.4 PLANT LOADS

Please refer to the relevant P&IDs as listed in Part A of this specification and the attached Polokwane WWTW Equipment List. The Electrical sub-contractor shall in cooperation with the Mechanical Contractor update this list which will form the basis for the detail design of each load centre. The updated and completed list and P&IDs shall be submitted with the design for approval by the Engineer.

1.5 MV INSTALLATION

The Medium Voltage (MV) Installation shall be designed to comply with the Standard Specifications in Part B.

The MV Installation shall be designed to be expandable to provide for the future phases of the Polokwane RWWTW.

The design shall incorporate the design of an Intake substation which provides for the housing of the switchgear required for this phase and subsequent phases. This building must also incorporate the central back-up diesel generator and any required step-up transformers required.

The MV Installation shall at minimum consist of the following components:

- A Medium Voltage (MV) Ring network that is expandable to include for the future phase 1B and subsequent phases. The Contractor shall indicate in his design how the future phases can be incorporated.
- The MV ring shall supply power to the following load centres:
 - Inlet Works
 - Primary sedimentation and Flow Balancing
 - Biological Reactor and Secondary Sedimentation
 - Maturation, Chlorination and Site Water services
 - Sludge Treatment Facility
- Step down transformers or Miniature Substations (Minisubs) at each of the load centres. Where the design calls for a separate transformer and switchgear the design shall include the design for the building to accommodate these. The tenderer shall include the details of all the buildings required to house the electrical equipment.

The MV design shall include a complete fault grading study and properly documented MV Protection relay settings.

MV Cables, joints and terminations and Installation shall comply with the Standard Specifications.

1.6 LV INSTALLATION

1.6.1 General Requirements

The design of the Low Voltage (LV) electrical system shall be based on the **updated P&IDs** and the **approved Equipment List**. The process designer has indicated in the Equipment List which items of equipment shall be fitted with **Variable Speed Drives (VSDs)**, and which drives are to be supplied from the **emergency backup power system**.

The **EC&I Sub-Contractor**, in coordination with the **Mechanical Contractor**, shall determine any additional equipment that requires emergency backup power and jointly define the most appropriate **starting method** for each motor or drive.

The Contractor shall maintain a separate **Motor Control Centre (MCC) Schedule** for each MCC forming part of the plant. The schedule shall, as a minimum, include the information indicated in the **Sample MCC Schedule** attached to this specification.

Each MCC shall be designed with **individual control supplies** for each drive. For MCCs containing drives designated for emergency backup operation, those drives shall be supplied from a **separate**

control supply to ensure that only the selected drives are enabled to start when the plant operates under emergency power conditions.

The control supply shall automatically disconnect if the incoming voltage falls outside the allowable limits for **overvoltage, undervoltage, or phase imbalance**. These parameters shall be individually configurable for each MCC. The control supply shall further incorporate logic to prevent excessive starting, limiting equipment to **no more than three start attempts per hour** when the supply remains out of specification.

1.6.2 Motor Control Centres (MCC's)

All MCCs shall comply with the requirements of the **IEC 61439** series of standards and any additional requirements specified in the **Standard Specifications**. Assemblies shall be **fully type-tested** and constructed to ensure compliance with the specified performance and safety criteria.

All motor starters shall be designed to provide **Type 2 coordination** in accordance with the **IEC 60947** series of standards, in particular **IEC 60947-4-1**.

Each MCC shall be designed to minimise the likelihood and consequence of **internal arcing faults**. The assembly shall be **type-tested for internal arc containment** in accordance with **IEC 61641**. The arc-resistant construction shall ensure that gases and arc products are safely vented away from personnel standing in front of the equipment.

Acceptance of MCCs shall be subject to:

- Submission and approval of **type test certificates**.
- **Inspection** of physical construction; and
- **Verification of the functional operation** of the arc-flash detection and protection system during factory and site testing.

1.6.3 Variable Speed Drives (VSDs)

Where called for in the updated Polokwane WWTW Equipment List or by the mechanical contractor, the starting method for the drive shall be a VSD conforming to the following minimum requirements in addition to those in the Standard Specifications.

1.6.3.1 Scope

This section defines the minimum technical and design requirements for low-voltage Variable Speed Drives (VSDs) to be supplied, installed, and commissioned by the Contractor. The intent is to ensure reliable, safe, and energy-efficient motor control under variable load and environmental conditions.

1.6.3.2 Applicable Standards

All VSDs and associated components shall comply with the latest editions of the following standards (or equivalent):

- **IEC 61800** series – Adjustable speed electrical power drive systems
- **IEC 61000-6-2 / 6-4** – Electromagnetic compatibility (EMC) standards
- **SANS/IEC 60529** – Degrees of protection provided by enclosures (IP rating)
- **SANS/IEC 60034** – Rotating electrical machines
- **SANS/IEC 61439** – Low-voltage switchgear and controlgear assemblies
- **SANS 10142-1** – The wiring of premises (Low-voltage installations)
- **SANS/IEC 60947-4-2** – AC semiconductor motor controllers and starters
- **IEEE 519** – Harmonic control in power systems

1.6.3.3 Design Requirements

1.6.3.3.1 General

- Drives shall be AC variable frequency type using IGBT technology for PWM output.
- Drives shall be suitable for three-phase, 400 V, 50 Hz supply systems.
- Each VSD shall include all components necessary for safe, reliable operation, including fuses, input disconnect, DC link components, filters, and control interface.
- Drives shall be designed for continuous operation at 40°C ambient temperature without derating.

1.6.3.3.2 Power and Control Interface

- **Input** voltage tolerance: **±10%** of nominal.
- Frequency tolerance: **±2%**.
- Power factor: ≥ 0.95 at rated load.
- Efficiency: $\geq 97\%$ at full load.
- Each VSD shall include:
 - Input circuit breaker or isolator with mechanical interlock.
 - EMC filter (Class A1 or A2 as per IEC 61800-3).
 - DC choke or line reactor to limit input current harmonics ($\text{THDi} \leq 35\%$ or as per IEEE 519).
 - Output reactors or filters where required to limit dv/dt and protect motor insulation. For all motors with cables between the VSD and Motor $>90\text{m}$, the VSD shall be fitted with an output reactor/filter.

1.6.3.4 Enclosures and Installation

- Enclosures shall be **minimum IP54** for indoor installation in treatment plant MCC rooms and **IP65** for wall-mounted or field installations.
- Enclosure material: **powder-coated mild steel** or **stainless steel (Grade 304/316)** in corrosive zones.
- Adequate ventilation and heat dissipation shall be ensured; forced cooling shall not rely solely on external air in humid or corrosive environments. The HVAC system for all rooms with VSDs installed shall be sized to remove the heat generated by the VSDs.
- VSDs shall be mounted in **segregated MCC sections** or standalone panels with appropriate access and safety clearances.
- Motor Compatibility and Protection
- VSDs shall be suitable for **standard IEC squirrel-cage induction motors** and **VSD-rated motors**.
- Drives shall provide the following protection functions as a minimum:
 - Overcurrent / short-circuit protection
 - Overvoltage / undervoltage
 - Motor overtemperature (via PTC or thermistor input)
 - Phase loss and phase imbalance
 - Earth fault and stall protection
 - Output frequency and torque limits
- Drives shall include **automatic restart** and **flying start** capability.

1.6.3.5 Control and Communication

- Each VSD shall have:
 - Local/Remote operation modes
 - Integrated keypad or HMI for setup and diagnostics
 - PID process control functionality

- 4–20 mA and 0–10 V analogue input/output channels
- Digital inputs/outputs configurable for start/stop, direction, fault reset, etc.
- Fieldbus communication shall be implemented via **industrial Ethernet protocols**, such as **Modbus TCP/IP, Profinet, or Ethernet/IP**, to suit and fully integrate with the PLC and control system architecture adopted for the project.
- Each drive shall communicate with the PLC/SCADA system for start/stop control, speed reference, and status feedback.

1.6.3.6 Harmonic Mitigation and EMC Compliance

- The Contractor shall ensure that total harmonic distortion (THD) at the point of common coupling does not exceed the limits set out in **IEEE 519**.
- Drives shall incorporate **DC link chokes** or **12-pulse / AFE technology** where harmonic limits cannot otherwise be met.
- Cables shall be **screened VSD-rated cables**, correctly terminated to maintain EMC compliance.
- EMC installation guidelines provided by the VSD manufacturer shall be strictly followed.

1.6.3.7 Environmental Conditions

- Ambient temperature: –5°C to +40°C (without derating).
- Relative humidity: up to 95%, non-condensing.
- Altitude: Apply the manufacturer's derating factors for site altitude.
- Vibration: as per IEC 60068-2-6, Class 2.
- Corrosion resistance suitable for **sewage gas and damp atmospheres**.

1.6.3.8 Testing and Documentation

1.6.3.8.1 Factory Tests

- Routine functional and performance testing per IEC 61800.
- Verification of harmonic mitigation features.
- Certificate of compliance with specified standards.

1.6.3.8.2 Site Tests

- Insulation resistance and continuity.
- Verification of correct parameter settings and communication with PLC/SCADA.
- Load test where practical.
- Demonstration of all protection and fault functions.

1.6.3.8.3 Documentation

Contractor shall submit:

- VSD data sheets and dimensional drawings
- Type test certificates
- Harmonic study and mitigation plan
- PLC/SCADA communication mapping
- Operation and maintenance manuals
- Parameter backup files in electronic format

1.6.3.9 Spares, Training and Support

- Contractor shall supply a **minimum of one set of spare control cards, fans, and keypad units** per drive type.

- Manufacturer-authorised **training for plant maintenance personnel** shall be provided.
- Drives shall carry a **minimum 24-month warranty** from the date of commissioning.
- Supplier shall have **local service and technical support** presence in South Africa.

1.6.3.10 Acceptance

Acceptance shall be subject to:

- Review and approval of all test documentation.
- Satisfactory performance of the drive during functional and process commissioning; and
- Compliance with this specification and all referenced standards.

1.6.4 LV Cable Installation.

1.6.4.1 Scope

This section defines the design, selection, and installation requirements for low-voltage (LV) power, control, and instrumentation cables. The objective is to ensure safe, reliable, and durable cable systems suited to the corrosive, humid, and outdoor environment.

1.6.4.2 Applicable Standards

All cable design, supply, and installation shall comply with the latest editions of the following standards (or their local equivalents):

- **SANS 1507** series – Electric cables with extruded solid dielectric insulation
- **SANS 10142-1** – The wiring of premises (Low-voltage installations)

1.6.4.3 Design Criteria

The Contractor shall prepare a **LV Cable Installation Method statement** aligned with this specification and submit it to the Engineer for approval before any installation commences.

1.6.4.3.1 System Parameters

- **Nominal system voltage:** 400/230 V, 3-phase, 4-wire, 50 Hz
- **Fault level at main switchboard:** As per the fault level study
- **Maximum allowable voltage drop:** 4% from origin to load terminals under full-load conditions
- **Design ambient temperature:** 40°C
- **Soil thermal resistivity (for buried cables):** 1.2 K·m/W
- **Corrosion classification:** C4 / severe (as per ISO 12944)

1.6.4.3.2 Cable Sizing

Cable sizes shall be determined considering:

- Continuous current-carrying capacity (including derating for grouping and temperature)
- Maximum permissible voltage drop
- Short-circuit thermal withstand capacity per IEC 60949
- Future expansion margin where required by the Employer
- Sizing calculations shall be carried out in accordance with **SANS 10142** and **IEC 60364**.

1.6.4.4 Cable Type Selection

1.6.4.4.1 Power Cables

- 600/1,000 V, Cu, PVC, PVC, SWA, PVC

- Cables shall be derated as per the requirements of SANS 10142 and the cable manufacturers requirements. Cables exposed to direct sun light shall be derated for solar radiation.

1.6.4.4.2 Control Cables

- 300/500 V, Cu, PVC, SWA, PVC, armouring may be omitted with the Engineer's approval, where mechanical protection is not required.
- Multi-core configurations with numbered cores or colour identification to SANS 1411.

1.6.4.4.3 Instrumentation and Signal Cables

- Twisted pair, overall screened, with aluminium/polyester tape or tinned copper braid.
- Shielding continuity shall be maintained throughout, with terminations per the EMC strategy.
- Cables to/from sensors, PLCs, and MCCs shall have Low Smoke Zero Halogen (LSZH) jackets in control panels.

1.6.4.4.4 Earthing and Shielding

- Cable armour shall be bonded and earthed at one or both ends as per the project earthing philosophy.
- Control and instrumentation cable screens shall normally be earthed at one end only to avoid earth loops.

1.6.4.5 Routing and Installation

- Cables shall be routed to minimise length and avoid areas of high heat, chemical exposure, or mechanical damage.
- Where crossing roadways or trenches, cables shall be installed in heavy-duty **HDPE or uPVC conduits**
- **Buried cables:** installed at minimum **700 mm** depth with a minimum 50mm sifted soil bedding, 50mm sifted soil cover with warning tape at 400mm below finished ground level.
- **Cable trays and ladders:** hot-dip galvanised (HDG) or stainless steel in high-corrosion zones.
- Power and control/instrumentation cables shall be routed separately with a minimum of 300mm separation, to limit electromagnetic interference (EMI).
- Penetrations through walls or floors shall be sealed to maintain water and gas tightness.

1.6.4.6 Termination and Identification

- All cable ends shall be identified using **engraved labels** showing cable reference number as per the cable schedule.
- Glanding shall use **nickel-plated brass glands** with PVC shrouds in non-corrosive areas and non-corrosive glands shall be used in wet areas.
- Terminations shall use crimped lugs, tightened to manufacturer torque settings.
- Cable cores shall be identified with colour coding or numbering per SANS 1411.

1.6.4.7 Testing and Quality Assurance

1.6.4.7.1 Factory Tests

The supplier shall provide factory test certificates in accordance with **IEC 60502-1**, confirming:

- Conductor resistance
- Insulation resistance
- High voltage withstand test
- Dimensional and marking compliance

1.6.4.7.2 Site Tests

Before energisation, the following tests shall be conducted:

- Visual inspection of installation and labelling

- Continuity and insulation resistance
- Polarity and phase rotation
- Earth continuity verification
- Voltage withstand test (as per SANS 10142)

1.6.4.7.3 Documentation

The contractor shall provide:

- Cable schedules and drum lists
- Voltage drop and fault level calculations
- As-built cable route drawings
- Test results and compliance certificates

1.6.4.8 Environmental and Safety Considerations

- Cables and materials shall be resistant to **moisture, sewage gases, and chemical vapours** typically present in wastewater treatment plants.
- All exposed materials shall be **UV-resistant** and suitable for outdoor use.
- Cables shall be selected and installed to maintain plant operability and safety under fault or flood conditions.

1.6.4.9 Acceptance

Final acceptance shall be subject to:

- Review of test and compliance documentation.
- Physical inspection and verification of workmanship; and
- Confirmation of conformity with this specification, drawings, and relevant SANS/IEC standards.

1.7 EMERGENCY BACKUP POWER FACILITIES

The system shall provide **automatic standby power** to essential and pre-selected loads across multiple Motor Control Centres (MCCs) via intelligent control and load-shedding logic. The design shall ensure reliable and safe operation of critical process units during utility supply interruptions while preventing overloading of the standby generator system.

1.7.1 Scope

This section defines the minimum technical, design, and performance requirements for a **centralised emergency backup power system** coupled to the **Medium Voltage (MV) distribution network** of the works.

1.7.2 Applicable Standards

All equipment, materials, and installations shall comply with the latest editions of the following standards (or equivalent):

- **SANS 10142-1:** Low-voltage electrical installations
- **SANS 10142-2:** Medium-voltage electrical installations
- **SANS 10087:** Electrical installations of standby generators
- **SANS/IEC 60947: Low-voltage switchgear and controlgear**
- **IEC 62271:** High- and medium-voltage switchgear and controlgear
- **SANS/IEC 60034:** Rotating electrical machines
- **SANS/IEC 61439:** Low-voltage switchgear assemblies
- **IEC 60204-1:** Safety of machinery – Electrical equipment of machines
- **SANS/ISO 8528: Generator set performance and testing**

- **IEEE 446:** Emergency and standby power systems
- **NFPA 110:** Standard for emergency and standby power systems

1.7.3 System Description

The Contractor shall design, supply, install, and commission a **centralised emergency power system** connected to the **MV distribution bus** of the plant's electrical network.

The system shall include:

- Medium Voltage (MV) generator(s) or LV generator(s) with step-up transformer
- MV switchgear and circuit breakers for coupling and isolation
- Automatic transfer and synchronisation controls
- Load management system integrated with plant PLC/SCADA
- Interfaces to all MCCs to enable selective energisation of designated critical equipment only
- Fuel storage, exhaust, ventilation, and protection systems

The system shall automatically start and assume supply to essential loads upon detection of mains failure, maintaining stable voltage and frequency within permissible limits.

1.7.4 Design Criteria

Parameter	Requirement
Nominal MV bus voltage	11 kV, 3-phase, 50 Hz (or as specified)
Generator voltage	11 kV (direct coupled) or 400 V via step-up transformer
Frequency tolerance	±1%
Voltage regulation	±1% under steady-state load
Power factor	0.8 lagging (min.)
Duty	Continuous (Prime) rating
Ambient temperature	40°C
Altitude	1,230 m a.s.l.
Starting time	≤10 seconds after mains failure
Acoustic limit	≤75 dB(A) at 7 m (typical)
Autonomy	Minimum 8 hours at 80% load (unless otherwise specified)

1.7.5 Generator and MV Coupling

1.7.5.1 Generator Set(s)

- Diesel engine-driven, 4-stroke, turbocharged, water-cooled type.
- Alternator: Brushless, synchronous machine with AVR, suitable for MV output or LV output with step-up transformer.
- Rated for full essential load, including motor starting currents.
- Transient voltage dip ≤15% on 100% load step; recovery within 1.5 seconds.
- Neutral earthing in accordance with the plant's earthing philosophy (typically resistance earthed).

1.7.5.2 MV Switchgear

- Metal-clad, withdrawable-type, complying with **IEC 62271-200**.
- Minimum short-circuit withstand: 25 kA for 3 seconds.

- Circuit breakers: vacuum type with motorised racking and interlocks.
- Busbar rated for full generator current and system fault level.
- Facilities for synchronisation, load transfer, and maintenance isolation.

1.7.5.3 Step-Up Transformer (if LV genset)

- Dry-type or oil-filled, ONAN-cooled transformer.
- 400 V / 11 kV, delta–star configuration, with neutral available for earthing.
- Rated for generator output with 10% overload capability for 1 hour.

1.7.6 Control and Load Management

1.7.6.1 Control Philosophy

- Upon mains failure detection, the system shall:
 1. Initiate generator start sequence.
 2. Open utility incomer circuit breaker.
 3. Close generator circuit breaker onto the MV bus once parameters are within tolerance.
 4. Sequentially energise pre-defined critical loads at each MCC under PLC/SCADA supervision.
- Non-essential loads shall remain locked out until normal supply is restored.
- Upon restoration of utility power:
 1. Synchronise generator(s) to the grid (The Contractor shall obtain the necessary permissions and minimum requirements from the supply authority).
 2. Transfer load back to mains.
 3. Cool down and shut down generator(s).

1.7.6.2 Load Selection and Control

- The Contractor shall configure a **priority-based load management system** to ensure that only designated essential equipment operates on emergency power.
- Control shall be exercised at MCC level using interlocks, PLC control signals, or networked I/O modules.
- Essential load examples:
 - Process PLCs and control panels
 - The drives indicated in the updated Polokwane WWTW Equipment List or by the mechanical contractor
 - Inlet and return pumps (one duty unit per process stream)
 - Critical instrumentation, lighting, and communication systems
- The system shall prevent backfeeding, cross-coupling, or simultaneous energisation of non-permitted loads.

1.7.6.3 Communication

- Control and monitoring integration via **TCP/IP Ethernet** using **Modbus TCP/IP, Profinet, or Ethernet/IP**, compatible with plant PLC architecture.
- SCADA shall display generator parameters, breaker positions, alarms, and available load capacity.
- Time-stamped event and fault logging shall be provided in both local and remote systems.

1.7.7 Protection and Safety

- Generator and switchgear protection shall include:
 1. Overcurrent, earth fault, over/under voltage, over/under frequency
 2. Reverse power, loss of excitation, differential protection (where applicable)
 3. Interlocks to prevent paralleling with utility supply unless explicitly designed for grid synchronisation. **See paragraph 1.7.6.1 above.**
- All circuits shall comply with **SANS 10142-2** for MV safety requirements.
- Earth fault protection coordination shall ensure selectivity across MV and LV tiers.
- Emergency stop pushbuttons shall be provided at the generator enclosure, MV switch room, and control room.

1.7.8 Environmental and Mechanical Requirements

- Enclosures rated minimum **IP54 (indoor)** and **IP65 (outdoor)**.
- Structural components hot-dip galvanised or stainless steel for corrosion resistance.
- Ventilation and exhaust systems designed for 40°C ambient and high humidity.

- Acoustic treatment to limit noise to ≤ 75 dB(A) at 7 m.
- Diesel day tank with bunded containment and level monitoring.

1.7.9 Testing and Commissioning

1.7.9.1 Factory Tests

- Type and routine tests per **IEC 60034, 62271, and ISO 8528**.
- Verification of control and communication functionality.

1.7.9.2 Site Tests

- Insulation, continuity, and protection relay testing.
- **Full** functional test including automatic start, MV coupling, and MCC load sequencing.
- **Simulated** mains fail and return scenarios.
- Measurement of voltage, frequency, and total harmonic distortion (THD $\leq 5\%$).
- Integration and SCADA communication verification.

1.7.9.3 Documentation

- As-built single-line diagrams and control logic drawings.
- Generator sizing and load analysis report.
- Relay settings and coordination studies.
- Factory and site test reports.
- **Operation** and maintenance manuals.

1.7.10 Training, Spares, and Warranty

- Comprehensive on-site training for plant maintenance staff.
- Supply of spare filters, fuses, relays, control modules, and fans per generator type.
- Warranty: Minimum 24 months from commissioning or 12 months from handover, whichever is later.
- Supplier must have an established service presence in South Africa.

1.7.11 Acceptance

Final acceptance shall be based on:

- Successful performance of all functional and integration tests.
- Review and approval of all documentation; and
- Compliance with this specification and applicable SANS/IEC/ISO standards.

1.8 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS FOR CONTROL & INSTRUMENTATION

The UPS systems shall form part of the plant's overall emergency power philosophy and shall operate seamlessly in conjunction with the **centralised MV-coupled standby generator system**.

A distributed UPS systems shall be provided which shall at minimum power all control systems and instrumentation and any system that would fail during the start-up of standby generator systems

1.8.1 Scope

This section defines the minimum technical and design requirements for the **Uninterruptible Power Supply (UPS)** systems that shall provide continuous, clean, and stable power to all **plant control systems, SCADA servers, PLCs, communication equipment, and critical instrumentation**.

1.8.2 Applicable Standards

All equipment and installations shall comply with the latest editions of the following standards (or approved equivalents):

- **SANS/IEC 62040-1:** General and safety requirements for UPS
- **SANS/IEC 62040-3:** Method of specifying performance and test requirements
- **SANS 10142-1:** Low-voltage electrical installations
- **IEC 61000-4 series:** Electromagnetic compatibility (EMC)
- **IEC 60950 / IEC 62368:** Safety for IT and communication equipment
- **IEEE 446:** Emergency and standby power systems
- **SANS 1464:** Safety performance standards for electrical equipment

1.8.3 System Description

The UPS systems shall supply **no-break power** to all designated **control panels, PLC racks, operator workstations, SCADA servers, critical field instruments, and network switches**.

Each UPS system shall be designed for:

- Continuous online operation.
- Automatic transfer to battery upon mains supply failure; and
- Seamless return to normal operation upon restoration of stable input power.

UPS units shall be located in **dedicated, temperature-controlled electrical rooms/MCC Compartments** and sized with sufficient autonomy to maintain control and instrumentation systems during:

1. Mains failure detection, generator start-up, and stabilisation (typically ≥ 15 minutes), and
2. Controlled process shutdown in the event of prolonged outages.

1.8.4 System Configuration

1.8.4.1 UPS Topology

- **True Online Double Conversion (VFI)** type complying with IEC 62040-3, Class 1 performance.
- Static bypass line for maintenance and overload conditions.
- Hot-swappable battery modules where feasible.
- Scalable modular design for redundancy (N+1 recommended for critical control systems).

1.8.5 System Rating and Autonomy

Parameter	Requirement
Nominal voltage	230 V AC, single-phase (control systems) / 400 V AC, 3-phase (server or network systems)
Frequency	50 Hz $\pm 1\%$
Output voltage regulation	$\pm 1\%$ steady state
Output frequency regulation	$\pm 0.1\%$ (on inverter)
Crest factor	Minimum 3:1
Efficiency	$\geq 90\%$ (AC-AC)
Overload capacity	125% for 10 min; 150% for 1 min
Harmonic distortion	THD $\leq 3\%$ at full load
Battery autonomy	Minimum 30 minutes full load (unless otherwise specified)

Design life of batteries	≥10 years at 25°C
Operating temperature	0°C – 40°C
Altitude	Up to 1,500 m without derating

1.8.6 Design and Installation Requirements

1.8.6.1 Redundancy and Segregation

- Each major process area (e.g. inlet works, biological treatment, sludge handling) shall be served by an independent UPS circuit.
- Redundant UPS units (N+1 or dual-fed systems) shall be provided for plant-wide SCADA and communication servers.
- UPS output distribution boards shall be segregated from normal power DBs and labelled “UPS SUPPLY – CONTROL CIRCUITS ONLY”.

1.8.6.2 Earthing and Neutral

- UPS input, output, and bypass neutrals shall be solidly bonded and referenced to the main LV neutral-earth point.
- Output earth leakage protection shall be provided and coordinated with downstream devices.

1.8.6.3 Communication and Monitoring

- Each UPS shall include a network communication interface supporting **Modbus TCP/IP, SNMP, or Profinet** for integration into the plant SCADA system.
- SCADA displays shall show:
 1. Input/output voltage and current
 2. Load percentage
 3. Battery voltage, temperature, and autonomy time
 4. Alarm/fault status and event history
- Email/SMS alarm capability shall be configured for power events or battery faults.

1.8.7 Mechanical and Environmental Requirements

- Enclosures: minimum IP20 (indoor) or IP54 if located in dusty or damp environments.
- Cabinet material: powder-coated steel or stainless steel (for aggressive atmospheres).
- Cooling: forced-air cooling with temperature monitoring and fan failure alarm.
- Installation: free-standing floor-mounted or wall-mounted, easily accessible for maintenance.

1.8.8 Batteries

1.8.8.1 Type

- Maintenance-free VRLA (Valve-Regulated Lead-Acid) or Li-ion type batteries designed for float service.
- Each battery string shall include isolation, fuse protection, and monitoring capability.
- Battery cabinets shall be ventilated and located in a dry, temperature-controlled room.

1.8.8.2 Battery Monitoring

- Battery Management System (BMS) required for large UPS systems (>10 kVA).
- Real-time monitoring of individual cell voltage, temperature, and impedance.
- Alarms for cell failure, over-temperature, and end-of-life conditions.

1.8.9 Bypass and Maintenance

- UPS shall include a static bypass for automatic transfer in case of internal failure or overload.
- Manual maintenance bypass shall be provided to allow isolation and servicing without interrupting supply to critical loads.
- Transfer between inverter and bypass shall be uninterrupted (<4 ms).

1.8.10 Testing and Commissioning

1.8.10.1 Factory Tests

- Functional, insulation, and performance tests in accordance with IEC 62040-3.
- Verification of communication interface operation and alarm functions.

1.8.10.2 Site Tests

- Input/output voltage and frequency verification.
- Full discharge battery autonomy test at rated load.
- Integration test with plant PLC and SCADA system.
- Simulation of power failure and recovery scenarios.
- Verification of bypass operation and redundancy (if applicable).

1.8.10.3 Documentation

- Factory test certificates and QA documentation.
- Sizing calculations and battery discharge curves.
- As-built wiring diagrams, IP addresses, and network configurations.
- Operation, maintenance, and safety manuals.

1.8.11 Spares, Training, and Warranty

- Minimum 2-year warranty from commissioning.
- Supply of spare fans, filters, fuses, and communication modules.
- At least one spare battery string for systems >20 kVA.
- On-site training for maintenance personnel on operation and alarm interpretation.
- Local after-sales service and 24/7 technical support required within South Africa.

1.8.12 Acceptance Criteria

The UPS system shall be accepted upon:

- Successful completion of all factory and site acceptance tests.
- Demonstrated autonomy meeting or exceeding specified duration.
- Verified SCADA integration and alarm functionality; and
- Approval of as-built documentation and compliance certificates.

1.9 DISTRIBUTED CONTROL SYSTEM (DCS)

1.9.1 Scope

This section defines the minimum technical and design requirements for the **Distributed Control System (DCS)** to be implemented at the Polokwane Regional Wastewater Treatment Plant. The system shall provide **automatic control, monitoring, interlocking, data acquisition, and communication** for all process and utility systems as represented on the approved **Plant Piping and Instrumentation Diagrams (P&IDs)**.

The control system may be based on either:

- Distributed Programmable Logic Controllers (PLCs) located in each process area, or
- A central PLC with Remote Input/Output (RIO) facilities at major load centres and MCCs.

The DCS shall integrate seamlessly with the **SCADA, UPS, and Emergency Generator Systems**, forming a unified and reliable plant automation environment.

1.9.2 Applicable Standards

All equipment, software, and installation work shall comply with the latest editions of:

- IEC 61131 series – Programmable Controllers
- IEC 61158 / IEC 61784 – Fieldbus and Industrial Ethernet communication
- IEC 61508 / IEC 61511 – Functional safety and Safety Instrumented Systems
- IEC 60204-1 – Safety of machinery: Electrical equipment
- SANS/IEC 60529 – Degrees of protection (IP rating)
- IEC 61000 series – Electromagnetic compatibility (EMC)
- SANS 10142-1 – Low-voltage electrical installations
- SANS 10142-2 – Medium-voltage electrical installations
- SANS/IEC 62443 – Industrial communication networks – Cybersecurity
- ISA 5.1 / ISO 14617 – Instrumentation symbols and identification
- SANS 60079 series – Electrical equipment for use in hazardous areas (if applicable)

1.9.3 System Description

The Contractor shall design, supply, install, and commission a Distributed Control System providing comprehensive control and monitoring for all plant areas.

Each control function, interlock, and monitoring point shall correspond directly to the items and control loops shown on the **approved plant P&IDs**, as listed below: (After the Mechanical Contractor has further developed the contractor design portions of the plant the final updated P&IDs shall be submitted for approval)

Process Area	P&ID Drawing Numbers
Inlet Works	PK278 01 PRC DRG 1000 1001 – 1010
Primary Settling	PK278 01 PRC DRG 1000 2001 – 2004
Flow Balancing	PK278 01 PRC DRG 1000 3001
Biological Reactor	PK278 01 PRC DRG 1000 4001 – 4016
Secondary Settling	PK278 01 PRC DRG 1000 5001 – 5004
Sludge Handling	PK278 01 PRC DRG 1000 6001 – 6006
Sludge Dewatering	PK278 01 PRC DRG 1000 7001 – 7012
Chlorination	PK278 01 PRC DRG 1000 8001 – 8002

All control loops, I/O points, and tag numbers shall be derived directly from these drawings and verified against the final issued P&ID revisions.

1.9.4 System Architecture

1.9.4.1 Control Network

- Redundant industrial Ethernet backbone (1 Gbps minimum) interconnecting all PLCs, RIO panels, SCADA servers, and operator workstations.
- Network topology: redundant ring or star with dual-core switches, supporting automatic switchover upon link failure.
- Communication protocols: Profinet, Modbus TCP/IP, or Ethernet/IP, as required for MCC and field device integration.
- Managed, industrial-grade switches with SNMP and VLAN support for network segmentation and security.

1.9.4.2 Controller Configuration

- Either distributed PLCs per process area or a central PLC with RIO panels at load centres, subject to Engineer's approval.
- Each controller shall have local autonomy to maintain essential control in case of network interruption.
- All PLCs shall communicate over the redundant Ethernet backbone and be powered via UPS-supported circuits.
- Control functions and tag addressing shall reference the P&ID loop numbers for traceability.

1.9.4.3 SCADA Integration

- A central SCADA system shall provide operator supervision, control, data logging, alarms, and trending.
- Each graphic display shall replicate the corresponding P&ID layout, using identical tag numbers and signal naming conventions.
- To maintain clarity of the graphic displays, the amount of live data on a screen shall where possible be limited to 7 items and the screens shall be arranged in a hierarchy to achieve this.
- Alarm and interlock settings shall be consistent with P&ID-defined process control philosophy.

1.9.5 Control Philosophy

1.9.5.1 General

- All automatic control, interlocking, and safety functions shall be derived from and validated against the plant P&IDs and process design criteria.
- The Contractor shall develop **Functional Design Specifications (FDS)** for each process area based on the P&IDs listed above.
- Each signal, loop, and device identified on the P&IDs shall have a corresponding I/O point in the PLC I/O list and be represented on SCADA graphics.

1.9.5.2 Process Control

- Control functions shall include automatic start/stop, interlocks, permissives, and setpoint adjustments as defined per P&ID.
- Each motor control point shall integrate with the relevant MCC for start/stop commands and status feedback.
- Analogue control loops (e.g., flow, level, pressure, pH, dissolved oxygen) shall use PID control implemented in the PLC.
- Duty/standby sequencing shall be automatically managed by the PLC.

1.9.5.3 Local and Central Control

- Each process area PLC shall allow **local HMI** operation for maintenance and local control under SCADA supervision.
- In case of communication loss to the central SCADA, local control shall remain functional for critical processes (e.g., return activated sludge, aeration blowers).

1.9.5.4 Safety and Interlocking

- All interlocks shall be clearly shown and documented in the FDS and verified against P&IDs.
- Interlock failure or bypass shall be alarmed in SCADA.
- Emergency stop and hardwired interlocks shall override software control.

1.9.6 Hardware Requirements

1.9.6.1 PLCs

- Modular, rack-mounted, industrial PLCs rated for continuous operation in 0–50°C environments.
- CPU performance suitable for ≥10,000 I/O points with 20% spare capacity.
- Dual redundant power supplies and communication modules for critical systems.
- All digital and analogue I/O shall have 20% spare capacity for future expansion.
- Input: 24 VDC, optically isolated. Output: 24 VDC or relay. Analogue: 4–20 mA, 12–16-bit resolution.

1.9.6.2 RIO Panels

- RIO panels located at MCCs and major equipment areas.
- Fibre optic or shielded Ethernet link to main PLC.
- Panels rated IP65 (outdoor) or IP54 (indoor), fully labelled per P&ID tag numbers.

1.9.6.3 SCADA System

- Dual redundant SCADA servers (hot standby configuration).
- Operator workstations with dual monitors for process overview and diagnostics.
- Engineering workstation with full programming and configuration tools.
- Data historian for minimum 30 days of process data.
- UPS-backed power for all automation hardware.

1.9.7 Software and Programming

- PLC programming shall conform to **IEC 61131-3** using structured, documented code.
- Each tag shall include the P&ID reference number and description.
- The Contractor shall produce:
 - I/O lists cross-referenced to the P&IDs
 - Functional design and logic diagrams
 - Alarm and trip matrix
 - SCADA tag list and mimic graphics referencing P&ID layouts
- SCADA shall provide trends, alarms, and reports for all process values shown on the P&IDs.

1.9.8 Communication and Integration

- PLCs, MCCs, and SCADA interconnected via Ethernet (Profinet, Modbus TCP/IP, or Ethernet/IP).
- The plant network implemented shall be a common TCP/IP based network for SCADA, control and field devices to facilitate easy expansion and communication.
- The plant network hardware shall be certified to natively handle the relevant Ethernet based protocol chosen for the site (ProfiNet, Modbus TCP, Ethernet/IP etc.)
- Field devices may use Profibus DP, Modbus RTU, or HART via appropriate I/O modules.
- Integration with power, UPS, and generator control systems over TCP/IP.
- Cybersecurity measures to include user authentication, network segmentation, and access control per IEC 62443.

1.9.9 Testing and Commissioning

1.9.9.1 Factory Acceptance Tests (FAT)

- I/O simulation and full functional testing per P&IDs and FDS.
- Verification of communication and failover performance.

1.9.9.2 Site Acceptance Tests (SAT)

- I/O loop checks from field device to SCADA.
- Functional testing of all control loops, interlocks, and alarms per P&IDs.
- Demonstration of network redundancy and UPS-backed operation.

1.9.10 Documentation

- As-built I/O lists, logic diagrams, and network drawings.
- Updated SCADA screen captures reflecting final P&ID layouts.
- Software backups and source code.

1.9.11 Training, Spares, and Warranty

- Formal training for operations and maintenance personnel.
- Spare PLC and RIO modules, communication cards, and switches.
- Warranty: minimum 24 months from commissioning or 12 months from handover, whichever is later.
- Local technical support and spare parts availability in South Africa.

1.9.12 Acceptance

The DCS shall be accepted after:

- Successful FAT and SAT execution.
- Verification that all control functions correspond to the **P&IDs listed in Section 3**; and
- Approval of final documentation and software by the Engineer.

1.10 CONTROL SYSTEM ARCHITECTURE NARRATIVE

This section must be read with section 9 above.

1.10.1 Overview

The Distributed Control System (DCS) for the Wastewater Treatment Plant shall provide an integrated, reliable, and modular control platform that enables centralised supervision, distributed control autonomy, and full visibility of all plant process functions as defined in the plant P&IDs (Ref. paragraph 1.9.3 above.).

The DCS architecture shall comprise a **hierarchical, Ethernet-based control network** consisting of **area-based PLCs or Remote I/O (RIO) panels** located at each major process area, **Motor Control Centres (MCCs)**, and a **central SCADA system** located in the plant control room.

All control; monitoring, interlocking, and alarm functions shall directly correspond to the plant's functional intent as shown on the following P&ID drawing packages:

Process Area	P&ID Drawing Numbers
Inlet Works	PK278 01 PRC DRG 1000 1001 – 1010
Primary Settling	PK278 01 PRC DRG 1000 2001 – 2004
Flow Balancing	PK278 01 PRC DRG 1000 3001

Biological Reactor	PK278 01 PRC DRG 1000 4001 – 4016
Secondary Settling	PK278 01 PRC DRG 1000 5001 – 5004
Sludge Handling	PK278 01 PRC DRG 1000 6001 – 6006
Sludge Dewatering	PK278 01 PRC DRG 1000 7001 – 7012
Chlorination	PK278 01 PRC DRG 1000 8001 – 8002

1.10.2 System Topology

The control network shall adopt a **redundant Ethernet ring topology**, connecting all PLCs, RIO panels, and the SCADA servers through industrial-grade managed switches. Each process area shall contain one or more control nodes (PLC or RIO panel) interfaced locally with MCCs and field instruments.

- **Primary Network:** 1 Gbps industrial Ethernet backbone, fibre optic medium, forming a redundant ring between all control panels and the control room.
- **Secondary Network:** Local copper Ethernet connections between MCC-mounted PLCs/RIOs and associated field I/O or local HMIs.
- **Fieldbus Layer:** Profibus DP, Modbus RTU, or HART protocols as required for variable speed drives (VSDs), instruments, and intelligent motor starters.

Network segmentation and VLANs shall be used to separate control traffic, SCADA data, and maintenance access to enhance cybersecurity and performance.

1.10.3 Control Node Allocation

Each process area shall be assigned a dedicated control node as follows:

Process Area	Control Node	Function
Inlet Works	PLC-INL or RIO-INL	Control of inlet screens, grit removal, and flow measurement.
Primary Settling	PLC-PRM	Control of sludge draw-off valves, scum pumps, and level instrumentation.
Flow Balancing	RIO-FLB	Monitoring and control of balancing tanks and transfer pumps.
Biological Reactor	PLC-BIO	Process control of aeration blowers, DO and MLSS control loops, internal recycle pumps, and selector zones.
Secondary Settling	RIO-SEC	Control of return activated sludge (RAS) and waste activated sludge (WAS) pumps.
Sludge Handling	PLC-SLG	Control of thickening, digestion, and transfer systems.
Sludge Dewatering	PLC-DWR	Interlocks with centrifuges, polymer systems, and conveyors.
Chlorination	RIO-CLN	Control of dosing pumps, analysers, and contact tank flow control.

Each PLC or RIO shall provide direct I/O interfaces to local instruments, actuators, and MCC starter signals as indicated on the respective P&IDs.

1.10.4 MCC and Electrical Integration

Each MCC shall contain communication-capable motor starters and VSDs integrated via Ethernet-based fieldbus (Profinet, Modbus TCP/IP, or Ethernet/IP) to the respective area PLC.

Control and feedback signals (start/stop, status, fault, current, and speed reference) shall be exchanged digitally. Each MCC shall have a **local HMI or operator station** allowing local/remote selection and status indication.

All MCCs shall report to the SCADA system via their associated PLCs, with interlocks and permissives enforced per the P&ID control logic.

1.10.5 SCADA and Central Control Room

The SCADA system, installed in the main control room, shall form the upper supervisory layer of the control architecture.

- Dual redundant SCADA servers shall communicate with all PLCs and RIOS over the control network.
- Operator workstations shall provide process graphics replicating the layouts and tag references of the P&IDs.
- Historical trending, alarm management, and event logging shall be fully integrated and accessible to authorised personnel.
- The system shall allow operator intervention at central or local level under controlled access and with full audit trail functionality.

1.10.6 Power Supply and Reliability

All PLCs, communication switches, and SCADA servers shall be powered from UPS-backed supplies to maintain continuous operation during power interruptions. Essential MCCs and PLCs associated with critical processes (e.g., aeration blowers, RAS pumps, chlorination) shall remain operational under emergency generator power as defined in the **Emergency Backup Power System Section of this specification** (Paragraph 1.7 above).

Each control node shall retain local control autonomy for its process area during communication loss to the central system.

1.10.7 Functional Design Basis

- All control loops, interlocks, and sequencing shall be derived directly from the referenced P&IDs.
- Tag naming, loop identification, and software documentation shall match P&ID numbering conventions.
- Each PLC program shall include functional blocks corresponding to each P&ID loop, enabling clear traceability from field device to logic and SCADA display.
- The Contractor shall develop **Functional Design Specifications (FDS)** for each process area, referencing the applicable P&ID drawings and control philosophy.

1.10.8 Cybersecurity and Access Control

- All network devices shall implement password protection, user authentication, and role-based access levels.
- The control network shall be isolated from external IT networks except at controlled gateways with firewalls.
- The Contractor shall ensure compliance with **SANS/IEC 62443** standards for industrial control system cybersecurity.

1.10.9 Documentation and Handover Requirements

At completion, the Contractor shall submit:

- Updated system architecture drawings showing network topology and PLC/RIO interconnections.
- Cross-referenced I/O lists mapped to the P&ID loop numbers.
- Final SCADA graphics with P&ID-based screen navigation.
- Software backups for all PLCs and SCADA servers; and

- Operation and Maintenance manuals including configuration details, user access procedures, and diagnostic tools.

1.10.10 Summary of Functional Integration

The completed DCS architecture shall ensure that:

- Every device and loop depicted on the P&IDs is represented in both PLC control logic and SCADA graphics.
- MCCs, field instruments, and actuators operate seamlessly under the DCS hierarchy.
- Control remains distributed and resilient under communication or power interruptions.
- Operators have intuitive, P&ID-based visibility and control of all plant processes from the central control room.

1.11 ACCESS CONTROL AND CCTV SYSTEM

1.11.1 Scope

This section of the specification defines the minimum design, supply, installation, integration, and commissioning requirements for the **Access Control and Closed-Circuit Television (CCTV) System** at the Polokwane Regional Wastewater Treatment Plant.

The purpose of this system is to:

- Provide controlled access to all plant buildings, switch rooms, MCC rooms, and operational areas.
- Record and monitor activities in **critical process and security-sensitive areas**.
- Interface with the plant's **Distributed Control System (DCS)** and **SCADA** for event indication and alarm notification.
- Ensure safety, operational oversight, and compliance with security requirements of the Employer.

The system shall be **contractor-designed**, ensuring full coverage of all access points and process areas as identified in the plant layout and P&IDs.

1.11.2 Applicable Standards

All equipment and installation work shall comply with the latest editions of:

- **SANS 50132 / IEC 62676** – CCTV Surveillance Systems
- **SANS 60839-11** – Electronic Access Control Systems
- **SANS 10142-1** – Electrical Installations (Low Voltage)
- **SANS 10287** – CCTV System Installation Code
- **SANS 164** – Plug and Socket-outlet Standards
- **SANS/IEC 62443** – Industrial Cybersecurity
- **PoPIA (Act No. 4 of 2013)** – Protection of Personal Information Act (data privacy and video retention)
- **ISO/IEC 27001** – Information Security Management
- Occupational Health and Safety Act (Act 85 of 1993)

1.11.3 System Overview

The system shall consist of two integrated subsystems:

1.11.3.1 Access Control System (ACS):

- Electronic control of personnel entry/exit to the works and designated areas using card readers, keypads, or biometric devices.
- Centralised event logging and management through an Access Control Server.
- Local control panels at each building with fail-safe door release on power loss or fire alarm activation.

1.11.3.2 CCTV Surveillance System:

- High-definition IP-based video surveillance of process and security zones.
- Real-time monitoring via the control room and event-driven recording on Network Video Recorders (NVRs).
- Integration with the ACS and SCADA for event-linked video pop-up, alarm tagging, and historical playback.

1.11.4 Design Requirements

- The Contractor shall design the system layout based on the **plant general arrangement drawings, P&IDs, and security risk assessment**.
- The system shall ensure full coverage of all **critical process areas**, including:
 - Inlet works and screen channels
 - Biological reactor basins and blower buildings
 - MCC rooms and control buildings
 - Sludge handling and dewatering areas
 - Chlorination and chemical storage facilities
 - Site perimeter entrances and vehicle access points
- All equipment shall be **industrial-grade** and suitable for the **outdoor wastewater environment** (minimum IP65 for cameras and access devices located outdoors).

1.11.5 Access Control System

1.11.5.1 Equipment and Operation

- **Door Controllers:** Intelligent, networked door controllers capable of standalone operation during communication loss.
- **Reader Devices:** Proximity card readers or biometric scanners compatible with the Employer's standard.
- **Locking Devices:** Fail-safe electromagnetic locks with mechanical override and local emergency release.
- **Power Supply:** 24 VDC with UPS backup for a minimum of 4 hours.
- **Enclosures:** Stainless steel or powder-coated steel, minimum IP54 (indoor), IP65 (outdoor).
- **Entry/Exit Logging:** All access transactions shall be recorded with date/time, user ID, and location.

1.11.5.2 Integration

- The ACS shall integrate with the **SCADA system** to indicate door open/closed status, forced entry, or system fault alarms.
- Events such as forced entry or unauthorised access shall automatically trigger corresponding CCTV camera recording and alarm display in the control room.
- Access permissions shall be centrally managed through a password-protected database with role-based user profiles.

1.11.6 CCTV System

1.11.6.1 Cameras and Coverage

- Cameras shall be **IP-based**, minimum **1080p (2 MP)** resolution, with **infrared illumination** for night operation.
- All cameras shall support **H.265 encoding**, PoE power, and ONVIF-compliant communication.
- Typical camera types:
 - Fixed dome or bullet cameras for process areas.
 - PTZ (pan-tilt-zoom) cameras for perimeter and large outdoor zones.
 - Explosion-proof housings where applicable.
- Each camera location shall be selected to ensure clear visibility of entry points, operator walkways, and critical equipment.

1.11.6.2 Recording and Storage

- **Network Video Recorders (NVRs):** Redundant, rack-mounted, industrial-grade.
- **Storage Capacity:** Minimum 30 days continuous recording retention at full frame rate and resolution.
- **Video Management System (VMS):**
 - Centralised monitoring and playback software accessible from the control room.
 - Event-driven recording triggered by motion, access control events, or SCADA alarms.
 - Operator-defined user levels for viewing and export.
- **Display:** Live video wall or dual-monitor workstation in the control room, with layout corresponding to plant zones per P&IDs.

1.11.7 Communication and Networking

- All access control panels, readers, and IP cameras shall communicate over the **plant's Ethernet backbone** using dedicated VLANs for security systems.
- Fibre optic backbone connection between major plant areas; Cat6A cabling for local camera and access device connections.
- Managed network switches rated for industrial environments (minimum 0–50°C).
- Network design shall ensure redundancy and prevent single-point failures.

1.11.8 Power Supply and UPS Integration

- All ACS and CCTV components shall be powered through dedicated distribution boards with UPS backup supply (minimum 4 hours).
- Power over Ethernet (PoE) switches shall include surge protection and overload isolation.
- Power supplies and backup arrangements shall comply with the **UPS System Specification**.

1.11.9 Software and Integration

- The Access Control and CCTV systems shall be **integrated on a single management platform** or interoperable software environment.
- Both systems shall communicate with the SCADA via TCP/IP for alarm signalling, event logs, and camera pop-up functionality.
- Software licenses shall be **perpetual**, with provision for future expansion and integration of additional devices.
- The Contractor shall provide all programming, configuration, and commissioning to achieve full operational functionality.

1.11.10 Testing, Commissioning, and Training

1.11.10.1 Factory Acceptance Tests (FAT)

Equipment verification, network configuration checks, and functional testing of integration between ACS and CCTV subsystems.

1.11.10.2 Site Acceptance Tests (SAT)

- Verification of camera coverage and image quality under normal and low-light conditions.
- Door operation, access permissions, and alarm testing.
- End-to-end integration verification with DCS/SCADA (event-linked video).

1.11.10.3 Training and Documentation

- Operator and maintenance staff shall receive full system training, including software management and data retrieval.

- The Contractor shall provide:
 - As-built drawings (layouts, network topology, cable routing)
 - Equipment schedules
 - Configuration and user manuals
 - Software backups and access credentials

1.11.11 Warranty and Support

- Minimum warranty period: **24 months** from final commissioning.
- Local technical support and spare parts availability in South Africa required.
- The Contractor shall offer optional service and maintenance contracts post-warranty, including software updates and periodic system checks.

1.11.12 Acceptance Criteria

Final acceptance of the Access Control and CCTV System shall be contingent upon:

- Verified coverage and functionality per the approved design.
- Demonstrated integration with SCADA and DCS systems.
- Submission and approval of all final documentation and system credentials.
- Successful completion of all FAT and SAT protocols to the Engineer's satisfaction.

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

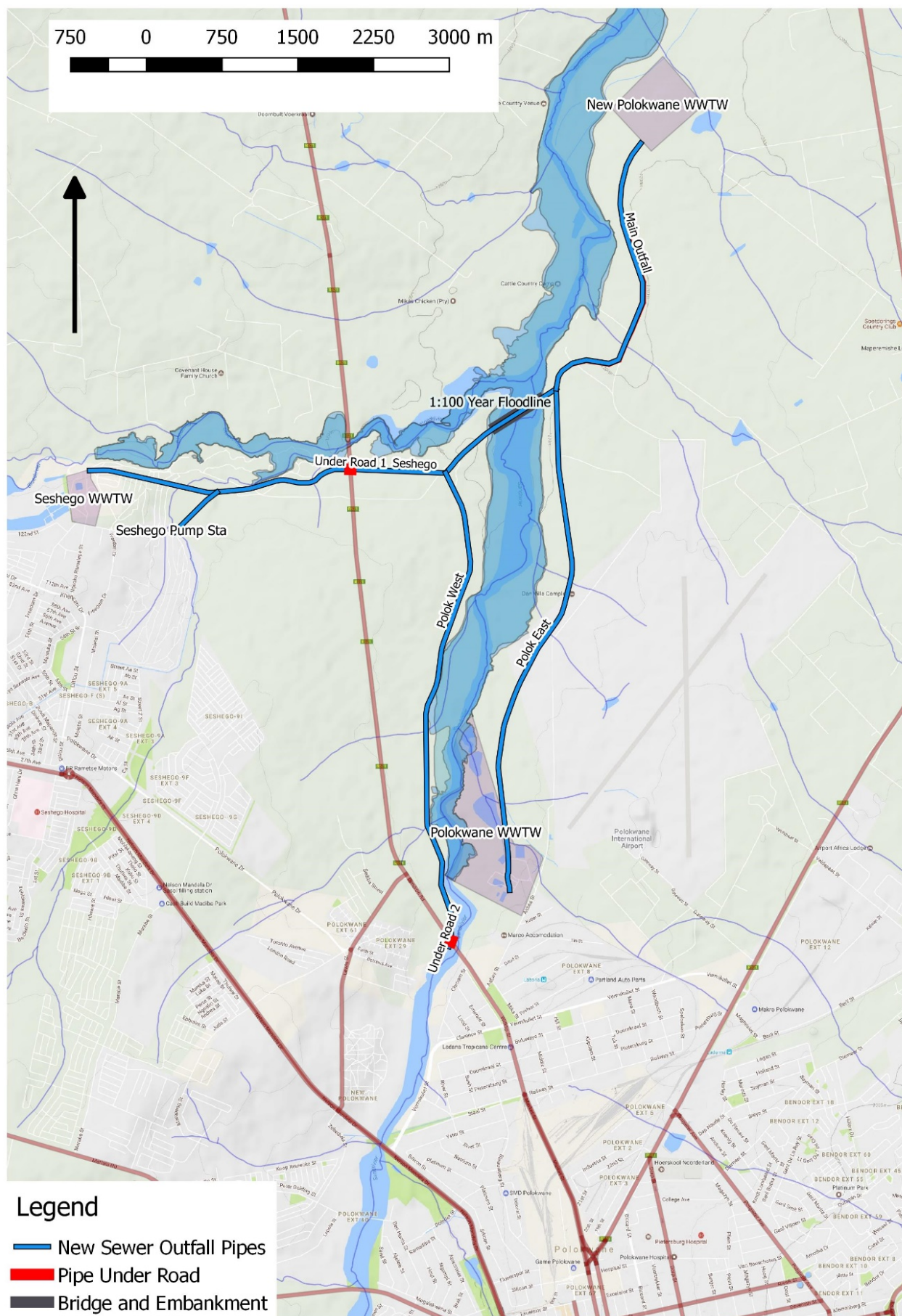
C4: SITE INFORMATION

C4.1 LOCALITY MAP

C4.2 GEOLOGICAL INVESTIGATION

C4.3 GEOHYDROLOGICAL STATUS REPORT

C4.1 LOCALITY MAP



C4.2 GEOLOGICAL INVESTIGATION

C4.3 GEOHYDROLOGICAL STATUS REPORT

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

PART C5 ANNEXURES

C5.1 WATER USE LICENSE

C5.2 ENVIRONMENTAL MANAGEMENT PLAN

C5.3 OHS SPECIFICATION

C5.4 ENVIRONMENTAL AUTHORISATION

C5.5 MECHANICAL DATASHEETS

C5.6 ELECTRICAL DATASHEETS

C5.7 OPERATION AND MAINTENANCE DATA

C5.8 DRAWINGS

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.1 WATER USE LICENSE

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.2 ENVIRONMENTAL MANAGEMENT PLAN

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.3 OHS SPECIFICATION

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.4 ENVIRONMENTAL AUTHORISATION

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.5 MECHANICAL DATASHEETS

FORM AT1 MECHANICAL DATASHEETS

1. INTRODUCTION

- a) Only Plant based on proven technology and of high reliability shall be considered for use.
- b) All Schedules shall be fully completed in block letters using a black pen or typing. Failure to complete all relevant sections may result in the Tender being rejected and/or disqualified, as per the evaluation procedure in Part T1.3 [Tender Data].
- c) Preference shall be given to locally manufactured Plant and components. Should items not be locally manufactured, Tenderers shall clearly identify these in their Tender.
- d) Tenderers shall ensure that they are fully acquainted with the contents of the Mechanical Specifications.
- e) The Contractor shall indicate, at tender stage, all variations from the Specification.
- f) The Corrosion Protection Systems offered shall be clearly identified by the Tenderers.
- g) The costs for quality control shall be included in the tendered rates.
- h) Tenderers shall ensure that the proposed Plant will fit into the spaces provided prior to submission of the Tender. Any alteration required for specific Plant shall be submitted with the Tender. If no information is received with the Tender, it will be assumed that the building, space or panel will accommodate the Plant offered.
- i) All Schedules concerning Plant incorporating proprietary brand products or units, shall be fully supplemented by the inclusion of applicable brochures, pamphlets, additional explanatory specifications, descriptions or notes in that order of availability and shall be submitted with the bid in a covering letter and bound separately.
- j) The Tenderer shall complete the Schedules giving details of suppliers of Plant.
- k) Where Tenderers wish to bring special characteristics of Plant offered to the attention of the Engineer, Tenderers shall supply descriptive literature and brochures to supplement information in the Schedules.
- l) Where the Specification calls for specific makes and types of Plant, the Tendered prices shall be based on such Plant.
- m) The Tenderer shall confirm that the materials specified are suitable for the water quality, both in terms of chemical analysis and sediment content. If unable to provide this written assurance, the Tenderer shall confirm this and propose possible alternative materials and supply details in a letter accompanying his Tender.
- n) In order to avoid expiry of the guarantee while Plant are still in storage prior to installation, the Employer will request the reinstatement of the guarantee at final commissioning of the plant. Tenderers are to make allowance within the Tender sum for the cost of reinstating the guarantee as per original Tender. No additional payment for such reinstatement will be made.
- o) To promote reinstatement, the Tenderer shall, together with his offer, provide the requirements for storage of the plant, prior to installation, in order for him to honour the implementation of the guarantee at a later stage.

- p) The Tenderer shall be deemed to have taken into account, inter alia, all of the operating requirements and physical conditions in preparing his Tender in addition to the operating and climatic conditions prevailing at the Site as set out in the Scope of Works in Part C3.1. Evidence satisfactory to the Engineer shall be provided that the designs offered will meet the design and operating criteria given in the following sections/paragraphs over the design life of the project (20 years).
- q) The Tenderer must immediately bring any discrepancies or misunderstandings, which may cause any doubts, regarding the requirements of the tender documents to the attention of the Engineer. No claims due to any discrepancies or misunderstandings will be valid after the Tender closing date.

DATASHEET AT1:AW:01

Reactor Outflow – Adjustable Weir

Equipment Tag:

01-BR-01-AW-01

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:	-	
Mount type:	Channel	
Method of operation:	Hand Operated	
Gate Size (mm x mm)	5000 x 1370	
Concrete invert to top of weir when fully closed	750	
Platform above invert of concrete	1715	
Min Gate Travel (m):	600	
Handwheel above platform	1100	
Material of frame:	304L S.S	
Material of door:	304L S.S	
Material of handwheel:	304L S.S	
Material of fasteners:	304L S.S	
Mass (kg):	-	
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1:AW:02

WAS Draw Off Basin 05– Adjustable Weir

Equipment Tag: 01-BR-01-AW-01

Number of Equipment Type: 2

Parameter	Required	Offered
Make & model:	-	
Mount type:	Channel	
Method of operation:	Hand operated	
Gate Size (mm x mm)	4400 x 1370	
Concrete invert to top of weir when fully closed	750	
Platform above invert of concrete	1470	
Min Gate Travel (m):	600	
Handwheel above platform	1100	
Material of frame:	304L S.S	
Material of door:	304L S.S	
Material of handwheel:	304L S.S	
Material of fasteners:	304L S.S	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1:AW:03

WAS Draw Off Basin 12– Adjustable Weir

Equipment Tag: 01-BR-01-AW-02

Number of Equipment Type: 2

Parameter	Required	Offered
Make & model:	-	
Mount type:	Channel	
Method of operation:	Hand operated	
Gate Size (mm x mm)	4400 x 1715	
Concrete invert to top of weir when fully closed	750	
Platform above invert of concrete	1470	
Min Gate Travel (m):	600	
Handwheel above platform	1100	
Material of frame:	304L S.S	
Material of door:	304L S.S	
Material of handwheel:	304L S.S	
Material of fasteners:	304L S.S	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1:AW:03

Reactor Basin 11 to 12 – Adjustable Weir

Equipment Tag:

01-BR-01-AW-04

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:	-	
Mount type:	Channel	
Method of operation:	Hand Operated	
Gate Size (mm x mm)	1200 x 200	
Concrete invert to top of weir when fully closed	200	
Platform above invert of concrete	1715	
Min Gate Travel (m):	200	
Handwheel above platform	1100	
Material of frame:	304L S.S	
Material of door:	304L S.S	
Material of handwheel:	304L S.S	
Material of fasteners:	304L S.S	
Mass (kg):	-	
County of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: DR:01

Instrumentation Air Dryer

Equipment Tag:

01-DW-01-DR-01, 01-DW-01-DR-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:	-	
Type:	-	
Site maximum temperature (°C):	40	
Site minimum temperature (°C):	0	
Operating temperature (°C):	-	
Air quality Requirement:	-	
Maximum Working Pressure (bar):	-	
Air treatment Capacity (m3/h):	-	
Nominal electrical Power:	-	
Connection Size (Inlet/Outlet):	-	
Unit Dimensions (L x W x H):	-	
Refrigerant Type:	-	
Refrigerant Quantity:		
CO2 equivalent:		
Pressure dewpoint (°C):	-	
Maximum Pressure Dew Point (°C):	-	
Maximum oil Content (droplets, aerosols, and vapor) (mg/m3):	-	
Mass (kg):	-	

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: AR:01

Inlet Works – Air Receiver

Equipment Tag:

01-IW-01-TK-01, 01-IW-01-TK-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Maximum Operating Pressure (kPa):	800	
Design Pressure (kPa):	1 000	
Diameter (mm):		
Height (mm):		
Capacity (litres):	240	
Operating temperature range:		
Body Material:		
Description Connection points and sizes:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: AR:02

Instrumentation Air – Air Receiver

Equipment Tag:

01-DW-01-TK-02, 01-DW-01-TK-03

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Maximum Operating Pressure (kPa):	800	
Design Pressure (kPa):	1 000	
Diameter (mm):		
Height (mm):		
Capacity (litres):	240	
Operating temperature range:		
Body Material:		
Description Connection points and sizes:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: SR:01

Air Scrubber & Blower– Chlorine Building

Equipment Tag:

01-MP-01-SR-01, 01-MP-01-BL-01

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:		
Type and design:	Dry Media	
Removal Efficiency:		
Air Flow Capacity:	65 Air Changes (High Pressure room 12.5m x 7.8m x 3.5m) (Low Pressure Room 4.6m x 3.0m x 3.5m)	
Max Pollutant Loading (kg/hr):		
Stack Height:		
Stack Diameter:		
Inlet Connection:		
Mass (kg):		
Country of manufacture:		
BLOWER		
Blower Type:		
Make & model:		
Motor power rating (kW):		
Gearbox make and model:		
Gearbox service factor:		
Gearbox power rating (kW):		
Gearbox ratio:		
Max Safe Blower turn down:		

Parameter	Required	Offered
Maximum Delivery Temperature:		
Maximum Delivery Pressure:		
Number of Blowers:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: XP:01

R-Recycle – Axial Pumps

Equipment Tag:

01-BR-01-XP-07, 01-BR-01-XP-08, 01-BR-01-XP-09

Number of Equipment Type:

3

Parameter	Required	Offered
Make, model and type:	-	
Maximum head capability (m):	-	
Design flow and head at best efficiency (l/s @ m - l/s @ m):	231.5 @ 0.7m – 231.5 @ 1.5m	
Flow and head range (l/s - l/s):	231.5	
Design power demand (kW):	-	
Motor rating (kW):	-	
Inlet diameter (mm):	650	
Draft Tube Diameter (mm):	650	
Draft Tube length (mm):	2000	
Solids Handling (mm):	75	
Impeller diameter (mm):	-	
Maximum shaft speed to perform specified duties:	-	
Minimum shaft speed to perform specified duties:	-	
Maximum submergence required for range of duties specified:	-	
Corrosion protection (description of coats and thickness):	-	
Mass(kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: XP:02

R-Recycle – Axial Pumps

Equipment Tag:

01-BR-01-XP-01, 01-BR-01-XP-02, 01-BR-01-XP-03, 01-BR-01-XP-04,
01-BR-01-XP-05, 01-BR-01-XP-06

Number of Equipment Type:

6

Parameter	Required	Offered
Make, model and type:	-	
Maximum head capability (m):	1.0	
Design flow and head at best efficiency (l /s @ m):	231.5 @ 0.7m – 231.5 @ 1.5m	
Flow and head range (l /s - l /s):	231.5	
Draft Tube Length (mm):	2000	
Draft Tube diameter (mm):	650	
Design power demand (kW):	-	
Motor rating (kW):	-	
Inlet diameter (mm):	650	
Impeller diameter (mm):	-	
Solids Handling (mm):	75	
Maximum shaft speed to perform specified duties:		
Minimum shaft speed to perform specified duties:	-	
Maximum submergence required for range of duties specified:	-	
Corrosion protection (description of coats and thickness):	-	
Mass(kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: XP:02

Belt Filter Press – Sludge Dewatering

Equipment Tag:

01-DW-01-BF-01, 01-DW-01-BF-02, 01-DW-01-BF-03, 01-DW-01-BF-04, 01-DW-01-BF-05

Number of Equipment Type:

5

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
Digested WAS & Primary sludge (kg/hr)	460	
Hydraulic loading for Waste activate sludge & Primary sludge (m ³ /hr):	26	
Undigested Waste Activate Sludge (kg/hr)	360	
Hydraulic loading for Undigested Waste Activate Sludge (m ³ /hr):	7.2	
Digested Primary sludge (kg/hr)	480	
Hydraulic loading for Primary sludge (m ³ /hr):	54	
Effective Belt Width (m)	-	
Total Belt Width (m)	-	
Suspended solids in service water (mg/l)	25	
Service water flow requirements (l/s)		
Service water pressure Requirements (m)		
Minimum Dry solids content (%):	22% - Digested Sludge 20% - Waste Activated Sludge	
Filtrate TSS Content (mg/l)	< 500	
Belt speed: • Maximum belt linear speed (m/min) Minimum belt linear speed (m/min)		
Drainage areas: • Gravity drainage zone (m ²) • Wedge drainage zone (m ²) • Compression zone drainage (m ²)		
Tracking and tensioning:		

Parameter	Required	Offered
Tracking system (hydraulic or pneumatic)		
Method of tensioning cloth		
Air supply required (m ³ /min)		
Air supply pressure (kPa)		
FILTER CLOTH		
Manufacturer		
Model No.		
Cloth material and weave		
Cloth aperture		
WARP tensile strength (kN/mm)		
Width tensile strength (kN/mm)		
Joint type		
Clipper seam strength % WARP strength		
Normal cloth tension (kN)		
Maximum cloth tension (kN)		
Minimum cloth tension (kN)		
Life of belt (Hours)		
Belt cost (Rand)		
Dewatering rollers Drum Dia. and Shaft Dia. • First • Second • Third • Fourth • Fifth • Sixth • Seventh • Eight • Ninth		

Parameter	Required	Offered
• Tenth • Eleventh • Twelfth • Thirteenth • Fourteenth • Tension rollers • Tracking rollers • Idler rollers		
Total number of compression rollers (No.)		
Bearing type		
DOSING OF POLY ELECTROLYTE		
Mixer for dilution water Type:		
Mixer for dilution water Dimensions:		
Flocculation tank: • Volume of unit • Dimensions • Method of mixing • Motor power (kW) • Motor speed (rpm) Impeller type • Mixing shear (s-1)		
Dimensions of unit (L x W x H):		
Dry and Wet Mass (kg):		
MATERIALS		
Materials of Frame:		
Materials of Shafts:		
Materials of Enclosures:		
Materials of Covers:		
Materials of Flocculation tank:		
Materials of Flocculation mixer:		
Materials of Dilution water mixer:		
Materials of Mixer head (dilute poly/ sludge):		

Parameter	Required	Offered
Materials of Wash and filtrate trays:		
Materials of Wash water piping:		
Materials of Spray bars:		
Bearings Minimum Life (Hours):	100 000	
Wash water pipe work Material:	-	
Press Drive Unit:	-	
Press Fasteners Material:	304/316 Stainless steel	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):		
Gearbox ratio:		
Maximum noise at 1 meter:	84dBA	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CT:01

Ferric Chloride – Calibration Tube

Equipment Tag:

01-DW-01-CT-01

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:		
Type and design:		
Body Material:		
Volume Capacity:	10 Litre	
Marked Units:	Litre and Milliliters	
Dimensions (L x W x H):		
Unit Increments:	10 Milliliters	
Outlet Connection size:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CJ:01

Chemical Injector – Ferric Chloride

Equipment Tag:

01-SD-01-MJ-06

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:		
Type and design:		
Maximum Operating Pressure (m):	8	
Flow Range (l/hr – l/hr):	420 - 110	
Nozzle orifice (mm)		
Maximum Operating Temperature (°C)		
Discharge Port (NPT)		
Number of discharge Ports:		
Weight (kg)		
Dimensions (L x W x H)		

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: WC:02

Chemical Injector – Ferric Chloride

Equipment Tag:

01-SD-01-MJ-02, 01-SD-01-MJ-03, 01-SD-01-MJ-04

Number of Equipment Type:

3

Parameter	Required	Offered
Make & model:		
Type and design:		
Maximum Operating Pressure (m):	8	
Flow Range (m ³ /h – m ³ /h):	4 - 10	
Nozzle orifice (mm)		
Maximum Operating Temperature (°C)		
Discharge Port (NPT)		
Number of discharge Ports:		
Weight (kg)		
Dimensions (L x W x H)		
Manufacturer:		

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: CL:01

Chlorine Gas Chlorinator & Ejector - Disinfection

Equipment Tag:

01-MP-01-CL-01, 01-MP-01-CL-02, 01-MP-01-IJ-01, 01-MP-01-IJ-02

Number of Equipment Type:

4

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
Dosage Range (kg/hr):	0.5 - 10	
Operating Vacuum:	-	
Required injector vacuum:	-	
Accuracy at Maximum Flow (%):	-	
Accuracy at Maximum Flow (%):	-	
Max and Min Chlorinator flow required (l/s):	-	
• Vacuum meter: • Measuring range • Size • Accuracy • Load capacity of optional contacts	-	
Material in contact with media: • Plastics • Springs • Seal, diaphragms	-	
Ambient Temperature:	0 – 40 °C	
Air Humidity:	55 %	
VACUUM EJECTOR		
Dosing media	Cl ₂ Gas	
Source of feed water	Clarifier effluent	
Locomotive Water Supply Pressure (m)	30	
Locomotive Water Back Pressure (m)	1.0	
Operation type:	Open Tank	

Parameter	Required	Offered
Ejector locomotive flow (l/s)	-	
Nozzle:	-	
Throat:	-	
Ejector Body Material:	-	
Type, diameter and class of pipe used to convey: • Clarifier effluent • Gaseous Chlorine • Chlorine solution	-	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: BP:01

Grit Sparging - Compressor

Equipment Tag:

01-IW-01-BP-01, 01-IW-01-BP-02

Number of Equipment Type:

2

Parameter	Required	Offered
Maximum operating pressure:		
Model Type: (Air-cooled, oil-injected, oil-free, water cooled)		
Stages:	1	
Operating pressure (kPa):	1 000	
Maximum Full load operating pressure		
Maximum operating temperature:		
Suction nozzle diameter (mm):		
Delivery nozzle diameter (mm):		
Maximum flow rate (l/s)		
Driver method:		
Crankshaft material:		
Crosshead bearing:		
Compressor protection description:		
Control types:		
Noise level - dB(A) at 1m:		
Mass (kg):		
Country of Manufacture:		

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: BP:02

Instrumentation Air - Compressor

Equipment Tag:

01-DW-01-BP-01, 01-DW-01-BP-02

Number of Equipment Type:

2

Parameter	Required	Offered
Maximum operating pressure:		
Model Type: (Air-cooled, oil-injected, oil-free, water cooled)		
Stages:	1	
Operating pressure (kPa):	1 000	
Maximum Full load operating pressure		
Maximum operating temperature:		
Suction nozzle diameter (mm):		
Delivery nozzle diameter (mm):		
Maximum flow rate (l/s)		
Driver method:		
Crankshaft material:		
Crosshead bearing:		
Compressor protection description:		
Control types:		
Noise level - dB(A) at 1m:		
Mass (kg):		
Country of Manufacture:		

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: DP:01

Ferric Chloride Dosing Pumps

Equipment Tag:

01-DW-01-DP-01, 01-DW-01-DP-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Minimum Flow rate (l/hr)	110	
Head at minimum Flow rate (m)	8.0	
Maximum Flow rate (l/hr)	420	
Head at maximum Flow rate (m)	8.0	
Maximum dynamic viscosity of solution Which can be pumped at maximum feed rate (Pa.s)	Ferric Chloride 43%	
Manufacturer of motor:		
Continuous maximum motor rating (kW):		
Motor class of insulation (explosion proof?):		
Pump Type (Piston/ Diaphragm):	-	
Diaphragm diameter (mm):	-	
Reduction Ratio (stroke/min):	-	
Martial of Body:	-	
Martial of Piston:	-	
Martial of Piston gaskets:	-	
Martial of Valve:	-	
Martial of Valve seat:	-	
Volume of Internal Bund Area incorporated in dosing station (ℓ):	1 000	

Parameter	Required	Offered
Volume of External Bund Area incorporated in dosing station (ℓ):	10 000	
Mass (kg):	-	
Country of Manufacture:		

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: BP:01

Grit Sparging - Compressor

Equipment Tag:

01-IW-01-BP-01, 01-IW-01-BP-02

Number of Equipment Type:

2

Parameter	Required	Offered
Maximum operating pressure:		
Model Type: (Air-cooled, oil-injected, oil-free, water cooled)		
Stages:	1	
Operating pressure (kPa):	1 000	
Maximum Full load operating pressure		
Maximum operating temperature:		
Suction nozzle diameter (mm):		
Delivery nozzle diameter (mm):		
Maximum flow rate (l/s)		
Driver method:		
Crankshaft material:		
Crosshead bearing:		
Compressor protection description:		
Control types:		
Noise level - dB(A) at 1m:		
Mass (kg):		
Country of Manufacture:		

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: BP:02

Instrumentation Air - Compressor

Equipment Tag:

01-DW-01-BP-01, 01-DW-01-BP-02

Number of Equipment Type:

2

Parameter	Required	Offered
Maximum operating pressure:		
Model Type: (Air-cooled, oil-injected, oil-free, water cooled)		
Stages:	1	
Operating pressure (kPa):	1 000	
Maximum Full load operating pressure		
Maximum operating temperature:		
Suction nozzle diameter (mm):		
Delivery nozzle diameter (mm):		
Maximum flow rate (l/s)		
Driver method:		
Crankshaft material:		
Crosshead bearing:		
Compressor protection description:		
Control types:		
Noise level - dB(A) at 1m:		
Mass (kg):		
Country of Manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:01

Air Filter – Sparging Compressor

Equipment Tag:

01-IW-01-FL-01, 01-IW-01-FL-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Air filter Application:	Inlet of Compressor	
Filter Class:	G4 or better	
Max flow Rate:		
Test Pressure drop:		
Material of Filter:		
Material of Body:		
Operating pressure of filter:		
Average Arrestance (Am) of ASHRAE test dust:		
Average Efficiency (Em) of 0.4 µm particles:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:02

Air Filter – Airlift Blowers

Equipment Tag:

01-IW-01-FL-03, 01-IW-01-FL-04

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Air filter Application:	Inlet of Blower	
Filter Class:	G4 or better	
Test Pressure drop:		
Max flow Rate:		
Test Pressure drop:		
Material of Filter:		
Material of Body:		
Operating pressure of filter:		
Average Arrestance (Am) of ASHRAE test dust:		
Average Efficiency (Em) of 0.4 µm particles:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:03

Air Filter – Fine Bubble Aeration

Equipment Tag:

01-BR-01-FL-01, 01-BR-01-FL-02, 01-BR-01-FL-03, 01-BR-01-FL-04,
01-BR-01-FL-05, 01-BR-01-FL-06, 01-BR-01-FL-07, 01-BR-01-FL-08,
01-BR-01-FL-09, 01-BR-01-FL-10, 01-BR-01-FL-11, 01-BR-01-FL-12

Number of Equipment Type:

12

Parameter	Required	Offered
Make & model:		
Type and design:		
Air filter Application:	Inlet of Blower	
Filter Class:	G4 or better	
Max flow Rate:		
Test Pressure drop:		
Material of Filter:		
Material of Body:		
Operating Pressure of filter:		
Average Arrestance (Am) of ASHRAE test dust:		
Average Efficiency (Em) of 0.4 µm particles:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:04

Liquid Filter – Ferric Dosing

Equipment Tag:

01-DW-01-FL-01, 01-DW-01-FL-02, 01-DW-01-FL-03, 01-DW-01-FL-04

Number of Equipment Type:

4

Parameter	Required	Offered
Make & model:		
Type and design:		
Liquid Application:	43% Ferric Chloride	
Filter Aperture size:	< 1mm	
Filter Pressure drop:		
Filter Flow capacity:	> 420l/hr	
Material of Filter:		
Material of Body:		
Operating Pressure of Filter:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:05

Instrumentation Air Filter – Pre-Air Dryer

Equipment Tag:

01-DW-01-FL-09, 01-DW-01-FL-10

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Filter Class:		
Max flow Rate:		
Test Pressure drop:		
Material of Filter:		
Material of Body:		
Operating Pressure of Filter:		
Average Arrestance (Am) of ASHRAE test dust:		
Average Efficiency (Em) of 0.4 µm particles:		
Minimum Efficiency of 0.4 µm particles:		
Penetration:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:06

Instrumentation Air Filter – Post-Air Dryer

Equipment Tag:

01-DW-01-FL-07, 01-DW-01-FL-08

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Filter Class:		
Max flow Rate:		
Test Pressure drop:		
Material of Filter:		
Material of Body:		
Operating Pressure of Filter:		
Average Arrestance (Am) of ASHRAE test dust:		
Average Efficiency (Em) of 0.4 µm particles:		
Minimum Efficiency of 0.4 µm particles:		
Penetration:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FL:07

Instrumentation Air Filter – Post-Air Vessel

Equipment Tag:

01-DW-01-FL-13, 01-DW-01-FL-14

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Type and design:		
Filter Class:		
Max flow Rate:		
Test Pressure drop:		
Material of Filter:		
Material of Body:		
Operating Pressure of Filter:		
Average Arrestance (Am) of ASHRAE test dust:		
Average Efficiency (Em) of 0.4 µm particles:		
Minimum Efficiency of 0.4 µm particles:		
Penetration:		
Mass (kg):		
Country of manufacture:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FBA:01

Fine Bubble Aeration – Basin 08

Equipment Tag:

01-BR-01-BL-01, 01-BR-01-BL-02, 01-BR-01-BL-03, 01-BR-01-AS-01

Number of Equipment Type:

4

Parameter	Required	Offered
Diffuser type:	Membrane Type (Ceramic not acceptable)	
Actual Oxygen Requirements (kgOxygen/d):	6 800	
Minimum Mixing requirement (m ³ /h/m ²):	20 m ³ /1000m ³ .min or 0.85m ³ /hr or 27m ³ /(day.m ²) whichever is the greatest	
Std. O ₂ Transfer Rate, (kgO ₂ /hr):	-	
Total Airflow (Nm ³ /hr):		
Air flow per diffuser (Nm ³ /hr):		
SOTE (%):		
Flux ratio (Nm ³ /m ² /hr):	-	
Diffuser bubble size (mm):	≤ 2	
No. of groups:		
No. of diffusers per group:		
No. of diffusers:		
Active membrane area (m ²):		
Diffuser Density (/m ²):		
Diffuser Water Depth:	(water depth 5.0 meters)	
Diffuser Make and model:		
Diameter:		
Material of coating:		
Ozone resistance (Yes/No):		

Parameter	Required	Offered
FOG resistant (Yes/No):		
Solvent resistant (Yes/No):		
Biofouling resistant (Yes/No):		
Friction coefficient		
Material of body		
Diffuser density		
Diffuser peak flow:		
Maximum flux ratio:		
Description of condensate purging method: (Inverted membrane sparging type not acceptable)		
Description of anti-fouling method: (Invasive method not acceptable)		
Condensate pipe work material:	304 stainless steel	
Fasteners material:	304 stainless steel	
Membrane material:	Premium EPDM	
Lateral pipe material:	-	
Lateral pipe friction loss (kPa)	≤ 1	
Feeder pipe material:	304 stainless steel	
Feeder pipe friction loss (kPa):	≤ 3	
Average oxygen transfer efficiency:	$> 27\%$ (proven with test results)	
Contactable References of diffused aeration membrane system: (Five Contact references required with the diffused aeration system in service for 7+ years)	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	

Parameter	Required	Offered
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
BLOWER		
Blower Type	Positive Displacement Blower (Roots Blower)	
Make & model:	-	
Motor power rating (kW):	-	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Blower turn down:	≥ 75%	
Maximum Delivery Temperature:	-	
Maximum Delivery Pressure:	-	
Blower filter grade:	≥ G4	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FBA:02

Fine Bubble Aeration – Basin 09

Equipment Tag:

01-BR-01-BL-04, 01-BR-01-BL-05, 01-BR-01-BL-06, 01-BR-01-AS-04

Number of Equipment Type:

4

Parameter	Required	Offered
Diffuser type:	Membrane Type (Ceramic not acceptable)	
Actual Oxygen Requirements (kgOxygen/d):	4 250	
Minimum Mixing requirement (m ³ /h/m ²):	20 m ³ /1000m ³ .min or 0.85m ³ /hr or 27m ³ /(day.m ²) whichever is the greatest	
Std. O ₂ Transfer Rate, (kgO ₂ /hr):	-	
Total Airflow (Nm ³ /hr):		
Air flow per diffuser (Nm ³ /hr):		
SOTE (%):		
Flux ratio (Nm ³ /m ² /hr):	-	
Diffuser bubble size (mm):	≤ 2	
No. of groups:		
No. of diffusers per group:		
No. of diffusers:		
Active membrane area (m ²):		
Diffuser Density (/m ²):		
Diffuser Water Depth:	(water depth 5.0 meters)	
Diffuser Make and model:		
Diameter:		
Material of coating:		
Ozone resistance (Yes/No):		

Parameter	Required	Offered
FOG resistant (Yes/No):		
Solvent resistant (Yes/No):		
Biofouling resistant (Yes/No):		
Friction coefficient		
Material of body		
Diffuser density		
Diffuser peak flow:		
Maximum flux ratio:		
Description of condensate purging method: (Inverted membrane sparging type not acceptable)		
Description of anti-fouling method: (Invasive method not acceptable)		
Condensate pipe work material:	304 stainless steel	
Fasteners material:	304 stainless steel	
Membrane material:	Premium EPDM	
Lateral pipe material:	-	
Lateral pipe friction loss (kPa)	≤ 1	
Feeder pipe material:	304 stainless steel	
Feeder pipe friction loss (kPa):	≤ 3	
Average oxygen transfer efficiency:	> 27% (proven with test results)	
Contactable References of diffused aeration membrane system: (Five Contact references required with the diffused aeration system in service for 7+ years)	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	

Parameter	Required	Offered
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
BLOWER		
Blower Type	Positive Displacement Blower (Roots Blower)	
Make & model:	-	
Motor power rating (kW):	-	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Blower turn down:	≥ 75%	
Maximum Delivery Temperature:	-	
Maximum Delivery Pressure:	-	
Blower filter grade:	≥ G4	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FBA:03

Fine Bubble Aeration – Basin 10

Equipment Tag:

01-BR-01-BL-07, 01-BR-01-BL-08, 01-BR-01-AS-03

Number of Equipment Type:

3

Parameter	Required	Offered
Diffuser type:	Membrane Type (Ceramic not acceptable)	
Actual Oxygen Requirements (kgOxygen/d):	2 550	
Minimum Mixing requirement (m ³ /h/m ²):	20 m ³ /1000m ³ .min or 0.85m ³ /hr or 27m ³ /(day.m ²) whichever is the greatest	
Std. O ₂ Transfer Rate, (kgO ₂ /hr):	-	
Total Airflow (Nm ³ /hr):		
Air flow per diffuser (Nm ³ /hr):		
SOTE (%):		
Flux ratio (Nm ³ /m ² /hr):	-	
Diffuser bubble size (mm):	≤ 2	
No. of groups:		
No. of diffusers per group:		
No. of diffusers:		
Active membrane area (m ²):		
Diffuser Density (/m ²):		
Diffuser Water Depth:	(water depth 5.0 meters)	
Diffuser Make and model:		
Diameter:		
Material of coating:		
Ozone resistance (Yes/No):		

Parameter	Required	Offered
FOG resistant (Yes/No):		
Solvent resistant (Yes/No):		
Biofouling resistant (Yes/No):		
Friction coefficient		
Material of body		
Diffuser density		
Diffuser peak flow:		
Maximum flux ratio:		
Description of condensate purging method: (Inverted membrane sparging type not acceptable)		
Description of anti-fouling method: (Invasive method not acceptable)		
Condensate pipe work material:	304 stainless steel	
Fasteners material:	304 stainless steel	
Membrane material:	Premium EPDM	
Lateral pipe material:	-	
Lateral pipe friction loss (kPa)	≤ 1	
Feeder pipe material:	304 stainless steel	
Feeder pipe friction loss (kPa):	≤ 3	
Average oxygen transfer efficiency:	> 27% (proven with test results)	
Contactable References of Diffused Aeration membrane system: (Five Contact references required with the diffused aeration system in service for 7+ years)	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	

Parameter	Required	Offered
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
BLOWER		
Blower Type	Positive Displacement Blower (Roots Blower)	
Make & model:	-	
Motor power rating (kW):	-	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Blower turn down:	≥ 75%	
Maximum Delivery Temperature:	-	
Maximum Delivery Pressure:	-	
Blower filter grade:	≥ G4	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FBA:04

Fine Bubble Aeration – Basin 11

Equipment Tag:

01-BR-01-BL-09, 01-BR-01-BL-10, 01-BR-01-AS-02

Number of Equipment Type:

3

Parameter	Required	Offered
Diffuser type:	Membrane Type (Ceramic not acceptable)	
Actual Oxygen Requirements (kgOxygen/d):	1 700	
Minimum Mixing requirement (m ³ /h/m ²):	20 m ³ /1000m ³ .min or 0.85m ³ /hr or 27m ³ /(day.m ²) whichever is the greatest	
Std. O ₂ Transfer Rate, (kgO ₂ /hr):	-	
Total Airflow (Nm ³ /hr):		
Air flow per diffuser (Nm ³ /hr):		
SOTE (%):		
Flux ratio (Nm ³ /m ² /hr):	-	
Diffuser bubble size (mm):	≤ 2	
No. of groups:		
No. of diffusers per group:		
No. of diffusers:		
Active membrane area (m ²):		
Diffuser Density (/m ²):		
Diffuser Water Depth:	(water depth 5.0 meters)	
Diffuser Make and model:		
Diameter:		
Material of coating:		
Ozone resistance (Yes/No):		

Parameter	Required	Offered
FOG resistant (Yes/No):		
Solvent resistant (Yes/No):		
Biofouling resistant (Yes/No):		
Friction coefficient		
Material of body		
Diffuser density		
Diffuser peak flow:		
Maximum flux ratio:		
Description of condensate purging method: (Inverted membrane sparging type not acceptable)		
Description of anti-fouling method: (Invasive method not acceptable)		
Condensate pipe work material:	304 stainless steel	
Fasteners material:	304 stainless steel	
Membrane material:	Premium EPDM	
Lateral pipe material:	-	
Lateral pipe friction loss (kPa)	≤ 1	
Feeder pipe material:	304 stainless steel	
Feeder pipe friction loss (kPa):	≤ 3	
Average oxygen transfer efficiency:	> 27% (proven with test results)	
Contactable References of Diffused Aeration membrane system: (Five Contact references required with the diffused aeration system in service for 7+ years)	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	

Parameter	Required	Offered
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
BLOWER		
Blower Type	Positive Displacement Blower (Roots Blower)	
Make & model:	-	
Motor power rating (kW):	-	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Blower turn down:	≥ 75%	
Maximum Delivery Temperature:	-	
Maximum Delivery Pressure:	-	
Blower filter grade:	≥ G4	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: FBA:05

Fine Bubble Aeration – Basin 12

Equipment Tag:

01-BR-01-BL-11, 01-BR-01-BL-12, 01-BR-01-AS-05

Number of Equipment Type:

3

Parameter	Required	Offered
Diffuser type:	Membrane Type (Ceramic not acceptable)	
Actual Oxygen Requirements (kgOxygen/d):	1 700	
Minimum Mixing requirement (m ³ /h/m ²):	20 m ³ /1000m ³ .min or 0.85m ³ /hr or 27m ³ /(day.m ²) whichever is the greatest	
Std. O ₂ Transfer Rate, (kgO ₂ /hr):	-	
Total Airflow (Nm ³ /hr):		
Air flow per diffuser (Nm ³ /hr):		
SOTE (%):		
Flux ratio (Nm ³ /m ² /hr):	-	
Diffuser bubble size (mm):	≤ 2	
No. of groups:		
No. of diffusers per group:		
No. of diffusers:		
Active membrane area (m ²):		
Diffuser Density (/m ²):		
Diffuser Water Depth:	(water depth 5.0 meters)	
Diffuser Make and model:		
Diameter:		
Material of coating:		
Ozone resistance (Yes/No):		

Parameter	Required	Offered
FOG resistant (Yes/No):		
Solvent resistant (Yes/No):		
Biofouling resistant (Yes/No):		
Friction coefficient		
Material of body		
Diffuser density		
Diffuser peak flow:		
Maximum flux ratio:		
Description of condensate purging method: (Inverted membrane sparging type not acceptable)		
Description of anti-fouling method: (Invasive method not acceptable)		
Condensate pipe work material:	304 stainless steel	
Fasteners material:	304 stainless steel	
Membrane material:	Premium EPDM	
Lateral pipe material:	-	
Lateral pipe friction loss (kPa)	≤ 1	
Feeder pipe material:	304 stainless steel	
Feeder pipe friction loss (kPa):	≤ 3	
Average oxygen transfer efficiency:	> 27% (proven with test results)	
Contactable References of Diffused Aeration membrane system: (Five Contact references required with the diffused aeration system in service for 7+ years)	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	

Parameter	Required	Offered
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
	Entity name: Contact name: Contact number: Contact Email:	
BLOWER		
Blower Type	Positive Displacement Blower (Roots Blower)	
Make & model:	-	
Motor power rating (kW):	-	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Blower turn down:	≥ 75%	
Maximum Delivery Temperature:	-	
Maximum Delivery Pressure:	-	
Blower filter grade:	≥ G4	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: GN:01

Fire flow Pump

Equipment Tag:

To be specified during construction

Number of Equipment Type:

3 - To be confirmed by fire flow engineer

Parameter	Required	Offered
Type of Pump	Centrifugal pump – dry or submersible installation to be specified by Contractor	
Make and model:	-	
Country of manufacture:	-	
Pump Flow Control:	-	
Duty Point at best efficiency (m ³ /hr @ m):	540 @ 45	
Pump best efficiency:	Pump speed to be selected by Contractor to ensure operation as close as possible to a pump specific speed of 50.-	
Flow range (m ³ /hr – m ³ /hr):	180 - 540	
Head range (m – m):	30-45	
Max Suction (m):	-	
Liquid Suspended Solids (mg/l)	-	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Minimum Solids handling capacity (mm):	6	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	Pump speed to be selected by Contractor to ensure operation	

Parameter	Required	Offered
	as close as possible to a pump SPECIFIC SPEED of 50.	
Maximum NPSH required:	-	
Inspection cover size (mm X mm):	-	
Design pressure for casing:	-	
Test pressure for casing:	-	
Balancing details:	-	
Mass(kg):	-	
PUMP MATERIALS		
Casing:	Ductile iron.	
Shaft:	Stainless steel.	
Shaft sleeve:	-	
Impeller:	Corrosion resistant to treated effluent (not disinfected).	
PUMP SEALS		
Type:	Mechanical / Gland packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal Water:	-	
PUMP BEARINGS		
Make, model and type:	-	

Parameter	Required	Offered
L10 life (hours):	100 000	

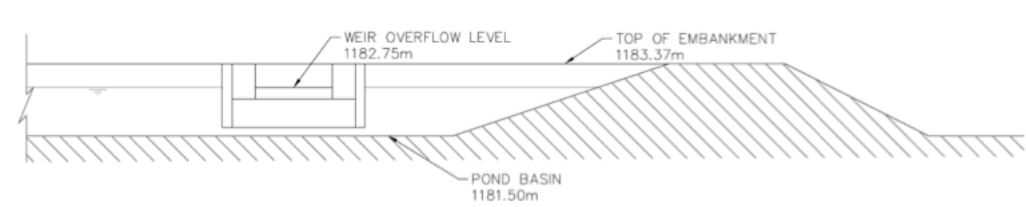
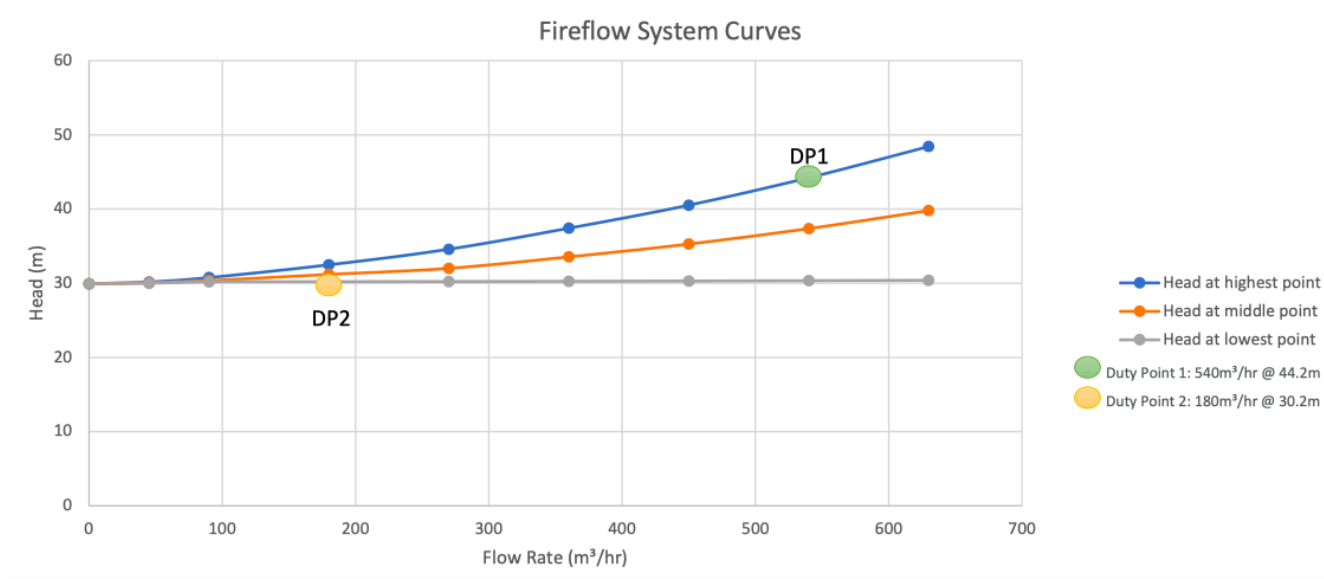
DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: GN:01



DATA SHEET REVISION: A

TENDERER	SIGNED	DATE
_____	_____	_____

DATASHEET AT1: FG:01

Recycle Channel Flap Gate

Equipment Tag:

01-BR-01-FG-01, 01-BR-01-FG-02, 01-BR-01-FG-03, 01-BR-01-FG-04,
01-BR-01-FG-05, 01-BR-01-FG-06 01-BR-01-FG-07, 01-BR-01-FG-08,
01-BR-01-FG-09,

Number of Equipment Type:

9

Parameter	Required	Offered
Make & model:	-	
Opening size (mm x mm)	650 x 350	
Pivot Radius (mm)	-	
Seat and Cover material:	-	
Seating Faces material:	-	
Pivot Lugs material:	-	
Links material:	Stainless steel	
Bushings:	Stainless steel	
Fasteners:	304 Stainless steel	
Mass of unit (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: GC:01

Grit Classifier

Equipment Tag:

01-IW-01-GC-01, 01-IW-01-GC-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
ADWF (m ³ /day):	40 000	
PWWF (m ³ /day):	100 000	
Maximum Operating capacity (kg/hr):	180	
Overall dimensions (mm X mm X mm):	-	
Discharge height (m)	-	
Rated motor power (kW):	-	
Operating speed (rpm):	-	
Trough Material:	304L Stainless Steel	
Hopper Material:	304L Stainless Steel	
Spiral Material:	-	
Wear bars Material:	304L Stainless Steel/ 3CR12	
Service water flow required (l/s):	-	
Service water head required (m):	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: HS:01

Hand Stop – Screenings Hydraulic Conveyor Launder

Equipment Tag:

01-IW-01-HS-01, 01-IW-01-HS-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Hand stop width (mm):	-	
Hand stop Hight (mm):	-	
Full static head (m):	-	
Material of Frame	Aluminium	
Sealing material:	Neoprene if required	
Frame Thickness (mm):	-	
Mass (kg):	-	
County of manufacture:	South Africa	

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: HS:02

Hand Stop – Linear Screen Launder

Equipment Tag:

01-IW-01-HS-03, 01-IW-01-HS-04

Number of Equipment Type:

2

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Hand stop width (mm):	-	
Hand stop Hight (mm):	-	
Full static head (m):	-	
Material of Frame	Aluminium	
Frame Thickness (mm):	-	
Sealing material:	Neoprene if required	
Frame Thickness (mm):	-	
Mass (kg):	-	
County of manufacture:	South Africa	

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: IM:01

Linear Screen Multi Port Injector

Equipment Tag:

01-SD-01-MJ-06

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:		
Type and design:		
Maximum Operating Pressure (m):	PN 10	
Flow Range (l/s – l/s):		
Nominal bore size:		
Main Pipe Nominal Diameter (mm):	250	
Minimum Velocity Gradient (G) (S ⁻¹)	60	
Media transported in Main line:	Waste activated Sludge	
Length without injection Point (mm):		
Length with injection Point (mm):		
Dimensions (L x W x H)		
Manufacturer:		

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: IM:02

Linear Screen Static Inline Mixer

Equipment Tag:

01-SD-01-IM-01, 01-SD-01-IM-02, 01-SD-01-IM-03, 01-SD-01-IM-04, 01-SD-01-IM-05

Number of Equipment Type:

5

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
Maximum Operating Pressure (m):	PN 10	
Flow Range (l/s – l/s):	-	
Nominal bore size:	-	
Main Pipe Nominal Diameter (mm):	-	
Minimum Velocity Gradient (G) (S ⁻¹)	60	
Media transported in Main line:	Waste activated Sludge	
Length without injection Point (mm):	-	
Length with injection Point (mm):	-	
Dimensions (L x W x H)	-	
Manufacturer:	-	

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: IM:03

Belt Press Static Inline Mixer

Equipment Tag:

1-DW-01-IM-01, 01-DW-01-IM-02, 01-DW-01-IM-03, 01-DW-01-IM-04, 01-DW-01-IM-05

Number of Equipment Type:

5

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
Maximum Operating Pressure (m):	PN 10	
Flow Range (l/s – l/s):	-	
Nominal bore size:	-	
Main Pipe Nominal Diameter (mm):	-	
Minimum Velocity Gradient (G) (S ⁻¹)	60	
Media transported in Main line:	Anaerobic Digested Sludge	
Length without injection Point (mm):	-	
Length with injection Point (mm):	-	
Dimensions (L x W x H)	-	
Manufacturer:	-	

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: LS:01

Linear Screen/ Belt Thickener

Equipment Tag:

01-SD-01-LS-01, 01-SD-01-LS-02, 01-SD-01-LS-03, 01-SD-01-LS-04, 01-SD-01-LS-05

Number of Equipment Type:

5

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
Undigested Waste Activate Sludge (kg/hr)	360	
Hydraulic loading for Undigested Waste Activate Sludge (m ³ /hr):	72	
Effective Belt Width (m)	-	
Total Belt Width (m)	-	
Suspended solids in service water (mg/l)	25	
Service water flow requirements (l/s)		
Service water pressure Requirements (m)		
Minimum Dry solids content (%):	5%	
Filtrate TSS Content (mg/l)	< 500	
Belt speed: - Maximum belt linear speed (m/min) - Minimum belt linear speed (m/min)		
Drainage areas: Gravity drainage zone (m²)		
Tracking and tensioning:		
Tracking system (hydraulic or pneumatic)		
Method of tensioning cloth		
Air supply required (m ³ /min)		
Air supply pressure (kPa)		
FILTER CLOTH		

Parameter	Required	Offered
Manufacturer		
Model No.		
Cloth material and weave		
Cloth aperture		
WARP tensile strength (kN/mm)		
Width tensile strength (kN/mm)		
Joint type		
Clipper seam strength % WARP strength		
Normal cloth tension (kN)		
Maximum cloth tension (kN)		
Minimum cloth tension (kN)		
Life of belt (Hours)		
Belt cost (Rand)		
Rollers Drum Dia. and Shaft Dia. • First • Second, etc. • Tension rollers • Tracking rollers • Idler rollers		
Total number of compression rollers (No.)		
Bearing type:		
DOSING OF POLY ELECTROLITE		
Mixer for dilution water Type:		
Mixer for dilution water Dimensions:		
Flocculation tank: • Volume of unit • Dimensions • Method of mixing • Motor power (kW) • Motor speed (rpm) • Impeller type		

Parameter	Required	Offered
• Mixing shear (s-1)		
Dimensions of unit (L x W x H):		
Dry and Wet Mass (kg):		
MATERIALS		
Materials of Frame:		
Materials of Shafts:		
Materials of Enclosures:		
Materials of Covers:		
Materials of Flocculation tank:		
Materials of Flocculation mixer:		
Materials of Dilution water mixer:		
Materials of Mixer head (dilute poly/ sludge):		
Materials of Wash and filtrate trays:		
Materials of Wash water piping:		
Materials of Spray bars:		
Bearings Minimum Life (Hours):	100 000	
Wash water pipe works Material:	-	
Press Drive Unit:	-	
Screen Fasteners Material:	304/316 Stainless steel	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):		
Gearbox ratio:		
Maximum noise at 1 meter:	84dBA	

DATA SHEET REVISION: B

TENDERER	SIGNED	DATE
_____	_____	_____

DATASHEET AT1: MX:01

Vertical Shaft Bio-Reactor

Equipment Tag:

01-BR-01-MX-01, 01-BR-01-MX-02, 01-BR-01-MX-03, 01-BR-01-MX-04, 01-BR-01-MX-05, 01-BR-01-MX-06, 01-BR-01-MX-07, 01-BR-01-MX-08, 01-BR-01-MX-09, 01-BR-01-MX-10, 01-BR-01-MX-11, 01-BR-01-MX-12, 01-BR-01-MX-13, 01-BR-01-MX-14

Number of Equipment Type:

14

Parameter	Required	Offered
Make and model:	-	
Type and Design:	Radial or Axial	
Mixing performance details:	No sludge build-up or Aeration	
Maximum solids consistency capability (mg/l):	< 6 000	
Mixing Energy at duty point (kW):	8 W/m ³ (Basin Volume: 1065 m ³)	
Speed Control:	Fixed Speed	
Motor power rating (kW):	-	
Operating speed range (rpm):	< 2.5 m/s tip speed for Radial type	
Impeller diameter (mm):	-	
Mixing thrust produced (N):	-	
Minimum impeller submergence required (mm):	3 000	
Material of impeller:	304L Stainless Steel	
Material of shaft:	Tubular LDX 2101 Duplex Stainless Steel	
Shaft diameter:	< 350mm	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Mass (kg):	-	

Parameter	Required	Offered
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: MX:02

Vertical Shaft Balancing Tank

Equipment Tag:

01-BT-01-MX-01, 01-BT-01-MX-02, 01-BT-01-MX-03, 01-BT-01-MX-04, 01-BT-01-MX-05, 01-BT-01-MX-06

Number of Equipment Type:

6

Parameter	Required	Offered
Make and model:	-	
Type and Design:	Radial or Axial	
Mixing performance details:	No sludge build-up or Aeration	
Maximum solids consistency capability (mg/l):	< 1 000	
Mixing Energy at duty point (kW):	8 W/m ³ (Tank Volume: 5 050m ³)	
Speed Control:	VSD	
Maximum safe turndown (%)	55	
Motor power rating (kW):	-	
Operating speed range (rpm):	< 2,5 m/s tip speed for Radial Type	
Impeller diameter (mm):	-	
Mixing thrust produced (N):	-	
Minimum impeller submergence required (mm):	Min Height Above TOC 0.3m with Min water depth shutoff at 0.6m	
Material of impeller:	304L Stainless Steel	
Material of shaft:	Tubular LDX 2101 Duplex Stainless Steel	
Shaft diameter:	< 350mm	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	

Parameter	Required	Offered
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: MX:03

Vertical Shaft Digested Sludge Day Tank

Equipment Tag:

01-SD-01-MX-06, 01-SD-01-MX-04, ,01-SD-01-MX-05, 01-SD-01-MX-07

Number of Equipment Type:

42

Parameter	Required	Offered
Make and model:	-	
Type and Design:	Radial or Axial	
Mixing performance details:	No sludge build-up or Aeration	
Maximum solids consistency capability (mg/l):	30 000	
Mixing Energy at duty point (kW):	8 W/m ³ (Sump Volume: 300m ³)	
Speed Control:	VSD	
Maximum safe turndown (%):	55	
Motor power rating (kW):		
Operating speed range (rpm):	< 2,5 m/s tip speed for Radial Type	
Impeller diameter (mm):	-	
Mixing thrust produced (N):	-	
Minimum impeller submergence required (mm):	Min Height Above TOC 0.3m with Min water depth shutoff at 0.8m	
Material of impeller:	304L Stainless Steel	
Material of shaft:	Tubular LDX 2101 Duplex Stainless Steel	
Shaft diameter:	< 350mm	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	

Parameter	Required	Offered
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: MX:04

Vertical Shaft WAS Draw-Off

Equipment Tag:

01-BR-01-MX-15

Number of Equipment Type:

1

Parameter	Required	Offered
Make and model:	-	
Type and Design:	Radial or Axial	
Mixing performance details:	No sludge build-up	
Maximum solids consistency capability (mg/l):	6 000	
Power demand at maximum duty point (kW):	20 – 30 W/m ³ (Draw-off box Volume: 50m ³)	
Motor power rating (kW):		
Speed Control:	VSD (Min Speed: 0.55 of Max Speed)	
Operating speed range (rpm):	< 2,5 m/s tip speed for Radial Type	
Impeller diameter (mm):	-	
Mixing thrust produced (N):	-	
Minimum impeller submergence required (mm):	Min Height Above TOC 0.3m	
Material of impeller:	304L Stainless Steel	
Material of shaft:	Tubular LDX 2101 Duplex Stainless Steel	
Shaft diameter:	< 350mm	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER	SIGNED	DATE
_____	_____	_____

DATASHEET AT1: MX:05

Vertical Shaft Thick Sludge Sump

Equipment Tag:

01-SD-01-MX-01, 01-SD-01-MX-02, 01-SD-01-MX-03

Number of Equipment Type:

3

Parameter	Required	Offered
Make and model:	-	
Type and Design:	Radial or Axial	
Mixing performance details:	No sludge build-up or Aeration	
Maximum solids consistency capability (mg/l):	50 000	
Power demand at maximum duty point (kW):	8 W/m ³ (Sump Volume: 150m ³)	
Motor power rating (kW):		
Speed Control:	VSD (Min Speed: 0.55 of Max Speed)	
Operating speed range (rpm):	< 2,5 m/s tip speed for Radial Type	
Impeller diameter (mm):	-	
Mixing thrust produced (N):	-	
Minimum impeller submergence required (mm):	Min Height Above TOC 0.3m with Min water depth shutoff at 0.6m	
Material of impeller:	304L Stainless Steel	
Material of shaft:	Tubular LDX 2101 Duplex Stainless Steel	
Shaft diameter:	< 350mm	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER	SIGNED	DATE
_____	_____	_____

DATASHEET AT1: MX:06

Vertical Shaft Filtrate Precipitation

Equipment Tag: 01-DW-01-MX-01

Number of Equipment Type: 1

Parameter	Required	Offered
Make and model:	-	
Type and Design:	Radial or Axial	
Mixing performance details:	No sludge build-up or Aeration	
Maximum solids consistency capability (mg/l):	50 000	
Power demand at maximum duty point (kW):	20 – 30 W/m ³ (Tank Volume: 12m ³)	
Motor power rating (kW):		
Speed Control:	VSD (Min Speed: 0.55 of Max Speed)	
Operating speed range (rpm):	< 2,5 m/s tip speed for Radial Type	
Impeller diameter (mm):	-	
Mixing thrust produced (N):	-	
Minimum impeller submergence required (mm):	Min Height Above TOC 0.3m with Min water depth shutoff at 0.6m	
Material of impeller:	304L Stainless Steel	
Material of shaft:	Tubular LDX 2101 Duplex Stainless Steel	
Shaft diameter:	< 350mm	
Gearbox make and model:	-	
Gearbox service factor:	> 1.75	
Gearbox power rating (kW):	-	
Gearbox ratio:	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER	SIGNED	DATE
_____	_____	_____

DATASHEET AT1: MT:01

Moisture Trap – Air Sparging Compressors

Equipment Tag:

01-IW-01-MT-01

Number of Equipment Type:

1

Parameter	Required	Offered
Make & model:		
Condensate discharge:	Continues/ Intermittent	
Valve Seat/ Tight Sealing		
Valve Seat Cleaning		
Body Material:		
Max Operating Pressure (kPa):	1 000	
Max Operating Temp		
Connection Type:		
Min Condensate load for tight sealing (kg/h):		
Country of manufacture:		
Mass (kg):		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: MT:02

Moisture Trap – Instrumentation Air

Equipment Tag:

01-DW-01-MT-01, 01-DW-01-MT-02

Number of Equipment Type:

2

Parameter	Required	Offered
Make & model:		
Condensate discharge:	Continues/ Intermittent	
Valve Seat/ Tight Sealing		
Valve Seat Cleaning		
Body Material:		
Max Operating Pressure (kPa):	1 000	
Max Operating Temp		
Connection Type:		
Min Condensate load for tight sealing (kg/h):		
Country of manufacture:		
Mass (kg):		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: HP:01

Poly Dosing Batch Feeder

Equipment Tag: 01-DW-01-HP-01, 01-DW-01-HP-02, 01-DW-01-HP-03, 01-DW-01-HP-04
Number of Equipment Type: 4

Parameter	Required	Offered
Make & model:	-	
Type and Model:	-	
Frame material:	-	
Dimensions (L x W x H):	-	
Hopper PolyElectrolyte Capacity (kg/hr):	5	
Hopper Capacity (kg)	100	
Mass (kg):	-	
Country of Manufacture:	-	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: PC:01

Equipment Service Gantry

Equipment Tag:

01-BR-01-PC-01, 01-BR-01-PC-02, 01-BR-01-PC-03, 01-BR-01-PC-04,
01-BR-01-PC-05, 01-MP-01-PC-01, 01-DW-01-PC-01, 01-DW-01-PC-02,
01-DW-01-PC-03, 01-DW-01-PC-04

Number of Equipment Type:

10

Parameter	Required	Offered
SWL [safe working load] (kg):	2 000	
Maximum expected load for this application (kg):	2 500	
Test Load (kg):	2 000	
STRUCTURE	-	
Technical Design Standard used:	ISO 53.020.01, ISO 53.020.20, ISO 53.020.30, ISO 53.020.99	
Grade of steel for structure:	-	
Description of corrosion protection systems used:	-	
Dimensions of maintenance platform (mm X mm):	-	
HOIST		
Make & model:	-	
Type and design:	-	
Details of overload prevention device:	-	
Factor of Safety for chain or cable:	-	
Country of manufacture:	-	
CRAWL TROLLEY		
Make & model:	-	
Type and design:	-	
Operating speed:	-	
Country of manufacture:	-	

Parameter	Required	Offered
END CARRIAGES		
Make & model:	-	
Type and design:	-	
Operating speed:	-	
Country of manufacture:	-	
RAILS		
Details of crane rail:	-	
Rail connection detail:	-	
Description of corrosion protection systems used:	-	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:01

Inlet Works Wash Water

Equipment Tag: 01-IW-01-CP-01, 01-IW-01-CP-02

Number of Equipment Type: 2

Parameter	Required	Offered
Type of Pump	Self-Priming Non-Contact Impeller Centrifugal Pump	
Make and model:	-	
Country of manufacture:	-	
Pump Flow Control:	Fixed Delivery	
Duty Point at best efficiency (m ³ /hr @ m):	45.0 @ 2.6	
Pump best efficiency:	-	
Flow range (l/s – l/s):	45 - 45	
Re-prime height (m):	≥ 2.0	
Liquid Suspended Solids (mg/l)	500 (0.05%)	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Minimum Solids handling capacity (mm):	75	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	< 1 500	
Maximum NPSH required for range of duties specified: • Head at this point (m): • Flow at this point (m³/s): • Shaft speed at this point (rpm): • NPSH available at this point:	-	
Inspection cover size (mm X mm):	-	
Design pressure for casing:	10 Bar	

Parameter	Required	Offered
Test pressure for casing:	10 Bar	
Balancing details:	-	
Mass(kg):		
PUMP MATERIALS		
Casing:	Cast Iron or Cast Steel	
Shaft:	Stainless steel	
Shaft sleeve:	-	
Impeller:	-	
PUMP SEALS		
Type:	Mechanical / Gland packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal Water:	-	
PUMP BEARINGS		
Make, model and type:	-	
L10 life (hours):	100 000	

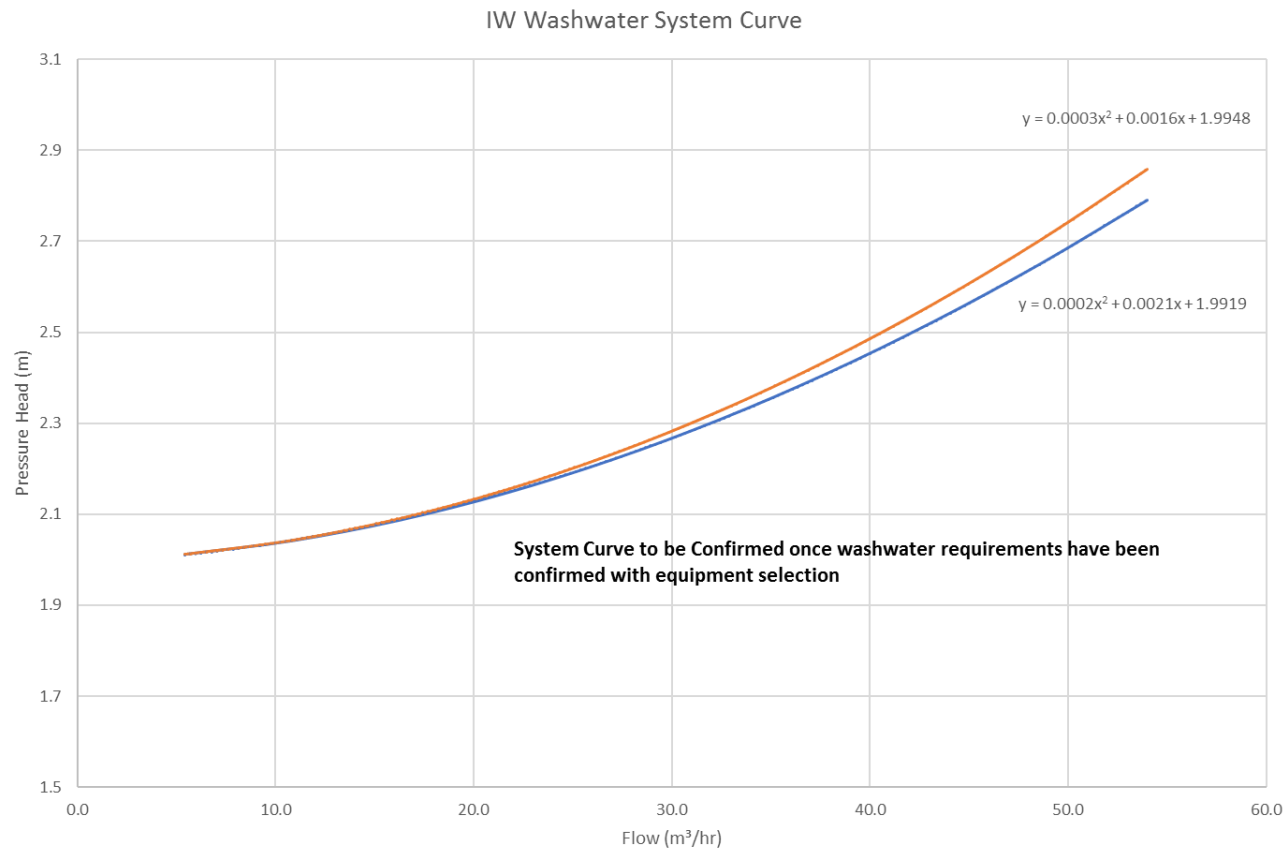
DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:01



DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:02

Primary Sludge Pumps

Equipment Tag:

01-PS-01-CP-01, 01-PS-01-CP-02, 01-PS-01-CP-03, 01-PS-01-CP-04

Number of Equipment Type:

4

Parameter	Required	Offered
Type of Pump	Self-Priming Non-Contact Impeller Centrifugal Pump	
Make, model:	-	
Country of manufacture:	-	
Pump Flow Control:	VSD	
Duty Point at best efficiency (m ³ /hr @ m):	54.0 @ 5.7	
Pump best efficiency:	-	
Flow range (m ³ /hr – m ³ /hr): • (Pump must operate within system curve area • ABCD safely and without deleterious effects)	36 – 90	
Re-prime height (m):	≥ 1.0	
Liquid Suspended Solids (mg/l)	30 000 (3%)	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Solids handling capacity (mm):	75	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	< 1 500	
Maximum NPSH required for range of duties specified: • Head at this point (m): • Flow at this point (l/s): • Shaft speed at this point (rpm): • NPSH available at this point:	-	
Inspection cover size (mm X mm):	-	

Parameter	Required	Offered
Design pressure for casing:	10 Bar	
Test pressure for casing:	10 Bar	
Balancing details:	-	
Mass(kg):		
PUMP MATERIALS	-	
Casing:	Cast Iron or Cast Steel	
Shaft:	Stainless steel	
Shaft sleeve:	-	
Impeller:	-	
PUMP SEALS		
Type:	Mechanical / Gland Packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal water:		
PUMP BEARINGS		
Make, model and type:	-	
L10 life (hours):	100 000	

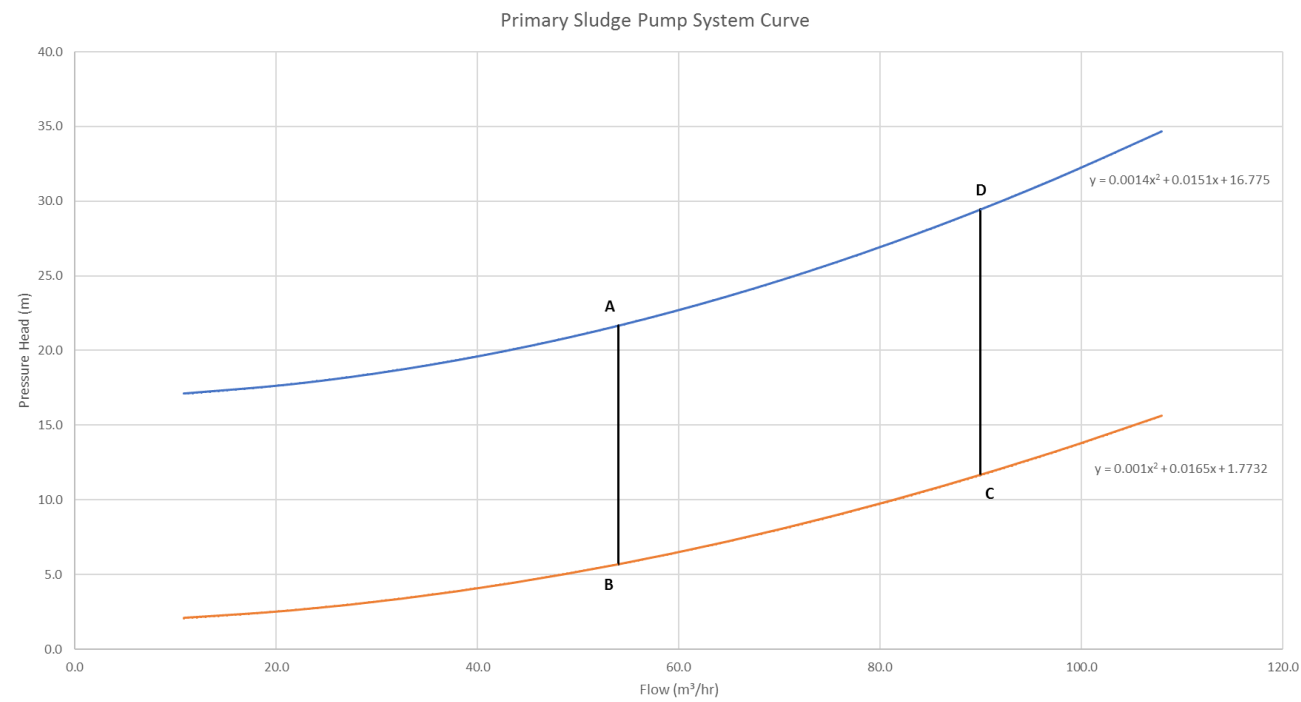
DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:02



DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:03

Waste Activated Sludge Pumps

Equipment Tag: 01-BR-01-CP-01, 01-BR-01-CP-02

Number of Equipment Type: 2

Parameter	Required	Offered
Type of Pump	Self-Priming Non-Contact Impeller Centrifugal Pump	
Make, model:	-	
Country of manufacture:	-	
Flow Control:	VSD	
Duty Point at best efficiency (m ³ /hr @ m):	217 @ 19.0	
Pump best efficiency:	-	
Flow range (m ³ /hr – m ³ /hr): (Pump must operate the required flow range safely and without deleterious effects)	150 – 250	
Re-prime height (m):	≥ 2.5	
Liquid Suspended Solids (mg/l)	5 000 (0.5%)	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Solids handling capacity (mm):	75	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	< 1 500	
Maximum NPSH required for range of duties specified: • Head at this point (m): • Flow at this point (l/s): • Shaft speed at this point (rpm): • NPSH available at this point:	-	
Inspection cover size (mm X mm):	-	

Parameter	Required	Offered
Design pressure for casing:	10 Bar	
Test pressure for casing:	10 Bar	
Balancing details:	-	
Mass(kg):		
PUMP MATERIALS	-	
Casing:	Cast Iron or Cast Steel	
Shaft:	Stainless steel	
Shaft sleeve:	-	
Impeller:	-	
PUMP SEALS		
Type:	Mechanical / Gland Packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal water:		
PUMP BEARINGS		
Make, model and type:	-	
L10 life (hours):	100 000	

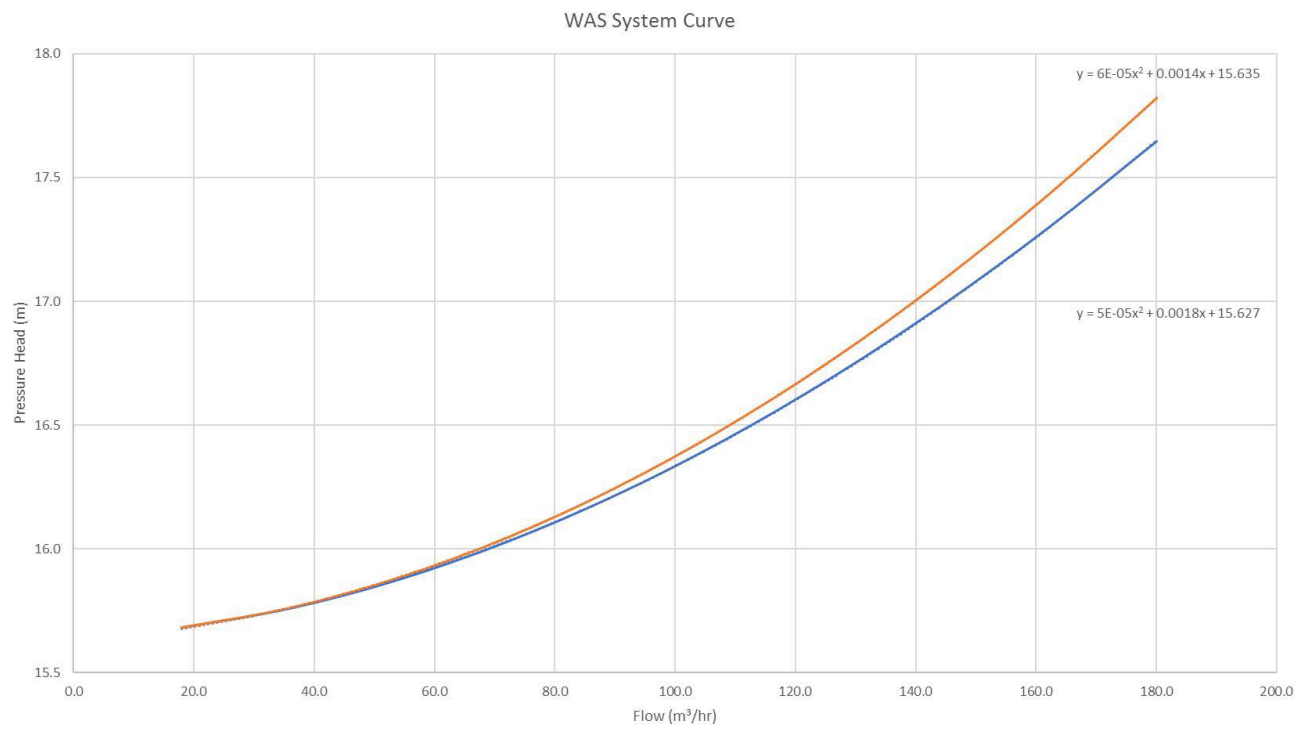
DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:03



DATA SHEET REVISION: B

TENDERER	SIGNED	DATE
_____	_____	_____

DATASHEET AT1: CP:04

Return Activates Sludge Pumps

Equipment Tag:

01-SS-01-CP-01, 01-SS-01-CP-02, 01-SS-01-CP-03, 01-SS-01-CP-04, 01-SS-01-CP-05, 01-SS-01-CP-06

Number of Equipment Type:

6

Parameter	Required	Offered
Type of Pump	Self-Priming Non-Contact Impeller Centrifugal Pump	
Make, model:	-	
Country of manufacture:	-	
Flow Control:	VSD	
Duty Point at best efficiency (m ³ /hr @ m):	416 @ 6.3	
Pump best efficiency:	-	
Flow range (m ³ /hr – m ³ /hr): (Pump must operate the required flow range safely and without deleterious effects)	200 – 630	
Re-prime height (m):	≥ 1.0	
Liquid Suspended Solids (mg/l)	30 000 (3%)	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Solids handling capacity (mm):	75	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	< 1 500	
Maximum NPSH required for range of duties specified: • Head at this point (m): • Flow at this point (l/s): • Shaft speed at this point (rpm): • NPSH available at this point:	-	
Inspection cover size (mm X mm):	-	

Parameter	Required	Offered
Design pressure for casing:	10 Bar	
Test pressure for casing:	10 Bar	
Balancing details:	-	
Mass(kg):	-	
PUMP MATERIALS	-	
Casing:	Cast Iron or Cast Steel	
Shaft:	Stainless steel	
Shaft sleeve:	-	
Impeller:	-	
PUMP SEALS		
Type:	Mechanical / Gland Packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal water:		
PUMP BEARINGS		
Make, model and type:	-	
L10 life (hours):	100 000	

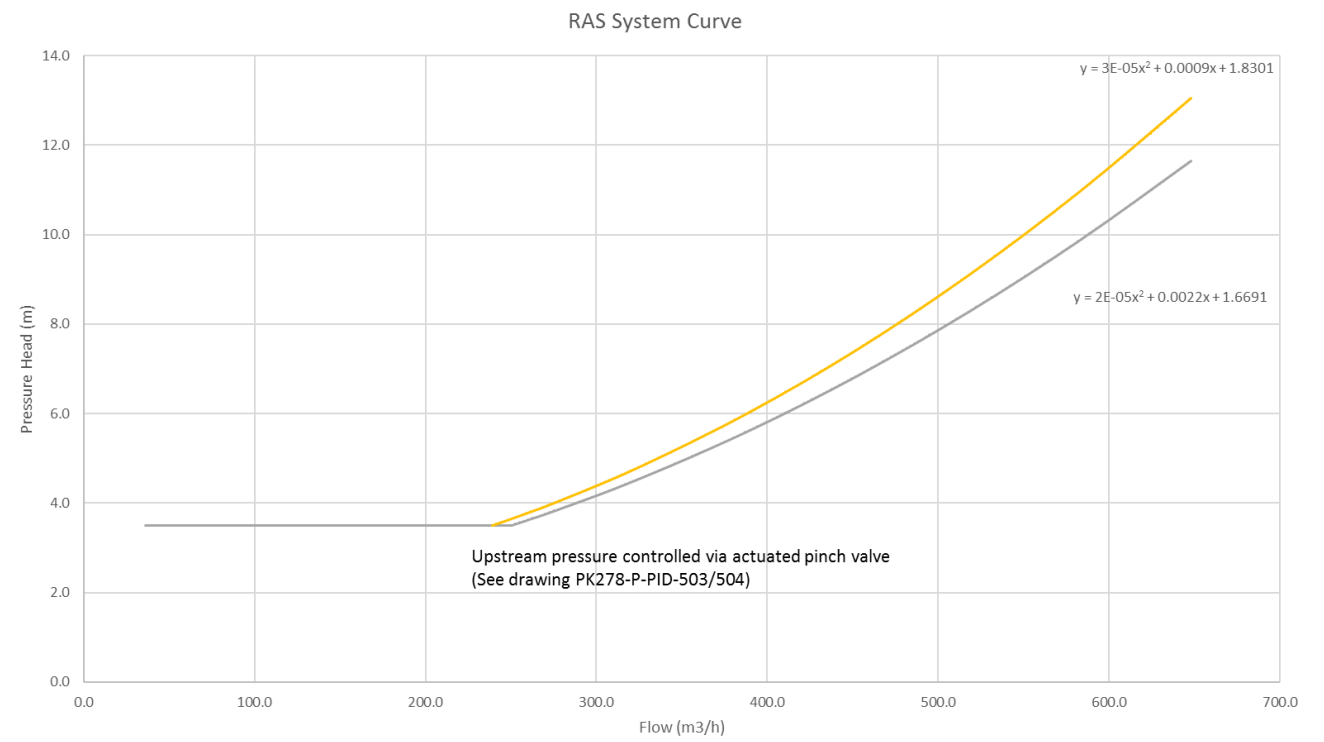
DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:04



DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:05

Thick Sludge Pumps

Equipment Tag: 01-SD-01-PP-01, 01-SD-01-PP-02

Number of Equipment Type: 2

Parameter	Required	Offered
Type of Pump	Progressive Cavity Pump	
Make, model:	-	
Country of manufacture:	-	
Flow Control:	Fixed Speed	
Duty Point at best efficiency (m ³ /hr @ m):	54.0 @ 21.5	
Pump best efficiency:	-	
Flow range (m ³ /hr – m ³ /hr): (Pump must operate the required flow range safely and without deleterious effects)	54 - 54	
Re-prime height (m):	≥ 3.5	
Liquid Suspended Solids (mg/l)	60 000 (6%)	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Solids handling capacity (mm):	-	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	< 1 500	
Maximum NPSH required for range of duties specified: • Head at this point (m): • Flow at this point (l/s): • Shaft speed at this point (rpm): • NPSH available at this point:	-	
Inspection cover size (mm X mm):	-	

Parameter	Required	Offered
Design pressure for casing:	10 Bar	
Test pressure for casing:	10 Bar	
Balancing details:	-	
Mass(kg):		
PUMP MATERIALS	-	
Casing:	Cast Iron or Cast Steel	
Shaft:	Stainless steel	
Shaft sleeve:	-	
Impeller:	-	
PUMP SEALS		
Type:	Mechanical / Gland Packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal water:		
PUMP BEARINGS		
Make, model and type:	-	
L10 life (hours):	100 000	

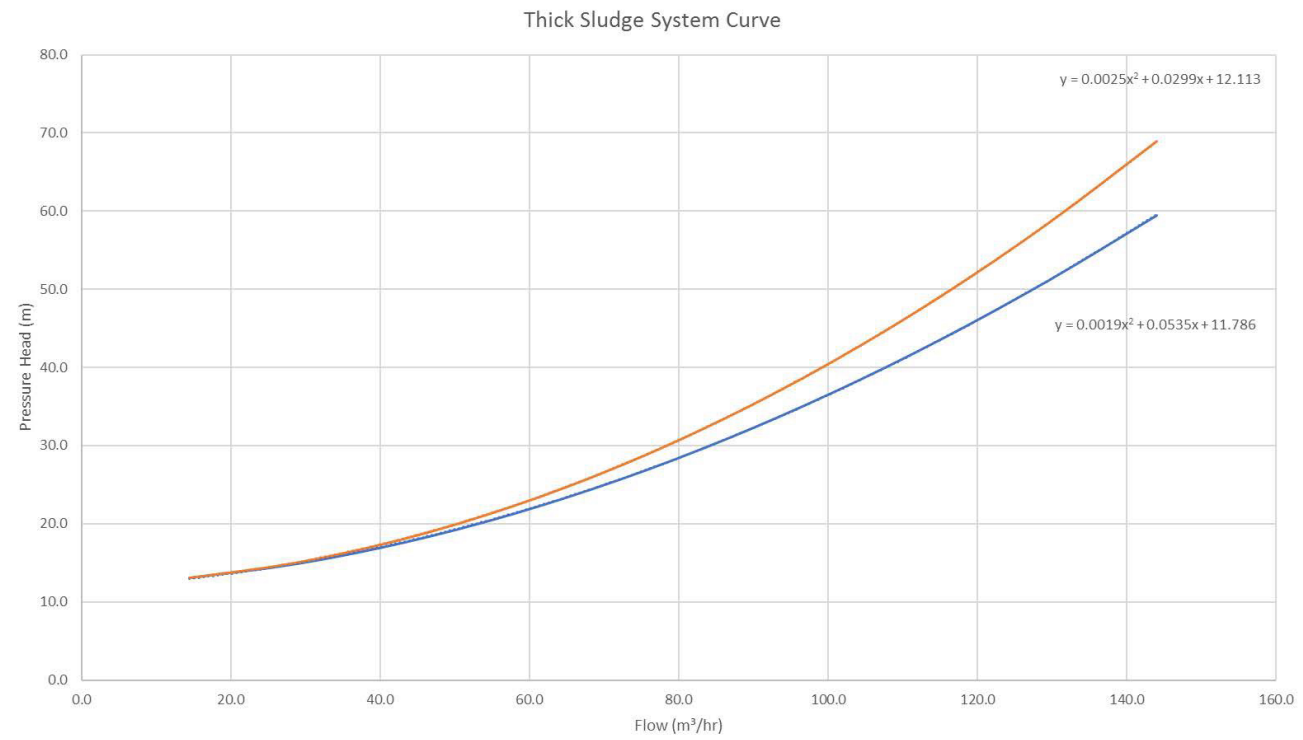
DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:05



DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:06

Digested Sludge Pump

Equipment Tag: 01-SD-01-PP-03, 01-SD-01-PP-04

Number of Equipment Type: 2

Parameter	Required	Offered
Type of Pump	Progressive Cavity Pump	
Make, model:	-	
Country of manufacture:	-	
Flow Control:	VSD	
Duty Point at best efficiency (m ³ /hr @ m):	54.0 @ 7.5	
Pump best efficiency:	-	
Flow range (m ³ /hr – m ³ /hr): (Pump must operate the required flow range safely and without deleterious effects)	50 - 80	
Re-prime height (m):	≥ 4.0	
Liquid Suspended Solids (mg/l)	30 000 (3%)	
Inlet diameter (mm):	-	
Outlet diameter (mm):	-	
Solids handling capacity (mm):	-	
Proposed impeller diameter (mm):	-	
Maximum impeller diameter for model of pump offered (mm):	-	
Minimum impeller diameter for model of pump offered (mm):	-	
Shaft speed (rpm):	< 1 500	
Maximum NPSH required for range of duties specified: • Head at this point (m): • Flow at this point (l/s): • Shaft speed at this point (rpm): • NPSH available at this point:	-	
Inspection cover size (mm X mm):	-	

Parameter	Required	Offered
Design pressure for casing:	10 Bar	
Test pressure for casing:	10 Bar	
Balancing details:	-	
Mass(kg):		
PUMP MATERIALS	-	
Casing:	Cast Iron or Cast Steel	
Shaft:	Stainless steel	
Shaft sleeve:	-	
Impeller:	-	
PUMP SEALS		
Type:	Mechanical / Gland Packing	
Make, model:	-	
Country of manufacture:	-	
Materials of rotating face:	-	
Material of stationary face:	-	
Seal water:		
PUMP BEARINGS		
Make, model and type:	-	
L10 life (hours):	100 000	

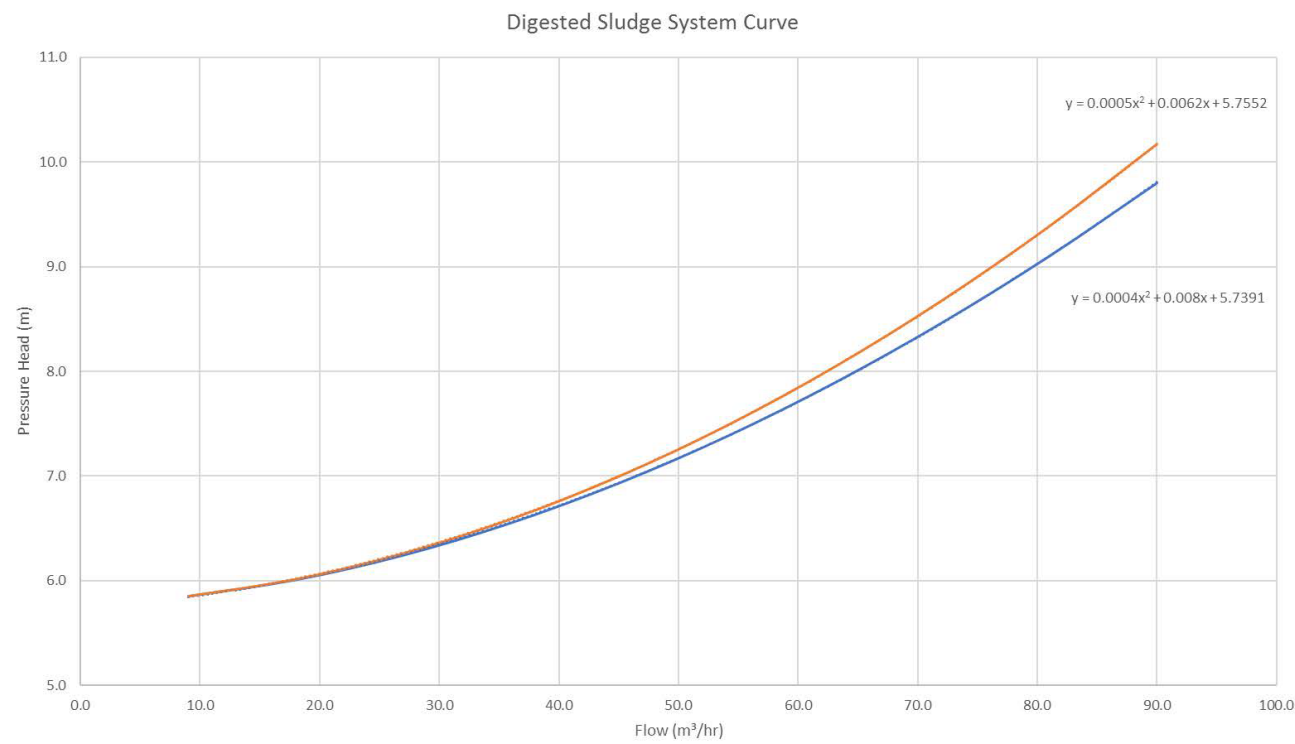
DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: CP:06



DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: RB:01

Secondary Clarifiers Rotating Bridge

Equipment Tag: 01-SS-01-RB-01, 01-SS-01-RB-02

Number of Equipment Type: 2

Parameter	Required	Offered
Description of bridge structure:	-	
Bridge width (mm):	1200	
Bridge design load (mm):	2500N per m ² of walkway area	
Mass of bridge (kg):		
BRIDGE BEARING		
Make of slewing bearing:	-	
Diameter of slewing bearing:	-	
Sealing arrangement for slewing bearing:	-	
Material of scraper mechanism:	304L Stainless Steel	
Description of scraper mechanism:		
Make of bridge gear motor:	-	
Rated motor power (kW):	-	
• Make of wheels:	-	
Wheel spacing (mm):	-	
Wheel diameter (mm):	-	
Wheel width (mm):	-	
Material of tyre:	-	
Tyre sidewall dimension (mm):	300	
Wheel/tyre load rating (kg):	-	
Wheel/tyre design load:	-	

Parameter	Required	Offered
SLIP RING ASSEMBLY		
Make and model:	-	
IP rating:	55	
Number of slip rings:	-	
Current Rating (A):	-	
Isolation level:	-	
STILLING CHAMBER Design details:		
WEIR PLATES Design details:		
SCUM REMOVAL EQUIPMENT Design details:	NOT REQUIRED	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: RB:02

Primary Clarifiers Rotating Bridge

Equipment Tag: 01-PS-01-RB-01, 01-PS-01-RB-02

Number of Equipment Type: 2

Parameter	Required	Offered
Description of bridge structure:	-	
Bridge width (mm):	1200	
Bridge design load (mm):	2500N per m ² of walkway area	
Mass of bridge (kg):		
Tank Diameter (m)	25	
BRIDGE BEARING		
Make of slewing bearing:	-	
Diameter of slewing bearing:	-	
Sealing arrangement for slewing bearing:	-	
Material of scraper mechanism:	Galvanised Mild Steel	
Description of scraper mechanism:		
Make of bridge gear motor:	-	
Rated motor power (kW):	-	
• Make of wheels:	-	
Wheel spacing (mm):	-	
Wheel diameter (mm):	-	
Wheel width (mm):	-	
Material of tyre:	-	
Tyre sidewall dimension (mm):	300	
Wheel/tyre load rating (kg):	-	

Parameter	Required	Offered
Wheel/tyre design load:	-	
SLIP RING ASSEMBLY		
Make and model:	-	
Number of slip rings:	-	
Current Rating (A):	-	
Isolation level:	-	
IP rating:	55	
STILLING CHAMBER Design details:		
WEIR PLATES Design details:		
SCUM REMOVAL EQUIPMENT Design details:		

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: SC:01

15mm Coarse - Front Raked Mechanical Screens

Equipment Tag: 01-IW-01-SC-03, 01-IW-01-SC-04

Number of Equipment Type: 2

Parameter	Required	Offered
Make and model:	-	
Type, design and screen aperture:	15 mm Front Raked Mechanical	
Peak flow through screen field (Mega Litre/day):	100	
Discharge from channel floor level	4050	
Discharge from Top of channel	1800	
Channel Width x Depth	1800 x 2250	
Maximum Channel Flow Depth in Front of Screen at PDWF	1523	
Mounting type:	Channel	
Max height differential across screen (mm)	75	
Operating range of unit, water flow (m ³ /s)	0 – 1.16	
Operating range of unit, screenings (kg/hr)	6 - 150	
Overall length (mm):		
Operating speed of rake mechanism (m/s):	-	
Head loss across screen at maximum flow (mm)	-	
Material of fasteners:	304L Stainless Steel	
Material of frame:	304L Stainless Steel	
Material of screen field:	304L Stainless Steel	
Method of replacing screen field:	-	
Screen bar dimensions (mm X mm):	-	
Material of rake assembly:	304L Stainless Steel	

Parameter	Required	Offered
Material of rake comb:	304L Stainless Steel	
Method of replacing rake comb:	-	
Material of chain:	Vesconite rollers, 304L S.S side plates & pins.	
Material of chain guides:	304L Stainless Steel	
Material of sprockets:	304L Stainless Steel	
Details of bottom bearing or turnaround:	-	
Lubrication of bottom bearing:	-	
Material of wiper assembly:	304L Stainless Steel	
Material of wiper blade:	UHDPE	
Description of overload protection system:	-	
MECHANICAL SCREEN MOTOR		
Manufacturer:		
Type of motor:		
Type of casing:		
Class of insulation (IP):		
Speed of rotation (rpm):		
Rated output (kW):		
Absorbed power at design duty (kW):		
Efficiency at full road		
Min. torque required at start		
Anti-condensation heater rating		
GEARBOX		
Manufacturer:		

Parameter	Required	Offered
Type and model:		
AGMA rating (kW):		
Thermal rating (kW):		
Service factor:	> 1.75	
Efficiency at rated output:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SC:02

6mm Coarse - Front Raked Mechanical Screens

Equipment Tag: 01-IW-01-SC-05, 01-IW-01-SC-06

Number of Equipment Type: 2

Parameter	Required	Offered
Make and model:		
Type, design and screen aperture:	6 mm Front Raked Mechanical	
Peak flow through screen field (Mega Litre/day):	100	
Discharge from channel floor level	4050	
Discharge from Top of channel	1800	
Channel Width x Depth	1800 x 2250	
Maximum Channel Flow Depth in Front of Screen at PDWF	1523	
Mounting type:	Channel	
Max height differential across screen (mm)	75	
Operating range of unit, water flow (m ³ /s)	0 – 1.16	
Operating range of unit, screenings (kg/hr)	6 - 150	
Overall length (mm):		
Operating speed of rake mechanism (m/s):		
Material of fasteners:	304L Stainless Steel	
Material of frame:	304L Stainless Steel	
Material of screen field:	304L Stainless Steel	
Method of replacing screen field:	-	
Screen bar dimensions (mm X mm):	-	
Material of rake assembly:	304L Stainless Steel	
Material of rake comb:	-	

Parameter	Required	Offered
Method of replacing rake comb:	-	
Material of chain:	Vesconite rollers, 304L S.S side plates & pins.	
Material of chain guides:	304L Stainless Steel	
Material of sprockets:	304L Stainless Steel	
Details of bottom bearing or turnaround:	-	
Lubrication of bottom bearing:	-	
Material of wiper assembly:	304L Stainless Steel	
Material of wiper blade:	UHDPE	
Description of overload protection system:	-	
Make and model of motor:	-	
MECHANICAL SCREEN MOTOR		
Manufacturer:		
Type of motor:		
Type of casing:		
Class of insulation (IP):		
Speed of rotation (rpm):		
Rated output (kW):		
Absorbed power at design duty (kW):		
Efficiency at full road		
Min. torque required at start		
Anti-condensation heater rating		
GEARBOX		
Manufacturer:		

Parameter	Required	Offered
Type and model:		
AGMA rating (kW):		
Thermal rating (kW):		
Service factor:	> 1.75	
Efficiency at rated output:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SC:03

3mm Fine - Mechanical Screens

Equipment Tag: 01-IW-01-SC-10, 01-IW-01-SC-11

Number of Equipment Type: 2

Parameter	Required	Offered
Make and model:		
Type, design and screen aperture:	3 mm Front Raked Bar screen	
Peak flow through screen field (Mega Litre/day):	100	
Discharge from channel floor level	4050	
Discharge from Top of channel	1800	
Channel Width x Depth	1800 x 2250	
Maximum Channel Flow Depth in Front of Screen at PDWF	1523	
Mounting type:	Channel	
Max height differential across screen (mm)	75	
Operating range of unit, water flow (m ³ /s)	0 – 1.16	
Operating range of unit, screenings (kg/hr)	6 - 75	
Overall length (mm):	-	
Operating speed of rake mechanism (m/s):	-	
Material of fasteners:	304L Stainless Steel	
Material of frame:	304L Stainless Steel	
Material of screen field:	304L Stainless Steel	
Method of replacing screen field:	-	
Screen bar dimensions (mm X mm):	-	
Material of rake assembly:	304L Stainless Steel	
Material of rake comb:	-	

Parameter	Required	Offered
Method of replacing rake comb:	-	
Material of chain:	Vesconite rollers, 304L S.S side plates & pins.	
Material of chain guides:	304L Stainless Steel	
Material of sprockets:	304L Stainless Steel	
Details of bottom bearing or turnaround:	-	
Lubrication of bottom bearing:	-	
Material of wiper assembly:	304L Stainless Steel	
Material of wiper blade:	UHDPE	
Description of overload protection system:	-	
MECHANICAL SCREEN MOTOR		
Manufacturer:		
Type of motor:		
Type of casing:		
Class of insulation (IP):		
Speed of rotation (rpm):		
Rated output (kW):		
Absorbed power at design duty (kW):		
Efficiency at full road		
Min. torque required at start		
Anti-condensation heater rating		
GEARBOX		
Manufacturer:		
Type and model:		

Parameter	Required	Offered
AGMA rating (kW):		
Thermal rating (kW):		
Service factor:	> 1.75	
Efficiency at rated output:		

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SC:04

Hand Raked Screens

Equipment Tag: 01-IW-01-SC-01, 01-IW-01-SC-02, 01-IW-01-SC-07, 01-IW-01-SC-08
Number of Equipment Type: 4

Parameter	Required	Offered
Make and model:	-	
Type, design and screen aperture:	-	
Peak flow through screen field (m3/hr):	-	
Max Screen Solids Loading Rate (ADWF) (kg/hr):	-	
Operating width of screen field (mm):	-	
Operating height of screen field (mm):	-	
Maximum headloss through screen (mm)	-	
Mounting type:	Channel	
Overall width of frame at level of screen field (mm):	-	
Overall height (mm above top of channel):	-	
Discharge level (mm above top of channel):	-	
Overall length (mm):	-	
Material of fasteners:	304L Stainless Steel	
Material of frame:	304L Stainless Steel	
Material of screen field:	304L Stainless Steel	
Screen bar dimensions (mm X mm):	-	
Overall mass of unit (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SC:05

1mm Fine - Mechanical Screens

Equipment Tag: 01-SD-01-SC-01, 01-SD-01-SC-02

Number of Equipment Type: 2

Parameter	Required	Offered
Make and model:		
Type, design and screen aperture:	1 mm Wedge Wire	
Peak flow through screen field (m ³ /day):	600	
Max Screen Solids Loading Rate (ADWF) (kg/hr):	6	
Discharge from channel floor level	2500	
Discharge from Top of channel	1500	
Channel Width	1000	
Channel Depth	1000	
Maximum Channel Flow Depth in Front of Screen at peak flow	550	
Max height differential across screen	150	
Operating range of unit, water flow	0 -1	
Operating range of unit, screenings	0,5 to 3	
Maximum headless through screen (mm)		
Mounting type:	Channel	
Operating speed of rake mechanism (m/s):		
Material of fasteners:	304L Stainless Steel	
Material of frame:	304L Stainless Steel	
Material of screen field:	304L Stainless Steel	
Method of replacing screen field:	-	
Screen bar dimensions (mm X mm):	-	

Parameter	Required	Offered
Material of rake assembly:	304L Stainless Steel	
Material of rake comb:	-	
Method of replacing rake comb:	-	
Material of chain:	Vesconite rollers, 304L S.S side plates & pins.	
Material of chain guides:	304L Stainless Steel	
Material of sprockets:	304L Stainless Steel	
Details of bottom bearing or turnaround:	-	
Lubrication of bottom bearing:	-	
Material of wiper assembly:	304L Stainless Steel	
Material of wiper blade:	UHDPE	
Description of overload protection system:	-	
MECHANICAL SCREEN MOTOR		
Manufacturer:		
Type of motor:		
Type of casing:		
Class of insulation (IP):		
Speed of rotation (rpm):		
Rated output (kW):		
Absorbed power at design duty (kW):		
Efficiency at full road		
Min. torque required at start		
Anti-condensation heater rating		
GEARBOX		

Parameter	Required	Offered
Manufacturer:		
Type and model:		
AGMA rating (kW):		
Thermal rating (kW):		
Service factor:	> 1.75	
Efficiency at rated output:		

DATA SHEET REVISION: A

TENDERER

SIGNED

DATE

DATASHEET AT1: SK:01

Skip Dolly and Rail Track- Inlet Works

Equipment Tag:

01-IW-01-MM-01, 01-IW-01-MM-02, 01-IW-01-MM-03, 01-IW-01-MM-04,
01-IW-01-SK-01, 01-IW-01-SK-02, 01-IW-01-SK-03, 01-IW-01-SK-04

Number of Equipment Type:

8

Parameter	Required	Offered
DOLLY, RAIL TRACK & SKIP		
Skip Dolly materials (body, bracings etc.)	Hot-dipped Galvanized Mild Steel	
Dolly wheels material:	Cast Iron	
Rails material:	Mild Steel & Uncoated	
Waste Skip Volume (m ³):	6	
Fasteners	304 Stainless Steel	
CAPSTAN WINCH		
Make & model:		
Drive:		
Motor rating (kW):		
Pulling force (kN)	2 000	
Rope speed (m/min)	8 – 10	
Rope diameter (mm)		
IP rating:	55	
Drive:	Electric	
Winch Dimensions (L x W x H):		
Mass:		
Country of Manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:01

Sluice Gate – 15mm Front Raked Screen

Equipment Tag:

01-IW-01-SG-02, 01-IW-01-SG-03, 01-IW-01-SG-04, 01-IW-01-SG-05

Number of Equipment Type:

4

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Method of Operation:	Manual	
Gate Size (mm x mm):	1800 x 2250	
Max head when gate closed (mm)	1600	
Max unbalanced head against which gate will operate (mm):	1600	
Height of platform above channel invert (mm)	2250	
Height of operating gear (handwheel) above platform (mm)	1100	
Min Gate Travel (m):	1550	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Frame minimum material thickness (mm):		
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	

Parameter	Required	Offered
Seal removal procedure:	-	
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:02

Sluice Gate – 6mm Front Raked Screen

Equipment Tag:

01-IW-01-SG-06, 01-IW-01-SG-07, 01-IW-01-SG-08, 01-IW-01-SG-09

Number of Equipment Type:

4

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Method of Operation:	Manual	
Gate Size (mm x mm):	1800 x 2250	
Max head when gate closed (mm)	1600	
Max unbalanced head against which gate will operate (mm):	1600	
Height of platform above channel invert (mm)	2250	
Height of operating gear (handwheel) above platform (mm)	1100	
Min Gate Travel (m):	1550	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Frame minimum material thickness (mm):		
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	

Parameter	Required	Offered
Seal removal procedure:	-	
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:03

Sluice Gate – 15mm and 6mm Bypass

Equipment Tag:

01-IW-01-SG-01, 01-IW-01-SG-10, 01-IW-01-SG-19, 01-IW-01-SG-20

Number of Equipment Type:

4

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Method of Operation:	Manual	
Gate Size (mm x mm):	1500 x 200	
Max head when gate closed (mm)	1370	
Max unbalanced head against which gate will operate (mm):	1370	
Height of platform above channel invert (mm)	2000	
Height of operating gear (handwheel) above platform (mm)	1100	
Min Gate Travel (m):	1400	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Frame minimum material thickness (mm):	-	
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	

Parameter	Required	Offered
Seal removal procedure:	-	
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):	-	
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:04

Sluice Gate – Vortex Degritter

Equipment Tag: 01-IW-01-SG-011, 01-IW-01-SG-012, 01-IW-01-SG-13, 01-IW-01-SG-014
Number of Equipment Type: 4

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Method of Operation:	Manual	
Gate Size (mm x mm):	1300 x 2250	
Max head when gate closed (mm)	1500	
Max unbalanced head against which gate will operate (mm):	1500	
Height of platform above channel invert (mm)	2250	
Height of operating gear (handwheel) above platform (mm)	1100	
Min Gate Travel (m):	1550	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Frame minimum material thickness (mm):		
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	

Parameter	Required	Offered
Seal removal procedure:	-	
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:05

Sluice Gate – 3mm Front Raked Screen

Equipment Tag:

01-IW-01-SG-15, 01-IW-01-SG-16, 01-IW-01-SG-17, 01-IW-01-SG-18

Number of Equipment Type:

4

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Method of Operation:	Manual	
Gate Size (mm x mm):	2000 x 2250	
Max head when gate closed (mm)	1500	
Max unbalanced head against which gate will operate (mm):	1500	
Height of platform above channel invert (mm)	2250	
Height of operating gear (handwheel) above platform (mm)	1100	
Min Gate Travel (m):	1550	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Frame minimum material thickness (mm):		
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	

Parameter	Required	Offered
Seal removal procedure:	-	
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: B

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:06

Sluice Gate – Primary Flow Division

Equipment Tag: 01-SS-01-SG-01, 01-SS-01-SG-02

Number of Equipment Type: 2

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Wall	
Method of Operation:	Manual	
Gate Size (mm x mm):	1000 x 750	
Max unbalanced head against which gate will operate	650	
Max head when gate closed	650	
Height of platform above wall	0	
Height of operating gear (hand wheel) above platform	1100	
Gate travel	750	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	
Seal removal procedure:	-	

Parameter	Required	Offered
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:07

Sluice Gate – Secondary Flow Division

Equipment Tag: 01-SS-01-SG-01, 01-SS-01-SG-02

Number of Equipment Type: 2

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Wall	
Method of Operation:	Manual	
Gate Size (mm x mm):	1000 x 700	
Max unbalanced head against which gate will operate	300	
Max head when gate closed	300	
Height of platform above wall	50	
Height of operating gear (hand wheel) above platform	1100	
Gate travel	750	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	
Seal removal procedure:	-	

Parameter	Required	Offered
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:08

Sluice Gate – Biological Reactor Bypass

Equipment Tag:

01-BR-01-SG-01 to 01-BR-SG-30

Number of Equipment Type:

30

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Channel	
Method of Operation:	Manual	
Gate Size (mm x mm):	1500 x 1500	
Max unbalanced head against which gate will operate	1200	
Max head when gate closed	1200	
Height of platform above wall	1800	
Height of operating gear (hand wheel) above platform	1100	
Gate travel	1300	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	
Seal removal procedure:	-	

Parameter	Required	Offered
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: SG:09

Sluice Gate – Service Water Abstraction

Equipment Tag: 01-MP-01-SG-01

Number of Equipment Type: 1

Parameter	Required	Offered
Make, Model and Type	-	
Mount type:	Wall	
Method of Operation:	Manual	
Gate Size (mm x mm):	750 x 750	
Max unbalanced head against which gate will operate	1200	
Max head when gate closed	1200	
Height of platform above wall	50	
Height of operating gear (hand wheel) above platform	1100	
Gate travel	750	
Maximum required operating torque for sluice gate's rated pressure (Nm [or N]):	75Nm	
Max. required operating torque for this application (Nm [or N]):	75Nm	
Material of frame:	304L Stainless Steel	
Material of door:	304L Stainless Steel	
Material of seal:	Vulcanised Rubber	
Material of door nut:	Brass	
Material of thrust nut:	Brass	
Material of guides and other sliding surfaces	PTFE	
Material of handwheel:	Cast Iron	
Material of spindle cover:	304L Stainless Steel	
Seal removal procedure:	-	

Parameter	Required	Offered
Material of fasteners:	304L Stainless Steel	
Diameter of handwheel [or equivalent] (mm):	-	
Gearbox ratio:	Hand Operated	
Torque limit:	-	
Mass (kg):		
County of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: VC:01

Vacuum Change over
Equipment Tag: 01-MP-01-VC-01
Number of Equipment Type: 1

Parameter	Required	Offered
Make and model:		
Body Material:		
Max Flow rate (l/s):		
Operating Pressure (kPa):		
Switching point (kPa):		
Load capacity of electrical contacts:		
Ambient Temperature:	55	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: VP:01

Chlorine Vaporiser

Equipment Tag: 01-MP-01-VP-01, 01-MP-01-VP-02

Number of Equipment Type: 2

Parameter	Required	Offered
Make & model:	-	
Type and design:	-	
Method of operation:	-	
Body material:	-	
Feed rate (kg/hr)	0.5 - 10	
Rated power (kW):	-	
Mass (kg):	-	
Country of manufacture:	-	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: WC:01

15mm Screen - Screenings Wash Compactor

Equipment Tag: 01-IW-01-WC-01, 01-IW-01-WC-04

Number of Equipment Type: 2

Parameter	Required	Offered
Make & model:		
Type and design:	Wash Compactor with Agitator	
Method of operation:	-	
Operating capacity(kg/hr):	150 – 6.0	
Overall dimensions (mm X mm X mm):	-	
Rated motor power (kW):	-	
Operating speed (rpm):	-	
Material of feed hopper:	304L Stainless Steel	
Material of screw:	304L Stainless Steel	
Material of screw trough:	304L Stainless Steel	
Material of discharge pipe:	304L Stainless Steel	
Material of compaction area:	304L Stainless Steel	
Material thickness of discharge pipe:	> PN10	
Details of wearing surfaces and liners:	-	
Required wash water flow (l/s):	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: WC:02

6mm Screen - Screenings Wash Compactor

Equipment Tag: 01-IW-01-WC-02, 01-IW-01-WC-05

Number of Equipment Type: 2

Parameter	Required	Offered
Make & model:		
Type and design:	Wash Compactor with Agitator	
Method of operation:	-	
Operating capacity(kg/hr):	150 – 6.0	
Overall dimensions (mm X mm X mm):	-	
Rated motor power (kW):	-	
Operating speed (rpm):	-	
Material of feed hopper:	304L Stainless Steel	
Material of screw:	304L Stainless Steel	
Material of screw trough:	304L Stainless Steel	
Material of discharge pipe:	304L Stainless Steel	
Material of compaction area:	304L Stainless Steel	
Material thickness of discharge pipe:	> PN10	
Details of wearing surfaces and liners:	-	
Required wash water flow (l/s):	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

DATASHEET AT1: WC:03

3mm Screen - Screenings Wash Compactor

Equipment Tag: 01-IW-01-WC-03, 01-IW-01-WC-06

Number of Equipment Type: 2

Parameter	Required	Offered
Make & model:		
Type and design:	Wash Compactor with Agitator	
Method of operation:	-	
Operating capacity(kg/hr):	75 – 6.0	
Overall dimensions (mm X mm X mm):	-	
Rated motor power (kW):	-	
Operating speed (rpm):	-	
Material of feed hopper:	304L Stainless Steel	
Material of screw:	304L Stainless Steel	
Material of screw trough:	304L Stainless Steel	
Material of discharge pipe:	304L Stainless Steel	
Material of compaction area:	304L Stainless Steel	
Material thickness of discharge pipe:	> PN10	
Details of wearing surfaces and liners:	-	
Required wash water flow (l/s):	-	
Mass (kg):	-	
Country of manufacture:	South Africa	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.6 ELECTRICAL DATASHEETS

The following Section of this Bid Specification Document outlines the mandatory requirements and expectations for all **Electrical Datasheets** pertaining to equipment and components proposed for the new 20.00 Ml/day Polokwane Regional Wastewater Treatment Plant (PRWWTP) for Polokwane Municipality.

Bidders are required to submit comprehensive, manufacturer-issued electrical datasheets as part of their technical submission. These datasheets are the primary means by which the Municipality and appointed engineering team will evaluate the suitability, performance, compatibility, and compliance of all proposed electrical infrastructure, from main switchgear and transformers down to individual sensors, Motor Control Centers (MCCs), and field instrumentation.

Failure to provide complete, accurate, and manufacturer-certified datasheets for ALL relevant electrical components may result in the technical disqualification of the bid. All supplied documentation must clearly demonstrate that the proposed equipment meets or exceeds the minimum performance, reliability, and safety standards specified within the Scope of Works, adhering strictly to South African national standards and environmental regulations. The datasheets must serve as a blueprint, confirming operational parameters, safety ratings, dimensional data, and power requirements necessary for seamless integration into the WWTW's SCADA and power distribution network.

Key information typically found in an electrical datasheet includes:

- **Absolute Maximum Ratings:** The limits (e.g., maximum voltage, current, and temperature) that must never be exceeded to prevent permanent damage to the component.
- **Recommended Operating Conditions:** The specific ranges within which the device is guaranteed to function reliably and meet its specified performance.
- **Electrical Characteristics:** Detailed specifications, often in tables and graphs, about performance aspects such as power consumption, input/output voltage levels, switching times, and impedance.
- **Pin Configurations and Functions:** Diagrams and tables illustrating the physical layout and purpose of each pin or connection, crucial for designing circuit boards.
- **Mechanical Dimensions and Packaging:** Physical specifications and thermal characteristics essential for the physical design and assembly of a product.
- **Application Information:** Guidance, sample circuits, and best practices for implementing the component effectively and avoiding common design errors.

In essence, these datasheet acts as a blueprint, providing the critical data needed for product selection, design, troubleshooting, and ensuring regulatory compliance.

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
1. 11kV Switchgear				
1.1	Ratings			
1.1.1	Rated voltage	kV	12kV	
1.1.2	Rated Power Frequency Withstand Voltage of CB	kV	28kV	
1.1.3	Rated Lightning Impulse Withstand Voltage of CB	kV	75kV	
1.1.4	Rated Frequency	Hz	50	
1.1.5	Rated short-time withstand current, (3 Sec) Symmetrical	kA	31.5	
1.2	Operating Details			
1.2.1	Operating sequence	-	O-0.3s-CO-3min-CO	
1.2.2	Break time	ms	60	
1.2.3	Opening time	ms	<45ms	
1.2.4	Closing time	ms	80	
1.2.5	Insulating medium	-	Gas	
1.3	Control Details			
1.3.1	Tripping and Closing Voltage	Vdc	Bidder to Specify	
1.3.2	Motor Rated Voltage	Vdc	Bidder to Specify	
1.4	Degree Of Protection as per IEC 60529			
1.4.1	Busbar Chamber	-	IP4X	
1.4.2	Switch And Contact Chamber	-	IP65	
1.4.3	CB Cubicle	-	IP4X	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
1.4.4	Arc vent ducts	-	Yes	
1.4.5	Painting colour	-	Bidder to Specify	
1.5	Cable Connections			
1.5.1	Incomer panel	-	Bidder to Specify	
1.5.2	Bus-section	-	N/A	
1.5.3	Feeder Panel	-	Bidder to Specify	
1.5.4	Control cabling	-	Rear, Bottom entry	
1.6	Cable earth switch	-	Yes	
1.7	Busbar earth switch	-	No	
1.8	Internal Arc resistance	-	Yes	
1.8.1	Accessibility type	-	A	
1.8.2	Access	-	FLR	
1.8.3	Arc duration	s	1	
1.8.4	Busbar Chamber	kA	31.5	
1.8.5	Circuit breaker Chamber	kA	31.5	
1.8.6	Cable Chamber	kA	31.5	
1.8.7	Arc venting	-	Yes	
1.9	System earthing	-	Solidly earthed	
1.10	Type of support Insulators	-	Solid Core	
1.11	Control Equipment On Panel			
1.11.1	Trip/close/Neutral switch	-	Yes	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
1.11.2	Local/Remote Switch (lockable)	-	Yes	
1.11.3	Remote trip/close port	-	Yes	
1.11.4	Earth Switch Position Indicator	-	White	
1.11.5	Circuit breaker open indication	-	Green	
1.11.6	Circuit breaker closed indication	-	Red	
1.11.7	Cable Live LED's	-	Yes	
1.11.8	Panel heaters	-	Yes (230V AC)	
1.11.9	LV compartment lighting	-	Yes	
1.12	Wiring requirements			
1.12.1	Auxiliary circuits	-	Black 2.5mm ²	
1.12.2	Secondary circuits	-	R,W,B phase colour	
1.12.3	Earthing circuits	-	Green/yellow	
1.12.4	Panel Wiring	-	Grey 2.5mm ² Multistrand	
1.12.5	CT secondary circuits	-	R,W,B phase colour	
1.13	Metering requirements			
1.13.1	Maximum Demand Ammeters per phase	-	Yes	
1.13.2	Multifunction power and energy meter	-	Yes	
1.14	Minimum Creepage Distance	mm/kV	31	
1.15	Type of Interlocks			
1.15.1	Cable Earth Switch for each feeder	-	Yes	
1.15.2	Generator supply circuit breaker	-	Yes	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
1.16	Maximum temperature of current carrying parts when carrying rated current continuously	°C	90	
1.17	Type and material of current carrying parts			
1.17.1	Type of main and arcing contacts	-	Bidder to Specify	
1.17.2	Material of contacts	-	Bidder to Specify	
1.17.3	Main disconnecter	-	Bidder to Specify	
1.17.4	Arcing	-	Bidder to Specify	
1.17.5	Cable earth switch	-	Bidder to Specify	
1.17.6	Contacts silver plated	-	Yes, Shall be more than 25 microns	
1.18	Dimensions and weight			
1.18.1	Height	-	Bidder to Specify	
1.18.2	Width	-	Bidder to Specify	
1.18.3	Depth	-	Bidder to Specify	
1.18.4	Weight	-	Bidder to Specify	
1.19	Outline drawing supplied by contractor - Digital and hard copy	-	Yes	
1.20	Number of maintenance instruction manuals	-	3	
1.21	Independent testing authority certificates held to prove type test ratings to SANS/IEC requirements	-	Yes	
1.22	Manufacturer	-	Bidder to specify	
1.23	Model/Type	-	Bidder to specify	
2. 110 and 48 Vdc System				
2.1	Battery			

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
2.1.1	Manufacturer	-	Bidder to Specify	
2.1.2	Type	-	Bidder to Specify	
2.1.3	Number of cells per battery	-	90 cells for 110 Vdc 40 cells for 48 Vdc	
2.1.4	Rated Ah	Ah	Bidder to Specify	
2.1.5	Float voltage per cell	V	Bidder to Specify	
2.1.6	Float voltage of battery for 110Vdc	V	126	
2.1.7	Float voltage of battery for 48Vdc	V	54	
2.1.8	Voltage per cell after discharge at 10 hour rate	V	1.7	
2.1.9	Overall dimensions of a battery bank	mm	Bidder to Specify	
2.2	Battery Chargers for 48 and 110 Vdc			
2.2.1	Manufacturer	-	Bidder to Specify	
2.2.2	Type	-	Thristor fired	
2.2.3	Rated output	A	At least 150	
2.2.4	Input voltage	V	415/230	
2.2.5	Input current	A	Bidder to Specify	
2.2.6	Input frequency	Hz	50	
2.2.7	Output float voltage for 110 Vdc	V	126	
2.2.8	Output float voltage for 48Vdc	V	54	
2.2.9	Output boost voltage per cell	V	1.48	
2.2.10	Output ripple	%	<5%	
2.2.11	Output Regulation under all combinations of input and output conditions 48 and 110 Vdc		±1% of set value	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
	Switchboards			
2.2.12	Rated Bus bar current	A	At least 400	
2.2.13	Rate Short-Circuit withstand current, 1 second	kA	25	
2.2.14	Degree of Protection	-	IP51	
2.2.15	Dimensions	mm	Bidder to Specify	
2.3	Moulded Case and Miniature Circuit Breakers			
2.3.1	Manufacturer		Bidder to Specify	
2.3.2	Type		Bidder to Specify	
2.3.3	Rated operational voltage	V	150	
2.3.4	Rated impulse withstand voltage	kV	15	
2.3.5	Rated normal current	A	Bidder to Specify	
2.3.6	Rated short circuit withstand current, 1 second	kA	25	
3. 11kV Circuit Breakers				
3.1	Manufacturer	-	Bidder to Specify	
3.2	Model	-	Bidder to Specify	
3.3	Type of Circuit Breaker	-	Gas Insulated Switchgear	
3.4	Design Altitude	Meters	1100 - 1400	
3.5	Type of Arc quenching medium	-	Vacuum	
3.6	Model	-	Bidder to Specify	
3.7	Rated (highest system) voltage	kV	12	
3.8	Nominal voltage	kV	11	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
3.9	Rated lightning impulse (BIL)	kV peak	75	
3.10	Power frequency one minute withstands voltage (wet and dry)	kV (r.m.s)	28	
3.11	Rated frequency	Hz	50	
3.12	Number of poles	-	3	
3.13	Rated Normal Current	A	Incomer: up to 1000A - Bidder to specify Feeder: up to 630A - Bidder to specify	
3.14	Rated Short-Circuit Making Current	kA	Bidder to Specify	
3.15	Rated Short-Circuit Breaking Current	kA	Bidder to Specify	
3.16	Duration of short-circuit	sec.	3	
3.17	Rated short time withstand current	kA	31.5	
3.18	Rated operating sequence	-	O-0.3s-CO-3 min-CO	
3.19	Rated out-of-phase making & breaking current	kA	25% x ISC at 2 x Un	
3.20	Minimum number of spare auxiliary contacts	-	Bidder to Specify	
3.21	Main Dimensions			
3.21.1	Depth	mm	Bidder to Specify	
3.21.2	Height	mm	Bidder to Specify	
3.21.3	Mass	kg	Bidder to Specify	
3.22	Manual Tripping & Closing Enclosure			
3.23	Degree of protection	-	IP55	
3.24	Operation counter	-	Included	
3.25	Local manual control	-	Included	
3.26	Test switches (dc)	-	Included	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
3.27	Anti-condensation heater	-	Included	
3.28	Local Control Panel	-	Included	
3.29	Anti-pumping relay	-	Included	
3.3	Local/remote point of control selector switch	-	Included	
3.31	Local operation push buttons	-	Included	
3.32	Minimum pressure lock-out and alarm relays	-	Included	
3.33	Light, anti-condensation heater and electricity socket outlet	-	Included	
3.34	Terminal blocks	-	Included	
3.35	Test switches (DC)	-	Included	
3.36	Pole discrepancy timer relay	-	Included	
4. Diesel Generators				
4.1	Manufacturer	-	Bidder to Specify	
4.2	Type	-	Bidder to Specify	
4.3	Normal Speed of Generator Set	rpm	1500	
4.4	Minimum Continuous Output at 0.85 p.f. lagging under Standard Conditions	kVA	750	
4.5	Diesel Engine	-	Diesel, Four stroke	
4.5.1	Maximum Cooling Water Temperature Rise	°C	100	
4.5.2	Lubricating Oil normal operating pressure	kPA	Bidder to Specify	
4.5.3	Lubricating Oil – running hours per litre of oil consumption	hours/L	5	
4.5.4	Fuel Consumption at full load	L/hour	Bidder to Specify	
4.5.5	Fuel Consumption at 75% load	L/hour	Bidder to Specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
4.5.6	Maximum momentary speed rise on rejection of rated output	%	5%	
4.5.7	Insulation Class of windings	-	F	
4.5.8	Dimensions:			
4.5.9	Width	mm	Bidder to Specify	
4.5.10	Depth	mm	Bidder to Specify	
4.5.11	Height	mm	Bidder to Specify	
4.5.12	Mass of generator set	kg	Bidder to Specify	
4.6	Noise level while running at:			
4.6.1	No load	dB (A)	72	
4.6.2	Rated output	dB (A)	75	
4.6.3	Type of Automatic Voltage Regulator	-	Bidder to Specify	
4.6.4	Governor: Type, Compliance	-	Bidder to Specify	
4.7	Control & Protection Panel Dimensions			
4.7.1	Width	mm	Bidder to Specify	
4.7.2	Depth	mm	Bidder to Specify	
4.7.3	Height	mm	Bidder to Specify	
4.8	Starting Battery			
4.8.1	Type	-	Ni-Cd	
4.8.2	Rating	Ah	Bidder to Specify	
4.9	Battery Charger			
4.9.1	Type	-	Automatic mode switching	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
4.9.2	Maximum rated output current	A	Bidder to Specify	
4.9.3	Resistive load	-	Bidder to Specify	
4.1	Generator controller			
4.10.1	Manufacturer	-	Bidder to Specify	
4.10.2	Auto switchover	-	Bidder to Specify	
4.10.3	Manual override	-	Bidder to Specify	
4.10.4	LCD screen	-	Bidder to Specify	
4.10.5	Keypad	-	Bidder to Specify	
4.10.6	Remote access and control	-	Bidder to Specify	
4.11	Voltage waveform			
4.11.1	Frequency	Hz	50	
4.11.2	THD	-	Bidder to Specify	
4.12	Sound attenuation			
4.12.1	Type	-	Bidder to Specify	
4.12.2	Measures	-	Bidder to Specify	
4.13	Fuel tank			
4.14.1	Type	-	Bidder to Specify	
4.14.2	Capacity	-	Bidder to Specify	
5. 0.4/11kV (Step-up) Voltage Transformers				
5.1	Manufacturer	-	Bidder to Specify	
5.2	Model	-	Bidder to Specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
5.4	Design Altitude	Meters	1100 - 1400	
5.5	Design Humidity	%	92	
5.6	Design Ambient operation temperature	°C	-10 to 40	
5.7	Indoor / Outdoor installation	-	Indoor	
5.8	Natural or forced Ventilation	-	Natural	
5.9	Rated (highest system) voltage	kV	11	
5.10	Rated primary voltage	V	400/415V	
5.11	Rated secondary voltage	kV	11	
5.12	Rated frequency	Hz	50	
5.13	Rating	kVA	Bidder to Specify	
5.14	Transformer vector group	-	Delta/Y (Dny11)	
5.15	Mounting	-	Floor mount	
5.16	Top-oil thermoelectric temperature-sensing element	-	To be Included	
5.17	Top oil temperature rise measured by thermometer	°C	<35	
5.18	Type of Bushings LV	-	Porcelain	
5.19	Type of Bushings MV	-	Porcelain	
5.2	Accuracy Class	-	Bidder to Specify	
5.21	Audible sounds	dB	<60	
5.22	Measurements	-	Bidder to Specify	
5.23	Cable termination type	-	Bidder to Specify	
5.24	Cable support	-	Bidder to Specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
6. Electricity Metering				
6.1	Manufacturer	-	Bidder to Specify	
6.2	Model	-	Bidder to Specify	
6.3	Operational voltage	V	230/400 VAC; 100 VDC	
6.4	Single/Multi-phase	-	Three phase	
6.5	Current transformer (Rated 230V, 400V, 11kV) - Ratio	-	Bidder to Specify	
6.6	Meter input	A	1A/5A	
7. Uninterruptable Power Supply (UPS)				
7.1	Manufacturer and type number	-	Bidder to specify	
7.2	True on line double conversion type	-	Yes	
7.3	IP rating of unit	-	IP65	
7.4	Battery type and manufacturer	-	Bidder to specify	
7.5	Battery bank housed in ventilated steel enclosure same colour as UPS unit.	-	Bidder to specify	
7.6	Total Harmonic Distortion	%	<5	
7.7	UPS power rating if 230Vin/230Vout single phase and confirm	-	Yes	
7.8	Provide technical brochure of UPS offered, both for single phase and three phase output units.	-	Bidder to specify	
7.9	Provide technical brochure for batteries and the enclosure	-	Bidder to specify	
7.1	UPS has load plus 20% rating	-	Yes	
7.11	Provide dimensioned drawing of product for the correct sizes offered	-	Bidder to include	
7.12	Local agent and support within Southern	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
	Africa - specify who and where.			
8. Motor Control Centres(MCC's)				
8.1	Manufacturer/Assembly	-	Bidder to Specify	
8.2	Rated operational Voltage	V	400 (3 phase)	
8.3	Rated Bus Bar Current	A	Up to 3000A	
8.4	Rate Short-Circuit withstand Current, 1 second	kA	25/40/50	
8.5	Degree of Protection	-	IP55	
8.6	Access for Maintenance	-	Front doors, rear removable panel	
8.7	Does the installation adhere to SANS 60439 Parts 1 and 2		Bidder to Specify	
8.8	Dimensions			
8.8.1	Width	mm	Bidder to Specify	
8.8.2	Depth	mm	Bidder to Specify	
8.8.3	Height	mm	Bidder to Specify	
8.8.4	Total weight	kg	Bidder to Specify	
8.9	Control gear manufacturer	-	Bidder to Specify	
8.10	Protection gear manufacturer	-	Bidder to Specify	
8.11	Does controlgear comply with SANS60947	-	Bidder to Specify	
8.12	Paint and finishes:			
8.12.1	Colour	-	Bidder to Specify	
8.12.2	Painting method	-	Bidder to Specify	
8.13	Type test certification			

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
8.13.1	Certificate number	-	Bidder to Specify	
8.13.2	Testing authority	-	Bidder to Specify	
8.13.3	Testing authority certification number	-	Bidder to Specify	
9. Variable speed drives(VSD's)				
9.1	Name of manufacturer	-	Bidder to specify	
9.2	Place of manufacture	-	Bidder to specify	
9.3	Rated input voltage	V	400V (3 phase) / 230V (1 phase)	
9.4	Input frequency tolerance	Hz	47-53	
9.5	Fundamental power factor	-	0.97	
9.6	The efficiency of the drive	%	>96	
9.7	Output voltage	V	0V to rated supply voltage	
9.8	Output frequency	Hz	0-300	
9.9	Output frequency resolution	Hz	0.01	
9.1	Acceleration/deceleration time	seconds	Bidder to specify	
9.11	Short time overload capacity	-	150% for 1 minute/every 10 minutes (constant torque) and 110% for 1 minute/every 10 minutes (squared torque)	
9.12	Temperature	°C	-10 to +40	
9.13	Max, relative humidity	%	95 % non-condensing	
9.14	PWM control type	-	Yes	
9.15	Total THD	%	< 5%	
9.16	Control	-	Sensorless Vector	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
9.17	VSDs to include the following:			
9.17.1	On-load isolator, door interlocked	-	Bidder to specify	
9.17.2	Passivce/active filter included?	-	Bidder to specify	
9.17.3	Input contactor with AC-4 duty	-	Bidder to specify	
9.17.4	In-line input fuses	-	Bidder to specify	
9.17.5	6/12 pulse input rectifier,	-	Bidder to specify	
9.17.6	DC bus with reactor/capacitors,	-	Bidder to specify	
9.17.7	Latest design IGBT's for the inverter section,	-	Bidder to specify	
9.17.8	Microprocessor control of the inverter,	-	Bidder to specify	
9.17.9	Local LCD digital display and input keypad for on-board controller,	-	Bidder to specify	
9.17.10	Manual start-stop control, mounted on front door of panel (flush mounted push button type)	-	Bidder to specify	
9.17.11	Automatic/manual control selection, mounted on front door of panel (flush mounted cam switch type)	-	Bidder to specify	
9.17.12	Manual reset, mounted on front door of panel (flush mounted push button type)	-	Bidder to specify	
9.17.13	Speed adjustment control, mounted on front door of panel – rheostat,	-	Bidder to specify	
9.17.14	Emergency stop push button	-	Bidder to specify	
9.17.15	Three Pilot lights, mounted on front door of panel (22mm diameter LED pilot light type): Motor running (Green), Drive on (Blue), Drive fault (Red)	-	Bidder to specify	
9.18	Type test certification			

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
9.18.1	Certificate number	-	Bidder to Specify	
9.18.2	Testing authority	-	Bidder to Specify	
9.18.3	Testing authority certification number	-	Bidder to Specify	
10. Programmable Logic Controllers (PLC's)				
10.1	Manufacturer	-	Bidder to specify	
10.2	Type	-	Bidder to specify	
10.3	Processor:			
10.3.1	Model No	-	Bidder to specify	
10.3.2	Maximum no of racks	-	Bidder to specify	
10.3.3	Processor speed	-	Bidder to specify	
10.3.4	I/O capacity (digital)	-	Bidder to specify	
10.3.5	I/O capacity (analogue)	-	Bidder to specify	
10.3.6	Memory capacity	-	Bidder to specify	
10.3.7	Memory extendable	-	Bidder to specify	
10.3.8	Total number required	-	Bidder to specify	
10.3.9	Communication protocol	-	Bidder to specify	
10.4	I/O cards:			
10.4.1	Model No	-	Bidder to specify	
10.4.2	I/O capacity (digital)	-	Bidder to specify	
10.4.3	I/O capacity (analogue)	-	Bidder to specify	
10.4.4	Total number required	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
10.5	Power Supply:			
10.5.1	Supply Voltage	-	Bidder to specify	
10.5.2	Maximum variation	-	Bidder to specify	
10.5.3	Backup facility	-	Bidder to specify	
10.6	Rack:			
10.6.1	No of slots	-	Bidder to specify	
10.6.2	DIN rail mount	-	Bidder to specify	
10.6.3	Extendable	-	Bidder to specify	
10.7	Software:			
10.7.1	Programming Package	-	Bidder to specify	
10.7.2	Language	-	Bidder to specify	
10.7.3	Version	-	Bidder to specify	
10.8	Technical Literature required with Tender submitted	-	Bidder to specify	
10.9	Compliance with specification	-	Bidder to specify	
11. Supervisory Control and Data Acquisition(SCADA)				
11.1	SCADA			
11.1.1	Manufacturer	-	Bidder to specify	
11.1.2	Version	-	Bidder to specify	
11.2	Scanpoints			
11.2.1	Size	-	Bidder to specify	
11.2.2	Extendable	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
11.3	Communcation protocol	-	Bidder to specify	
11.4	Functions as per specifications	-	Bidder to specify	
11.5	Type of antivirus to be provided for the SCADA unit	-	Bidder to specify	
11.6	Workstation			
11.6.1	Operating system	-	Windows 10 Professional	
11.6.2	Processor family	-	Intel Xeon E5	
11.6.3	Chipset	-	Intel C602	
11.6.4	Form factor	-	Minitower	
11.6.5	Memory	-	16GB 1600 MHz DDR3 (expandable)	
11.6.6	Storage	-	1 TB SATA (expandable)	
11.6.7	Storage controller	-	SATA 6 Gb/s (RAID compatible)	
11.6.8	Optical drive	-	SATA SuperMulti DVD +/- RW	
11.6.9	Graphics	-	Full HD HDMI; Support for up four VGA monitors	
11.6.10	Ports	-	2 x USB 3.0; 2 x USB 2.0; 2 x PS/2 line in, line out	
11.6.11	Communication	-	Wireless 802.11 b/g/n	
11.6.12	Display	-	2 x Ethernet (independent IP) RS 232/422/485	
11.6.13	Warranty	-	42" FULL HD LED with tilting wall mount bracket	
11.6	SCADA server	-		
11.6.1	Operating system	-	Windows 10 Professional or Enterprise Windows Server 2008/2012/2016	
11.6.2	Processor family	-	Intel Xeon E5	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
11.6.3	Chipset	-	Intel C610	
11.6.4	Form factor	-	19" rack mount 1U or 2U	
11.6.5	Memory	-	16GB (minimum) DDR4 DIMM up to 2133MT/s (expandable)	
11.6.6	Storage	-	2 TB (minimum) SATA (expandable) With SSD option	
11.6.7	Storage controller	-	SATA 6 Gb/s with RAID with SSD option	
11.6.8	Optical drive	-	SATA SuperMulti DVD +/- RW	
11.6.9	Graphics	-	Full HD HDMI; Support for up four VGA monitors	
11.6.10	Ports	-	2 x USB 3.0; 2 x USB 2.0; 2 x PS/2 line in line out	
11.6.11	Communication	-	Wireless 802.11 b/g/n	
11.6.12		-	4 x 1GbE Ethernet (independent IP) RS 232/422/485	
11.6.13	Warranty	-	3-year warranty on all parts, labour with next business day onsite service	
11.7	19" Rack mount historian			
11.7.1	Operating system	-	Windows 10 Professional or Enterprise Windows Server 2008/2012/2016	
11.7.2	Processor family	-	Intel Xeon E5	
11.7.3	Chipset	-	Intel C610	
11.7.4	Form factor	-	19" rack mount 1U or 2U	
11.7.5	Memory	-	16GB (minimum) DDR4 DIMM up to 2133MT/s (expandable)	
11.7.6	Storage	-	8 TB (minimum) SATA (expandable) With SSD option	
11.7.7	Storage controller	-	SATA 6 Gb/s with RAID with SSD option	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
11.7.8	Optical drive	-	SATA SuperMulti DVD +/- RW	
11.7.9	Graphics	-	Full HD HDMI; Support for up four VGA monitors	
11.7.10	Ports	-	2 x USB 3.0; 2 x USB 2.0; 2 x PS/2 line in line out	
11.7.11	Communication	-	Wireless 802.11 b/g/n	
11.7.12		-	4 x 1GbE Ethernet (independent IP) RS 232/422/485	
11.7.13	Warranty	-	3-year warranty on all parts, labour with next business day onsite service	
11.8.	Software			
11.8.1	Type	-	64-bit, Windows based package	
11.8.2	Has the SCADA package been locally developed and supported?	-	Bidder to specify	
11.8.3	Has the user manuals and documentation been handed to the Engineer?	-	Bidder to specify	
12. Human Machine Interface (HMI)				
12.1	HMI			
12.1.1	Manufacturer	-	Bidder to specify	
12.1.2	Model	-	Bidder to specify	
12.2	Display			
12.2.1	Size	-	Bidder to specify	
12.2.2	Type	-	Touchscreen	
12.2.3	Monochrome/colour (state)	-	65536 colours	
12.2.4	Graphics capability (yes/no)	-	Bidder to specify	
12.2.5	Number of pixels (resolution)	-	800 x 640 pixel viewing resolution	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
12.2.5	Backlight lifetime	-	54000 hours of continuous operations	
12.2.6	Brightness and contrast adjustment	-	Yes	
12.3	Data entry pad			
12.3.1	Static and dynamic keys	-	Bidder to specify	
12.3.2	Service keys	-	Bidder to specify	
12.3.3	Alphanumeric keys	-	Bidder to specify	
12.4	Memory			
12.4.1	Type	-	Bidder to specify	
12.4.2	Size	-	Bidder to specify	
12.4.3	Extendable	-	Bidder to specify	
12.5	Communication protocol	-	Bidder to specify	
12.6	Software			
12.6.1	Programming software	-	Bidder to specify	
12.6.2	Version	-	Bidder to specify	
12.7	Functions as per detailed specification	-	Bidder to specify	
12.8	Other equipment offered by Tenderer:	-	Bidder to specify	
13. LV Power and Control Cables				
13.1	Manufacturer	-	Bidder to specify	
13.2	Model/Type	-	Bidder to specify	
13.3	Rated voltage	V	600/1000	
13.4	Insulating compound	-	PVC/XLPE	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
13.5	Sheathing compound	-	PVC	
13.6	Conductor	-	Copper/Aluminium	
13.7	Metallic armour	-	SWA/STA	
14. Instrumentation and Control Cables				
14.1	Manufacturer	-	Bidder to specify	
14.2	Model/Type	-	Bidder to specify	
14.3	Rated voltage	V	600/1000	
14.4	Insulating compound	-	PVC/XLPE	
14.5	Sheathing compound	-	PVC	
14.6	Conductor	-	Copper/Aluminium	
14.7	Metallic armour	-	SWA/STA	
15. MV Cables				
15.1	Manufacturer	-	Bidder to specify	
15.2	Model/Type	-	Bidder to specify	
15.3	Rated voltage	kV	6.35/11	
15.4	Insulating compound	-	XLPE	
15.5	Sheathing compound	-	PVC	
15.6	Conductor	-	Copper/Aluminium	
15.7	Metallic armour	-	SWA/STA	
16. Earthing and Lightning Protection				
16.1	List subcontractor will provide an earth resistivity survey and report including a recommended design	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
16.2	Manufacturer and type of copper rods installed and to SANS specifications - provide brochure	-	Bidder to specify	
16.3	Manufacturer and type of brass clamps to be used - provide brochure	-	Bidder to specify	
16.4	Type of earth well and cover to be provided - provide brochure or picture	-	Bidder to specify	
16.5	State who will provide the earthing and lightning protection certificates of compliance and certified resistance test sheets at each site.	-	Bidder to specify	
17. Instruments				
For all instruments, the following information is to be provided at minimum:				
17.1	Accuracy	%	Bidder to Specify	
17.2	Response time	per second	Bidder to Specify	
17.3	Working temperature range	°C	Bidder to Specify	
17.4	Working pressure range	kPa	Bidder to Specify	
17.5	Life expectancy	months	Bidder to Specify	
17.6	Maintenance period	months	Bidder to Specify	
17.7	IP rating	-	IP65 at minimum	
17.9	Dimensions	mm	Bidder to Specify	
17.10	Has the instrument brochure been provided to the Engineer?	-	Bidder to Specify	
17.11	Operating altitude	-	All altitudes up to 1400m	
17.12	Is the instrument able to operate in a corrosive environment?	-	Yes	
18. LV Distribution Board				

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
18.1	Manufacturer	-	Bidder to Specify	
18.2	Rated operational Voltage	V	400	
18.3	Rated Bus Bar Current	A	Bidder to Specify	
18.4	Rate Short-Circuit withstand Current, 1 second	kA	10/25/40/50	
18.5	Degree of Protection	-	IP55	
18.6	Access for Maintenance	-	Front/rear	
18.7	Dimensions			
18.7.1	Width	mm	Bidder to Specify	
18.7.2	Depth	mm	Bidder to Specify	
18.7.3	Height	mm	Bidder to Specify	
18.7.4	Total weight	kg	Bidder to Specify	
18.7.5	Control gear manufacturer	-	Bidder to Specify	
18.7.6	Protection gear manufacturer	-	Bidder to Specify	
19. Large Format LV Circuit Breaker				
19.1	Manufacturer	-	Bidder to Specify	
19.2	Type	-	Bidder to Specify	
19.3	Rated operational Voltage	V	400/415	
19.4	Rated impulse withstands Voltage	kV	8	
19.5	Rated normal Current	A	Bidder to Specify	
19.6	Rated Frequency	Hz	50	
19.7	Rated Short Circuit breaking Capacity	kA	5	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
19.8	Rated Short Circuit making Capacity	kA	5	
19.9	Extinguishing medium	-	Air/vacuum	
19.10	Rated Short Circuit withstand Current, 1 second	kA	10/25/40/50	
19.11	Design Features:			
19.11.1	Number of Poles	-	3	
19.11.2	Stored Energy Operation	-	Yes	
19.11.3	With drawable Mounting	-	Yes	
19.11.4	Rated Supply Control Circuit	Vdc	110	
19.11.5	Shunt and Adjustable Over-Current release	-	Yes	
19.11.6	Closing and Opening Push Button	-	Yes	
19.11.7	Auxiliary Contacts	-	up to 4 NO + 4 NC	
19.11.8	Overall Dimension (Width/Depth/Height)	mm	Bidder to Specify	
19.11.9	Total Weight	kg	Bidder to Specify	
20. Moulded Case and Miniature Circuit Breakers				
20.1	Manufacturer	-	Bidder to Specify	
20.2	Manufacturer type designation	-	Bidder to Specify	
20.3	Reference Standard	-	SANS	
20.4	Country of manufacturer	-	RSA	
20.5	Rated Operational Voltage			
20.18.1	AC MCCBs and MCBs	V	500	
20.18.2	DC MCCBs and MCBs	Vdc	110	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
20.6	Rated Normal Current			
20.6.1	AC MCCBs and MCBs	A	5A to 1000A	
20.6.2	DC MCCBs and MCBs	A	5A to 200A	
20.6.3	Rated Duty	-	Uninterrupted	
20.6.4	Rated Impulse withstand Voltage	kV	8	
20.6.5	Rated Frequency	Hz	50	
20.6.6	Rated Short Circuit breaking capacity	kA	25/40/50	
20.6.7	Rated Short Circuit making capacity	kA	25/40/50	
20.6.8	Rated Short Circuit withstand current, 1 sec	kA	25/40/50	
20.7	Number of poles			
20.7.1	AC MCCBs and MCBs	-	1/2/3/4	
20.7.2	DC MCCBs and MCBs	-	1/2	
20.7.3	Fixed installation	-	Yes	
20.7.4	Over-Current release	-	Yes	
20.7.5	Auxiliary Contacts	-	As required	
20.8	Mounting frame	-	Bidder to Specify	
21. Interior lighting				
21.1	Name of manufacturer	-	Bidder to specify	
21.2	Place of manufacture	-	Bidder to specify	
21.3	Manufacturer's reference	-	Bidder to specify	
21.4	Specification to which luminaire complies	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
21.5	Does the luminaire bear either the SABS mark or IEC mark?	-	Bidder to specify	
21.6	Material of housing	-	Bidder to specify	
21.7	Material of diffuser	-	Bidder to specify	
21.8	Material of sealing gasket	-	Bidder to specify	
21.9	Does the control gear comply with SANS 16347?	-	Bidder to specify	
21.10	Mass of luminaire as delivered (kg)	-	Bidder to specify	
21.11	Material of terminals	-	Bidder to specify	
21.12	Provide photometric files	-	Bidder to specify	
21.13	Life expectancy of luminaire?	-	Bidder to specify	
21.14	Have test reports been included in the tender?	-	Bidder to specify	
21.15	Has all documentation required been submitted with the tender?	-	Bidder to specify	
21.16	Guarantee Period - Luminaire	-	Five Years	
21.17	Guarantee Period - Control Gear	-	18 Months	
22. Exterior lighting				
22.1	Name of manufacturer	-	Bidder to specify	
22.2	Place of manufacture	-	Bidder to specify	
22.3	Manufacturer's reference	-	Bidder to specify	
22.4	Specification to which luminaire complies	-	Bidder to specify	
22.5	Does the luminaire bear either the SABS mark or IEC mark?	-	Bidder to specify	
22.6	Material of housing	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
22.7	Material of diffuser	-	Bidder to specify	
22.8	Material of sealing gasket	-	Bidder to specify	
22.9	Does the control gear comply with SANS 16347?	-	Bidder to specify	
22.1	Mass of luminaire as delivered (kg)	-	Bidder to specify	
22.11	Material of terminals	-	Bidder to specify	
22.12	Provide photometric files	-	Bidder to specify	
22.13	Life expectancy of luminaire?	-	Bidder to specify	
22.14	Have test reports been included in the tender?	-	Bidder to specify	
22.15	Has all documentation required been submitted with the tender?	-	Bidder to specify	
22.16	Guarantee Period - Luminaire	-	Five Years	
22.17	Guarantee Period - Control Gear	-	18 Months	
23. CCTV				
23.1	Name of manufacturer	-	Bidder to specify	
23.2	Place of manufacture	-	Bidder to specify	
23.3	Does the installation adhere to SANS 10222?	-	Bidder to specify	
23.4	Power supply			
23.4.1	Input voltage	V	Bidder to specify	
23.4.2	Over-voltage protection	-	Bidder to specify	
23.4.3	Over-current protection	-	Bidder to specify	
23.4.4	Short-circuit protection	-	Bidder to specify	
23.4.5	Lightning and surge protection	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
23.5	Supporting infrastructure	-		
23.5.1	Dedicated network cabinet with network switches and/or routers	-	Bidder to specify	
23.6	Cameras	-		
23.6.1	Manufacturer	-	Bidder to specify	
23.6.2	Model	-	Bidder to specify	
23.6.3	Colour	-	Black	
23.6.4	Ingress protection rating	-	IP66	
23.6.5	Built-in intelligent video analysis	-	Bidder to specify	
23.6.6	Resolution in day/night mode	-	1280 x 720p	
23.6.7	Focusing system type	-	Digital focusing system, Automatic	
23.6.8	Are the cameras fixed or rotating?	-	Bidder to specify	
23.6.9	Guarantee Period	-	Bidder to specify	
23.7	Digital video recorder (DVR)			
23.7.1	Make	-	Bidder to specify	
23.7.2	Model	-	Bidder to specify	
23.7.3	Storage period	-	Minimum of 30 days	
23.7.4	Colour	-	Black	
23.7.5	Number of channels	-	Bidder to specify	
23.7.6	Processor	-	Bidder to specify	
23.7.7	Functionality	-	Bidder to specify	
23.8	Playback			

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
23.8.1	Connectivity to LAN/WAN for remote access	-	Bidder to specify	
23.8.2	Security protocol measures	-	Bidder to specify	
23.9	Display			
23.9.1	Make	-	Bidder to specify	
23.9.2	Model	-	Bidder to specify	
23.9.3	Resolution	-	HD compatibility	
23.9.4	Size	-	Bidder to specify	
23.9.5	Colour	-	Black	
23.1	Provide technical brochure with tender submission	-	Bidder to specify	
24. Access Control				
24.1	Name of manufacturer	-	Bidder to specify	
24.2	Place of manufacture	-	Bidder to specify	
24.3	Does the installation adhere to SANS 2220 and SANS 60839?	-	Bidder to specify	
24.4	Power supply			
24.4.1	Input voltage	V	230	
24.4.2	Over-voltage protection	-	Bidder to specify	
24.4.3	Over-current protection	-	Bidder to specify	
24.4.4	Short-circuit protection	-	Bidder to specify	
24.4.5	Lightning and surge protection	-	Bidder to specify	
24.6	Access control panel (main entrance gate)	-		
24.6.1	Colour	-	Black	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
24.6.2	Ingress protection rating	-	IP68	
24.6.3	Type	-	Card reader/biometric access control panel and identification scanning	
24.6.4	Maximum card reader distance	-	7.6cm	
24.6.6	Guarantee Period	-	Bidder to specify	
24.7	Boom gate			
24.7.1	Opening angle	-	Bidder to specify	
24.7.2	Battery backup	-	Bidder to specify	
24.7.3	Material	-	Bidder to specify	
24.7.4	Manufacturer	-	Bidder to specify	
24.7.5	Model	-	Bidder to specify	
24.8	Access control panel (buildings)	-		
24.8.1	Colour	-	Black	
24.8.2	Ingress protection rating	-	IP68	
24.8.3	Type	-	Card reader/biometric system with magnetic lock on doors	
24.8.4	Maximum card reader distance	-	7.6cm	
24.8.5	Guarantee Period	-	Bidder to specify	
24.9	Access control computer			
24.9.1	Remote unit at access gate	-	Bidder to specify	
24.9.2	Connectivity/communications to main control	-	Bidder to specify	
24.9.3	Main control computer	-	Bidder to specify	
24.9.4	Software version	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
25. Intruder alarm				
25.1	PIR Motion detector			
25.1.1	Manufacturer	-	Bidder to specify	
25.1.2	Model/Type	-	Bidder to specify	
25.1.3	Current (alarm/standby):	-	Bidder to specify	
25.1.4	Voltage (operating):	Vdc	Bidder to specify	
25.1.6	Max relative Humidity:	%	95%	
25.1.7	Temperature (operating):	°C	-10 to +40	
25.1.8	Colour:	-	Bidder to specify	
25.1.9	Dimensions:	mm	Bidder to specify	
25.1.10	Material:	-	Bidder to specify	
25.2	Panic button	-		
25.2.1	Manufacturer	-	Bidder to specify	
25.2.2	Model/Type	-	Bidder to specify	
25.2.3	Minimum operating voltage	Vdc	Bidder to specify	
25.2.4	Maximum operating voltage	Vdc	Bidder to specify	
25.2.5	Maximum current consumption in mA	mA	Bidder to specify	
25.2.6	Dimensions (Ø x D)	mm	Bidder to specify	
25.2.7	Mass	grams	Bidder to specify	
25.2.8	Housing material	-	Bidder to specify	
25.2.9	Colour (housing)	-	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
25.2.10	Colour (cover)	-	Bidder to specify	
25.2.11	Temperature (operating):	°C	-10 to +40	
25.2.12	Maximum relative humidity	%	95	
25.2.13	Protection class	-	IP40	
25.3	Alpha Numeric Keypad			
25.3.1	Manufacturer	-	Bidder to specify	
25.3.2	Model/Type	-	Bidder to specify	
25.3.3	Dimensions	mm	Bidder to specify	
25.3.4	Weight	kg	Bidder to specify	
25.3.7	Indicators	-	Illuminated keys Status indicators Warning and indicating tones	
25.3.9	Relative humidity	-	Bidder to specify	
25.3.10	Temperature (operating)	°C	-10 to +40	
25.3.11	Current	mA	Bidder to specify	
25.3.12	Voltage (input)	Vdc	Bidder to specify	
25.4	Outdoor siren			
25.4.1	Manufacturer	-	Bidder to specify	
25.4.2	Model/Type	-	Bidder to specify	
25.4.3	Input power	Vdc	9 to 15	
25.4.4	Voltage on +12V CHR	Vdc	12,0 to 14.5	
25.4.5	Output voltage on +BAT	Vdc	19.8 (+/- 0.2)	
25.4.6	Residual ripple allowed	mV	250	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
25.4.7	Consumption in standby	mA	Bidder to specify	
25.4.8	Autonomy on internal battery	hours	72	
25.4.9	Length of alarm	-	OUT: 180 sec / IND: 31 min	
25.4.10	Consumption in alarm & sound power	-	Bidder to specify	
25.4.11	Consumption in only alarm light	mA	Bidder to specify	
25.4.12	Order voltage SIR and I/O	Vdc	Bidder to specify	
25.4.13	Triggering voltage SIR and I/O	Vdc	Bidder to specify	
25.4.14	Reset voltage SIR and I/O	Vdc	Bidder to specify	
25.4.15	Backup power supply	-	Bidder to specify	
25.4.16	Output Power	-	Bidder to specify	
25.5	Outdoor strobe light			
25.5.1	Manufacturer	-	Bidder to specify	
25.5.2	Model/Type	-	Bidder to specify	
25.5.3	Input power	Vdc	9 to 15	
25.5.4	Consumption in standby	mA	Bidder to specify	
25.5.5	Autonomy on internal battery	hours	72	
25.5.6	Length of alarm	-	OUT: 180 sec / IND: 31 min	
25.5.7	Consumption in alarm & sound power	-	Bidder to specify	
25.5.8	Consumption in only alarm light	mA	Bidder to specify	
25.5.9	Order voltage SIR and I/O	Vdc	Bidder to specify	
25.5.10	Triggering voltage SIR and I/O	Vdc	Bidder to specify	

POLOKWANE RWWTW: ELECTRICAL DATASHEETS				
REF.	DESCRIPTION	UNIT	REQUIRED	OFFERED
25.5.11	Reset voltage SIR and I/O	Vdc	Bidder to specify	
25.5.12	Backup power supply	-	Bidder to specify	
25.5.13	Output Power	-	Bidder to specify	

DATA SHEET REVISION: 0

TENDERER

SIGNED

DATE

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.7 OPERATIONS AND MAINTENANCE DATA

An Operations and Maintenance (O&M) Contract for the Polokwane Municipality 20 Ml/day Polokwane Regional Wastewater Treatment Plant (PRPRWWTW) has been integrated into the overall bid specification document, additional twelve months O&M Term Service Contract period over and above the construction period specified. This contract section shall outline the post-commissioning obligations of the Contractor, who is also responsible for the construction of the Civil, Mechanical, Electrical, and Instrumentation works which makes this contract a **Build and Operate Model (BOM)**.

C5.7.1 OPERATIONS AND MAINTENANCE (O&M) CONTRACT PROVISIONS

1. SCOPE OF WORK FOR THE OPERATIONS AND MAINTENANCE (O&M) PHASE

The Contractor shall, upon Practical Completion and Commissioning of the 20.00 Ml/day PRWWTW, assume full responsibility for its operation, management, and maintenance. The scope includes:

- **Plant Operation:** 24/7 management of the entire wastewater treatment process (inlet works, biological reactors, secondary clarification, sludge handling, disinfection, etc.) to ensure continuous and efficient operation.
- **Maintenance:** Routine, preventative, and corrective maintenance of all civil, mechanical, electrical, and instrumentation (CME&I) infrastructure and equipment to ensure their optimal performance and design life.
- **Compliance Monitoring & Reporting:** Continuous monitoring and reporting of effluent quality in accordance with the National Water Act and the General Authorisation limits set by the Department of Water and Sanitation (DWS), including the SANS 241 standards where applicable to the final disposal or reuse of waste products including final treated effluent and sludge.
- **Sludge Management:** Complete handling, treatment (digestion/dewatering), and disposal of all generated sludge at a licensed facility.
- **Chemical and Consumables Supply:** Procurement, storage, and management of all necessary chemicals, spare parts, and consumables.
- **Staffing:** Provision of adequately qualified and experienced staff, including a Plant Manager/Supervisor and process controllers certified according to Regulation 2834, available on-site for the duration of shifts.

2. CONTRACT DURATION AND COMMENCEMENT

The O&M contract shall commence immediately following the successful completion of the commissioning and acceptance tests of the PRWWTW. The initial term of the O&M contract shall be for a period of **twelve (12) months** with options for renewal, according to the discretion of the Municipality.

3. Performance Standards and Key Performance Indicators (KPIs)

The Contractor's performance will be measured against specific KPIs, which will be benchmarked during an initial period (if applicable). Failure to meet these standards may result in penalties or contract termination.

- **Effluent Quality:** Compliance with all DWS licence conditions (e.g., Chemical Oxygen Demand, Suspended Solids, pH, E.Coli limits). Non-compliance events must be reported immediately.
- **Plant Availability/Uptime:** Target availability of the plant and key equipment (e.g., 98.00 % operational uptime).
- **Operational Efficiency:** Optimisation of energy and chemical consumption.

- **Reporting:** Timely submission of monthly O&M reports, compliance reports, and safety records to the Polokwane Municipality.
- **Safety & Environment:** Adherence to the Occupational Health & Safety Act of 1993 and all environmental management requirements.

4. PAYMENT AND FINANCIAL PROVISIONS

The contract shall specify a clear payment mechanism, structured to incentivise efficient and effective performance.

- Payment follows a fixed monthly O&M fee based on Part C: Schedule 25 and a deductible component linked to underperformance penalties for under-achievement of KPIs. The O&M rate provided under Part C: Schedule 25 includes all components requirements necessary for the O&M functions for each months. This shall include but not limited to staffing, electricity, water, chemicals, maintenance and breakdown equipment, repairs, waste handling and disposal, cleaning, landscape management and skill transfer to Municipal employees responsible for taking over the PWWTW upon the end of the O&M Contract.
- Underperformance penalties for O&M shall be R 5,000.00 per day per KPI underachieved (Environmental Impact Management related KPIs) and R 5,000.00 per each incident of non-compliance on Occupational Health and Safety regulations.
- All invoices shall be submitted monthly and processed according to the Municipality's standard payment cycle.
- Price adjustments for inflation will be managed via an agreed-upon index (e.g., Contract Price Adjustment coefficients and CPI or a specific industry index) prescribe for the rest of the CME&I Contract.
- The O&M Certificates shall continue and be integrated with the entire CME&I payment certificates, which should be submitted monthly.

5. ASSET MANAGEMENT AND HANDOVER

- **Asset Condition:** The Contractor is responsible for maintaining the assets in a good working order, reasonable wear and tear excepted. A condition assessment will be conducted at the start and end of the O&M term and any damages or non-functional equipment shall be rectified prior to the final handover to the Municipality and the Project Engineer shall certify the suitable and operational condition of the PWWTW before handing over.
- **Manuals & Training:** The Contractor shall provide comprehensive O&M manuals and training to the Employer's (Municipality's) personnel during the contract period to facilitate a smooth eventual handover.

6. GOVERNING LAW AND DISPUTE RESOLUTION

The contract shall be governed by the laws of the Republic of South Africa and FIDIC Red Book (2017 Edition) for specific clauses for dispute resolution, often involving mediation, adjudication or arbitration. The dispute resolution mechanism in the FIDIC Red Book (2017 Edition) is a multi-tiered process primarily detailed in **Clause 21: Disputes and Arbitration** with initial stages in **Clause 20: Employer's and Contractor's Claims** and **Sub-Clause 3.7: Agreement or Determination**). The process shall follows a progressive path as prescribe below:

a) Engineer's Determination (Sub-Clause 3.7)

The initial step for any claim (whether by the Employer or Contractor) is for the Engineer to manage it.

- The Engineer must first consult with both Parties in an endeavours to reach a binding agreement within 42 days.
- If no agreement is reached, the Engineer makes a **fair determination** within a further 42 days, considering all relevant circumstances.
- This determination is binding on both Parties unless a **Notice of Dissatisfaction (NOD)** is issued within 28 days. If no NOD is given, the determination becomes final and binding.

b) Dispute Avoidance/Adjudication Board (DAAB) (Clause 21)

If a Party is dissatisfied with the Engineer's determination and issues a NOD, the matter becomes a "Dispute" and must be referred to a standing **Dispute Avoidance/Adjudication Board (DAAB)** for a decision.

- **Dispute Avoidance (Sub-Clause 21.3):** The Parties may jointly request the DAAB to provide informal assistance or an opinion to help avoid a dispute. This assistance is not binding and the DAAB is not bound by the views expressed during this stage.
- **Adjudication (Sub-Clause 21.4):** A formal dispute is referred to the DAAB, which must give its reasoned decision within 84 days. The DAAB's decision is binding immediately, and the Parties must comply promptly ("pay now, argue later"), even if a Party gives a subsequent NOD.
- A Party can issue a NOD regarding the DAAB's decision within 28 days. Failure to issue a NOD makes the DAAB decision final and binding.

c) Amicable Settlement (Sub-Clause 21.5)

If a NOD has been issued after the DAAB decision, the Parties must attempt to settle the dispute amicably.

- This cooling-off period lasts for 28 days (reduced from 56 days in the 1999 edition).
- Arbitration cannot commence until this period has passed, unless both parties agree otherwise.

d) Arbitration (Sub-Clause 21.6)

If the dispute is not resolved through amicable settlement, it is finally settled by international arbitration.

- The arbitration is typically conducted under the **Rules of Arbitration of the International Chamber of Commerce (ICC Rules)**, unless otherwise specified in the Contract.
- The arbitral tribunal has the power to open up, review, and revise any decision or determination made by the Engineer or the DAAB.
- **Direct routes to arbitration** exist in specific cases, such as a Party failing to comply with a final and binding Engineer's determination or a DAAB decision, or if no DAAB is in place.

7. INSURANCE AND RISK

The Contractor shall maintain all necessary insurances, including public liability and asset insurance, for the duration of the O&M period. The risk register developed during the design and build phases shall be continually updated and managed.

8. SANS SPECIFICATIONS IN THE O&M CONTRACT

The Operations and Maintenance (O&M) Contract shall explicitly reference the latest editions of relevant South African National Standards (SANS), as developed by the South African Bureau of Standards (SABS). These standards ensure quality, safety, and regulatory compliance throughout the Operation And Maintenance Phases.

The Contractor is responsible for ensuring all O&M activities adhere to the following SANS specifications, in addition to the core legislative requirements of the **National Water Act** and the **Occupational Health & Safety Act of 1993**:

a) General and Management Standards

- **SANS ISO 9001:** Quality management systems: The Contractor must implement and maintain a quality management system for the O&M of the facility.
- **SANS 1921-1:** Construction and management requirements for works contracts Part 1: General engineering and construction works: Applicable to ongoing civil maintenance and minor works within the O&M period.

b) Civil, Mechanical, Electrical, and Instrumentation (CME&I)

- **SANS 1200 series:** Standardized specifications for civil engineering construction: These form the baseline for all civil works, including pipe trenches (SANS 1200 DB), bedding (SANS 1200 LB), and pipelines. The O&M phase requires adherence to these standards during repairs and infrastructure replacement.
- **SANS 10400:** The application of the National Building Regulations: Ensuring all building structures within the PRWWTW site comply with safety and structural integrity standards.
- **SANS 10142:** The wiring of premises: Applicable to all electrical installations, maintenance, and fault finding within the plant.
- **SANS 10254:** The installation, maintenance, replacement and repair of fixed electric storage water heating systems: Ensuring the safe operation of any associated water heating systems.
- **SANS 10162:** The structural use of steel: Relevant for the inspection and maintenance of all structural steelwork and mechanical equipment supports.

c) Operational and Performance Standards

- **DWS General Authorisation (GA) Limits/Effluent Quality:** While SANS 241 is the standard for drinking water, the primary O&M performance standard for *discharge* is compliance with the specific Wastewater Limit Values (WLVs) detailed in the DWS's General Authorisations under the National Water Act. The contract must list these exact limits as mandatory performance metrics.
- **SANS 10252 Parts 1 & 2:** Water supply and drainage for buildings: Governing internal water and drainage installations related to the administration buildings, laboratories, and operational facilities.

9. PERFORMANCE STANDARDS AND KEY PERFORMANCE INDICATORS (KPIs)

The Contractor's performance shall be rigorously measured against the stipulated SANS standards and regulatory limits:

- a) Effluent Quality Compliance:** The Contractor must ensure that all final treated effluent discharged from the 20.00 Ml/day PRWWTW consistently meets or exceeds the specific limits set out in the Facility's Water Use License and the DWS General Authorisations. This includes continuous monitoring and monthly reporting on:
- pH (between 6 and 9 units)
 - Chemical Oxygen Demand (COD) (not exceeding 75.00 mg/l, or specific licensed limit)
 - Suspended Solids (SS) (not exceeding 25.00 mg/l, or specific licensed limit)
 - Faecal Coliforms (e.g., < 1000 cfu/100ml for general release, specific limits apply for reuse)
 - Nutrient limits (Ammonia, Nitrates, Phosphates) as specified by the DWS in the license.
- b) Asset Management and Condition:** At handover, and annually thereafter, the Contractor shall provide an asset condition report confirming that all CME&I assets are maintained in accordance with their original design specifications and relevant SANS 1200 and SANS 10142 maintenance requirements, ensuring a minimum of 98.00 % plant availability.
- c) Laboratory Quality Control:** All water quality testing and sampling procedures must align with established SANS methods for the analysis of water and wastewater, ensuring data integrity for compliance reporting.

10. MEMORANDUM OF AGREEMENT (MOA)

A formal **Memorandum of Agreement (MOA)** shall legally binds Polokwane Municipality and the appointed Contractor to the terms and conditions outlined in the bid specification and contract documents. The O&M Contract shall comply with the MFMA Section 33 and the **Municipal Systems Act**. The MOA below serves as the execution document that formalizes the relationship and references the full contract documents (e.g., the detailed Scope of Work, Pricing Data, and the main Conditions of Contract which is FIDIC Red Book 2017 Edition).

MEMORANDUM OF AGREEMENT (MOA)

FOR THE OPERATIONS AND MAINTENANCE (O&M) OF THE 20.00 M³/DAY
WASTEWATER TREATMENT WORKS (WWTW) IN POLOKWANE MUNICIPALITY
ENTERED INTO BY AND BETWEEN:

POLOKWANE LOCAL MUNICIPALITY

A municipality established in terms of the Local Government: Municipal Structures Act, 117 of 1998, with its address at [Insert Municipality Address], (hereinafter referred to as the "Employer")

AND

.....
[CONTRACTOR NAME]

A company duly incorporated in accordance with the laws of the Republic of South Africa, with registration number [Insert Registration Number], and its registered address at [Insert Contractor Address], (hereinafter referred to as the "Contractor")

(The Employer and the Contractor hereinafter collectively referred to as "the Parties")

1. INTERPRETATION

- 1.1 The headings in this Agreement are for convenience only and shall not affect its interpretation.
- 1.2 In this Agreement, unless the context otherwise requires, the singular includes the plural and vice versa.

2. PURPOSE AND DURATION

- 2.1 The purpose of this Agreement is to legally bind the Parties to the terms and conditions for the Operation and Maintenance of the new 20.00 M³/day PRWWTW, following the successful completion of the design, civil, mechanical, electrical, and instrumentation works.
- 2.2 This Agreement shall commence on the **Effective Date** defined as the date of signature by the Client (Polokwane Municipality) on the Completion Certificate upon completion of the **Build Phase** and shall remain in force for a period of **twelve months [1 year]** with the possibility of extension.

3. ENTIRE AGREEMENT AND PRECEDENCE

- 3.1 This Memorandum of Agreement, together with the following incorporated documents, constitutes the entire agreement between the Parties:
 - The signed Form of Offer and Acceptance.
 - The Conditions of Contract (FIDIC Red Book 2017 Edition);
 - The Scope of Work (Parts C3 of the Bid Specification Document);
 - The Pricing Data/Schedules (Part C2 of the Bid Specification Document);
 - All Annexures (Part C5 of the Bid Specification Document), including the detailed SANS specifications and DWS compliance limits; and
 - All relevant Polokwane Municipality Supply Chain Management (SCM) Policies.
- 3.2 In the event of any conflict between the provisions of this MOA and any Annexure or other incorporated document, the provisions of this MOA shall take precedence, followed by the main Conditions of Contract.

4. OBLIGATIONS OF THE CONTRACTOR

- 4.1 The Contractor hereby agrees and undertakes to perform all Services for the O&M of the PRWWTW as set out in the Scope of Work (Part C3: Specifications and Part C5.7 Operation and Maintenance Data).
- 4.2 The Contractor will ensure that all operations and maintenance activities meet the Performance Standards and Key Performance Indicators (KPIs) specified in the bid document, including adherence to all relevant **SANS standards** and the **DWS General Authorisation limits**.
- 4.3 The Contractor shall ensure that its employees, agents, representatives, and sub-contractors comply with this Contract and all applicable South African Laws in the execution of the Works, including the Occupational Health & Safety Act of 1993.

5. OBLIGATIONS OF THE EMPLOYER (POLOKWANE MUNICIPALITY)

- 5.1 The Employer undertakes to grant the Contractor access to the site and existing infrastructure necessary for the performance of the O&M services.
- 5.2 The Employer shall pay the Contractor the amount due in accordance with the Pricing Data and the conditions of the contract.

6. CONFIDENTIALITY AND DATA PROTECTION

- 6.1 The Contractor acknowledges that it may process information classified as confidential or personal information (as defined in the **Protection of Personal Information Act, 2013 (POPIA)**) on behalf of the Employer.
- 6.2 The Contractor undertakes to keep such information confidential and maintain appropriate security measures to prevent unauthorised access or disclosure.

7. DISPUTE RESOLUTION

- 7.1 The Parties agree to the dispute resolution mechanism detailed in the Conditions of Contract (FIDIC Red Book 2017 Edition which is briefly described under C5.7.1 O&M Contract Data: Governing Law and Dispute Resolution, starting with good faith negotiations and escalating to formal adjudication or arbitration if unresolved.

8. GENERAL

- 8.1 **No Variation:** No amendment or variation of this Agreement shall be valid or of any force unless it is recorded in writing and signed by authorised representatives of both Parties.
- 8.2 **Cession/Assignment:** Neither Party may cede, assign, transfer, or otherwise make over any of its rights or obligations contemplated in this Agreement without the prior written consent of the other Party.
- 8.3 **Authority to Sign:** The persons signing this MOA warrant that they are duly authorised to enter into this contract on behalf of their respective entities.

THUS DONE AND SIGNED AT ON THIS DAY OF

..... 20

FOR THE EMPLOYER: POLOKWANE LOCAL MUNICIPALITY

Signature:

Print Name:

Capacity: The City Manager (or duly authorised delegate)

Address:

.....

.....

Witness (Client):

Signed by:

Print Name:

FOR THE CONTRACTOR:

Company Name:

Signature:

Print Name:

Capacity:

Address:

.....

.....

Witness (Contractor):

Signature:

Print Name:

POLOKWANE MUNICIPALITY

CONSTRUCTION, OPERATIONS AND MAINTENANCE OF THE POLOKWANE REGIONAL WASTEWATER TREATMENT WORKS (PRWWTW): PHASE 2B

C5.8 DRAWINGS

The following section of this bid specification document outlines the mandatory requirements and expectations for all **Mechanical and Electrical Datasheets** pertaining to equipment and components proposed for the new 20 ML/day Wastewater Treatment Plant (WWTP) at Polokwane Municipality.

Bidders are required to submit comprehensive, manufacturer-issued electrical datasheets as part of their technical submission. These datasheets are the primary means by which the Municipality and appointed engineering team will evaluate the suitability, performance, compatibility, and compliance of all proposed electrical infrastructure, from main switchgear and transformers down to individual sensors, Motor Control Centers (MCCs), and field instrumentation.

Failure to provide complete, accurate, and manufacturer datasheets for ALL relevant electrical components may result in the technical disqualification of the bid. All supplied documentation must clearly demonstrate that the proposed equipment meets or exceeds the minimum performance, reliability, and safety standards specified within the Scope of Works, adhering strictly to South African National Standards and environmental regulations. The datasheets must serve as a blueprint, confirming operational parameters, safety ratings, dimensional data, and power requirements necessary for seamless integration into the WWTP's SCADA and power distribution network.

This section of the Bid Specification details the comprehensive set of **Drawings** that form an integral part of the contract documents for the 20.00 ML/day Polokwane Regional Wastewater Treatment Works (PRWWTW) project. These drawings provide the detailed visual representations, precise dimensions, layouts, and technical specifications that the Contractor must adhere to during all phases of construction, installation, and commissioning.

GENERAL PROVISIONS AND CONTRACTOR OBLIGATIONS

- **Contract Documents:** The Drawings, in conjunction with the Specifications and the Bill of Quantities, define the entire scope of work. In the event of any discrepancy, the order of precedence defined in the contract conditions shall apply.
- **Accuracy and Compliance:** The Contractor is fully responsible for ensuring all materials and workmanship conform to the details shown on the drawings and all relevant SANS specifications.
- **Care and Supply:** The original Drawings are held in the custody and care of the Employer (Polokwane Municipality). Copies will be supplied to the successful Contractor, who is responsible for keeping a current set on Site for access by the Engineer and all personnel.
- **Errors/Defects:** If the Contractor discovers any error or defect of a technical nature in a drawing, they must promptly notify the Employer/Engineer in writing before proceeding with the affected work.

TYPES OF DRAWINGS INCLUDED

The bid document includes the following types of drawings, which serve as the basis for the bid submission and final construction:

- **Civil Drawings:** Depict the layout, dimensions, and general appearance of all structures and buildings within the WWTP site, including administration blocks, treatment units, ponds and pump houses.
- **Structural Drawings:** Detail the underlying framework, foundations, load-bearing elements, and reinforcement schedules for all civil works and treatment tanks, ensuring structural integrity.

- **Piping and Instrumentation Diagrams (P&IDs):** Provide schematic overviews of the entire treatment process flow, detailing all interconnected piping, fittings, valves, instrumentation, and control loops.

DELIVERABLES DURING THE CONTRACT

The successful Contractor will be required to develop and submit additional drawings throughout the project lifecycle:

- **Shop Drawings:** Detailed drawings prepared by the Contractor or manufacturers for specific fabrication or assembly of components, requiring approval by the Engineer before procurement or fabrication can commence.
- **As-Built Drawings:** A complete, updated set of records showing the exact as-built locations, sizes, and details of the work as executed on site. These are mandatory before the final Taking-Over Certificate is issued.

LIST OF DRAWINGS

The following files are included for the Tender Document:

- PM18.25.26 Drawings VOL1 RWWTW
- PM18.25.26 Drawings VOL2 RWWTW
- PM18.25.26 Drawings VOL3 RWWTW
- PM18.25.26 Drawings VOL4 RWWTW
- PM18.25.26 Drawings VOL5 RWWTW
- PM18.25.26 Drawings VOL6 RWWTW
- PM18.25.26 Drawings VOL7 RWWTW
- PM18.25.26 Drawings VOL8 RWWTW

NOTE: The complete set of drawings supplied with this bid document is issued for the purpose of tendering only. Bidders are advised that these drawings are for their retention and reference during the tender preparation process. Do not return the drawings with your submitted bid documentation.

END OF BID DOCUMENT