

**MOKOLO AND CROCODILE
WATER AUGMENTATION PROJECT
PHASE 2 (MCWAP-2)**

TENDER NO 054/2024/PMID/MCWAP2/RFB

**PART C3.1
SPECIFICATION**

SECTION 10

PIPE JACKING

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**SECTION 10
PIPE JACKING**

TABLE OF CONTENTS

	PAGE
SECTION 10	1
10.1 SCOPE OF WORK.....	1
10.2 DEFINITIONS.....	1
10.2.1 Definitions	1
10.2.2 References.....	2
10.3 LEGAL REQUIREMENTS AND RESPONSIBILITIES	2
10.4 SAFETY OF WORKS AND PERSONS AND ENVIRONMENTAL CARE.....	2
10.4.1 General.....	2
10.4.2 Safety Notices for Underground Work.....	2
10.4.3 Control of Entry	3
10.4.4 Environmental Care	3
10.5 MATERIALS	3
10.5.1 Jacking Elements.....	3
10.6 EQUIPMENT	3
10.6.1 General.....	3
10.6.2 Jacks.....	3
10.6.3 Intermediate Jacking Stations.....	4
10.6.4 Shield	4
10.6.5 Lighting.....	4
10.6.6 Ventilation.....	5
10.6.7 Use of Internal Combustion Engines	6
10.7 CONSTRUCTION.....	6
10.7.1 General.....	6
10.7.2 Safety Control Requirements	7
10.7.3 Recording of Movements.....	7
10.7.4 Temporary Supports	8
10.7.5 Restriction on Blasting	9
10.7.6 Excavation	9

PART C3.1 - SPECIFICATION

10.7.7	Jacking Procedure	11
10.7.8	Backfilling and Disposal of Excavated Material	11
10.7.9	Grouting and Plugging.....	12
10.7.10	Installation of Service Pipe	12
10.7.11	Annulus Grouting	12
10.7.12	Record Drawings.....	12
10.8	TOLERANCES.....	12
10.8.1	General.....	12
10.8.2	Permissible Deviations	13
10.8.3	Checking Alignment.....	13
10.9	TESTING.....	13
10.10	MEASUREMENT AND PAYMENT	13
10.10.1	Principles	13
10.10.2	Scheduled Items.....	14

LIST OF TABLES

TABLE 10/1 EXCAVATION CLASSIFICATION	9
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SECTION 10

PIPE JACKING

10.1 SCOPE OF WORK

This Section covers the design of the jacking elements and the jacking process, the manufacturing and insertion by jacking of concrete sleeve pipelines of diameter between 0.8 m and 3 m under infrastructure with disruption constraints such as busy roads, railways, canals, rivers etc., without disturbing the activities associated with such infrastructure. The Employer has defined the location, the minimum depth, the alignment constraints and the minimum internal diameter of the jacking element. Available geotechnical information is provided by the Employer in the interpretive geotechnical report included in the Contract documents. While the Employer is responsible for the design of the service pipe to be installed in the sleeve by the Contractor, the Contractor is responsible for the design of the skid or roller elements required for the installation of the service pipe as well as the installation process to prevent floating and damage to the coating. The Contractor is also responsible for grouting the annulus as specified and when required.

This Section needs to be read in conjunction with all the relevant specification sections included in this Contract.

10.2 DEFINITIONS

10.2.1 Definitions

For the purposes of this Section the following definitions shall apply:

- a) **“Annulus”** is the space between the internal diameter of the jacked sleeve pipe and the outer diameter of the installed service pipe.
- b) **“Composite pipe”** means a pipe comprising a steel cylinder with a reinforced concrete outer coating.
- c) **“Intermediate jacking station”** means a transverse joint in a jacking structure at which jacking is performed.
- d) **“Jacking”** means the action of pushing a sleeve pipeline into position.
- e) **“Jacking frame”** means a frame on which the jacks are mounted and through which the jacking forces are transmitted.
- f) **“Jacking pipe”** is a reinforced concrete pipe or composite pipe designed specifically for the jacking application. Commercially available jacking pipes complying with SANS 677 can be used if accompanied by an approved system application design.
- g) **“Jacking structure”** means an assembly comprising the jacking frame, the permanent pipes being jacked and the shield.
- h) **“Lead pipe”** means a pipe that has a rebated end over which the trailing end of the shield is fitted and that is intended to be the first pipe to be used in the jacking process.
- i) **“Reception pit”** means an excavated shaft that is located at the end of a jacked section of a pipeline and from which the shield is recovered.

PART C3.1 - SPECIFICATION

- j) **“Shield”** means a device that is located at the leading end of the jacking structure and is intended to provide protection for workmen at the leading end, and to prevent collapse of the face of the tunnel excavation.
- k) **“Thrust pit”** means an excavated shaft at the commencement point of a jacked section of a pipeline, in which the jacking structure and other equipment are installed and from which the jacking operations are carried out.
- l) **“Thrust plate”** means a steel plate that is placed against the end of the concrete pipe against which the jack operates and that is intended to ensure that the jacking forces are spread over the end face of the pipe.

10.2.2 References

When reference is made to a Code of Practice, Specification or Standard, the reference shall be taken to mean the latest edition or replacement at time of tender of the Code, Specification or Standard; including addenda, supplements, modifications and revisions thereto. Where a previous version is intentionally used, it will be indicated as such. Where reference is made to a Code, Specification or Standard that has subsequently been withdrawn and not replaced, the intended content will remain relevant unless confirmed otherwise in writing by the Engineer.

10.3 LEGAL REQUIREMENTS AND RESPONSIBILITIES

The Employer will arrange all way-leaves and clarify conceptual design aspects with the relevant authority. The Contractor shall comply with the relevant way leave requirements and all statutory controls and regulations with which the Contractor has to comply in carrying out the underground Works and all statutory appointments.

Whenever any official from a Government Department or Authority with jurisdiction over the relevant surface servitude above the underground Works visits the Site, the Contractor shall inform the Engineer immediately of such visit for the purpose of enabling the Engineer to participate in all such inspections, discussions and decisions arising there from.

10.4 SAFETY OF WORKS AND PERSONS AND ENVIRONMENTAL CARE

10.4.1 General

In addition to the provisions of Clause 10.3, the safety precautions taken in the pipe jacking works shall comply with the appropriate requirements of Section 2 – Occupational Health and Safety. The requirements of Clause 10.3 and Section 2 including any deviations from these shall be reflected in the Method Statement to be submitted for approval to the Engineer in terms of Clause 10.7.1.3 at least 14 days prior to the commencement of construction.

10.4.2 Safety Notices for Underground Work

The Contractor shall provide, erect and maintain all the required safety notices for underground work in accordance with the SANCOT standard pictograms published in SANS 1186 or similar approved safety notices.

10.4.3 Control of Entry

The Contractor shall establish and maintain effective systems to control access to the Works. A description of the systems of control to be used by the Contractor shall be submitted to the Engineer for approval at least 14 days before work commences. During construction, the Engineer reserves the right to withdraw any approval given if he is not satisfied that the systems, as approved, are being applied and enforced.

Where persons not normally engaged on the underground Works are authorised to enter the underground Works, they shall at all times be accompanied by a representative of the Contractor or Engineer.

10.4.4 Environmental Care

This Section needs to be read in conjunction with Section 3 - Socio Economic Requirements and Section 4 – Environmental Management respectively. Site specific provisions and intended deviations from the requirements stated in these Sections shall be reflected in a method statement for this construction process to be submitted for approval by the Engineer at least 14 days prior to the commencement of construction.

10.5 MATERIALS

10.5.1 Jacking Elements

The permanent jacking elements shall be reinforced concrete pipes, complying with the requirements of SANS 677. They shall have a minimum load designation of 100D unless specifically indicated otherwise on the Drawings and the joint shape should be the Ogee Type.

The Employer is required to only indicate the long term load conditions. However, the Contractor shall design the reinforced concrete jacking elements to suit his jacking equipment and the selected jacking process (Construction load conditions).

The jacking elements shall be procured well in advance of the start of their installation process to allow for the required curing and the 28 day strength characteristics to be signed off.

A separate steel service pipe is to be installed in the completed sleeve in compliance with Section 33 – Laying and Pressure Testing of Steel Pipes.

10.6 EQUIPMENT

10.6.1 General

The Contractor shall provide and use suitable equipment for handling sleeve pipes and placing them in position, for jacking the pipes, for lubrication of the outer surface of the pipes and for excavation for the pipes.

10.6.2 Jacks

Each set of jacks shall be fitted with a suitably calibrated pressure gauge in good working order, in a position such that the actual jacking forces can be read at any time during the jacking operation. To transfer the load from the jacks to the pipes, suitable thrust plates shall be provided for placing against the ends of the pipes.

10.6.3 Intermediate Jacking Stations

Under certain circumstances it may be necessary to provide an intermediate jacking station within a jacked length between the thrust and reception pits. Such a station shall consist of a pair of modified sleeve pipes. In order to form and protect the joint between these pipes, the Contractor shall provide cylindrical mild steel sleeves of wall thickness at least 8 mm and of such diameter and length that they overlap the modified sleeve pipes for a distance of at least 150 mm on either side of the joint.

10.6.4 Shield

A suitable shield for fitting to the front of the lead pipe shall be provided by the Contractor to protect workmen and prevent collapse of the face or roof of the excavation ahead of the jacked structure.

The shield shall be directionally adjustable. The method by which the shield is to be steered to achieve the specified tolerance in line and level shall be submitted for approval by the Engineer in the form of a draft Method Statement for subsequent discussion, agreement, amendment and resubmission (if necessary).

10.6.5 Lighting

10.6.5.1 Mains Lighting and Power System

Electrical cables for the supply of light and power shall be securely and safely fastened in place in such a way that cables are not damaged during construction. All power and lighting cables shall be maintained in good condition. Separate circuits shall be provided for lighting and power purposes and these circuits shall be protected by automatic earth leakage relays. All circuits shall be kept clear of signal and telephone cables. All electrical installations shall be adequately earthed to the approval of the Engineer and shall comply in all respects with statutory regulations.

The Contractor shall install, operate and maintain a lighting system in the sleeve until the completion of the Works. All lighting systems in underground Works and hand held electrically operated tools shall be operated at a voltage of 250 V. The lighting along all sleeves shall consist of at least 40 W waterproofed fluorescent lamps at intervals not exceeding 15 m, fitted along one side wall of the pipe such that illumination on a horizontal plane at floor level is not less than 10 lux and no significant area of the floor is in shadow. All hazards shall be clearly illuminated at all times.

Suitable high-intensity movable lamps shall also be provided by the Contractor to illuminate any area in the underground Works where the Engineer may wish to carry out testing or other inspection e.g. at a monitoring station or to inspect geological features.

All broken lamps shall be replaced immediately.

After excavation, modifications may be required to the lighting system to allow for subsequent construction and the Contractor shall make due allowances for this in his rates.

10.6.6 Ventilation

10.6.6.1 General

The Contractor shall install, operate and maintain a ventilation system in the underground Works to enable the Works to be constructed in healthy, well ventilated conditions. Dust shall be abstracted at or adjacent to the source.

To minimise the dust hazard arising from drilling operations in rock excavations, all holes shall be wet drilled. Water sprays or atomisers shall be used to prevent dust rising during mucking operations including keeping the floors of haulage ways damp.

The Contractor shall include a full and detailed Method Statement detailing his proposed ventilation system in the tunnels as part of the Jacking Method Statement submitted to the Engineer for his approval. The statement shall be accompanied by supporting calculations. The Method Statement shall be submitted at least 14 days before the start of any underground excavation. Approval of this Method Statement by the Engineer shall not relieve the Contractor of his obligations in terms of the Contract.

The Contractor shall take gas and dust concentration (air quality) readings at the face, bulkhead and elsewhere to measure the presence of noxious or other harmful gases or dust at least weekly and more regularly if necessary and when called upon to do so by the Engineer. When called for by the Engineer, the Contractor shall collect samples of air in the underground Works and send them for laboratory analysis.

Average concentrations shall not exceed the following limits:

Carbon dioxide:	5 000 parts/million by volume
Carbon monoxide:	50 parts/million by volume
Nitric oxide:	25 parts/million by volume
Nitrogen dioxide:	3 parts/million by volume
Hydrogen sulphide:	10 parts/million by volume

The above values shall relate to average concentrations over an 8 hour working shift. The maximum permissible limit at any time underground shall be the following:

Carbon dioxide:	15 000 parts/million by volume
Carbon monoxide:	100 parts/million by volume
Nitric oxide:	35 parts/million by volume
Nitrogen dioxide:	5 parts/million by volume
Hydrogen sulphide:	15 parts/million by volume

The Contractor shall ensure that the concentrations at all times comply with both the average and the maximum concentration levels.

When gas or dust concentrations exceed the specified limits, all persons in the affected area shall be notified and be required to wear respirators of a type approved by the Safety Officer.

The ventilation system used during construction shall ensure that at all times a minimum oxygen content of 19% by volume is present in the underground Works. Furthermore, the minimum fresh

PART C3.1 - SPECIFICATION

air requirements given herein refer to the air existing in such works and additional provision shall be made to account for any losses, e.g. due to leaks in the ducts, for which the Contractor shall make provision in the ventilation calculations.

Irrespective of the ventilation system used, the Contractor shall install adequate measures such as air movers and/or dust extractors to prevent the occurrence of “dead spots”. Instruments to register all the various noxious gases and dust shall at all times be available at each heading in good working order and condition. These shall be supplied and maintained by the Contractor for the duration of the underground work.

The Contractor shall be responsible for operating the ventilation system in the underground Works until all construction work is completed, including all work to be carried out by Subcontractors.

10.6.6.2 Maintenance of Ventilation Systems

All equipment and ducting shall be maintained in sound working order at all times. Any damage to ducting shall be repaired without delay.

Failure by the Contractor to comply with the above requirements or to maintain the prescribed ventilation standards will entitle the Engineer to order a temporary halt of all work within the affected area until the specified requirements are met, without any extension of time being granted and without any additional payment to the Contractor.

10.6.6.3 Records

The Contractor shall record all air quality readings and submit two copies of the recordings to the Engineer on a weekly basis unless otherwise instructed.

10.6.7 Use of Internal Combustion Engines

No internal combustion engine other than diesel engines shall be used in the underground Works.

10.7 CONSTRUCTION

10.7.1 General

10.7.1.1 Authority to Jack Pipeline under Facilities controlled by Third Parties

Except where otherwise required in terms of the Specification, the Employer will obtain prior permission from any third party who controls the land or any structure on the land (or both) under the surface of which the pipeline is to be jacked. He will also specify the said third party's requirements for warnings and procedures to be observed before and during jacking operations. Refer to Clause 10.3.

10.7.1.2 Competence

Jacking and excavation shall be supervised and undertaken only by persons fully conversant with this type of work.

10.7.1.3 Method Statement

The Contractor shall submit detailed design calculations, specifications and working drawings to show his methods of installation and methods of providing temporary support for the road, rail track or other infrastructure and any modifications to any structure required at least 14 days before pipe jacking commences.

Designs shall be carried out by a registered Professional Civil Engineer with adequate experience in this field. Calculations, specifications and drawings shall be signed by the Engineer responsible for their preparation. The Contractor shall not commence any work prior to the approval in principle by the Engineer of the design and associated relevant construction method statement.

10.7.1.4 Contractor solely Responsible

The Contractor shall remain solely responsible for the design and implementation of the jacking operation. Any permission or approval to proceed given in terms of Clause 10.7.1.3, or otherwise, shall not indicate acceptance by the Employer or the Engineer of any responsibility for safety or adequacy of jacking structure and methods of working and, in terms of the Contract, shall not limit the obligations and liabilities of the Contractor in regard to such safety or adequacy.

10.7.2 Safety Control Requirements**10.7.2.1 Jacking not to impair Safety**

The concrete sleeve shall be jacked under the road, railway or other infrastructure as applicable, without disrupting the normal operation of and without disturbing the alignment or levels of such infrastructure, to an extent that may impair the safety of traffic or the public using that infrastructure.

10.7.2.2 Examination of Structures at Risk

Before commencing work in the vicinity of any infrastructure, the Contractor shall make a detailed examination of the infrastructure, record its condition and levels, and submit a copy of such record to the Engineer prior to the commencement of construction. The record shall include at least a detailed level survey and a photographic record with clear date reference prior to construction.

10.7.3 Recording of Movements**10.7.3.1 General**

The Contractor shall take measurements after the construction period and shall record any change in line or level (or both) of any road, rail track, or other infrastructure being traversed. A copy of such record shall be made available to the Engineer immediately after the measurements have been recorded. This applies in particular to roadways and railways as described below.

10.7.3.2 Working under Roadways

Before commencing work under a roadway, the Contractor shall measure levels on the road surface directly over the jacking line and for a distance of at least 5 m on each side of the jacking line. These levels shall be measured at 500 mm intervals along each line of the road paint markings. In

PART C3.1 - SPECIFICATION

cases where the road has no painted shoulder markings, the shoulder levels shall be measured 300 mm from the edges of the surfacing.

Where the road has paved side drains, levels shall also be measured in the invert of the drains.

In order to facilitate control of the measuring of levels, the exact position of each spot height shall be identified and discreetly marked on the road surface before the levels are measured.

After completion of the Works, the Contractor shall re-measure the levels in the same positions as before, and shall submit to the Engineer the records of levels taken before and after jacking. The submission of such records shall be a prerequisite for any consideration by the Engineer of the acceptability or otherwise of completion of the Works or the issue of any certificate of completion.

If, within the Defects Notification Period, the road shows any sign of settlement in the vicinity of the jacked pipe, the road authority may re-measure levels on the Site.

The Contractor shall be held responsible for the rectification, to the satisfaction of the road authority, of any deformation that occurs in the road surface in the vicinity of the jacked pipe during the said period.

10.7.3.3 Working under Railways

Before commencing work under a railway the Contractor shall install benchmarks on either side of the embankment adjacent to the rail lines. The benchmarks shall be identified and installed at 500 mm intervals and for a distance of at least 5 m on each side of the jacking line. Before commencing work under the railway, the Contractor shall record levels on these benchmarks.

After completion of the Works, the Contractor shall re-measure the levels in the same manner as before, and shall submit to the Engineer the records of levels taken before and after jacking. The submission of such records shall be a prerequisite for any consideration by the Engineer of the acceptability or otherwise of the completion of the Works or the issue of any certificate of completion.

If, within the Defects Notification Period, the embankment shows any sign of settlement in the vicinity of the jacked pipe, the rail authority may re-measure levels on the Site.

The Contractor shall be held responsible for the rectification, to the satisfaction of the rail authority, of any deformation that occurs to the rail lines in the vicinity of the jacked pipe during the said period.

10.7.4 Temporary Supports

Except when such support is provided by others, the Contractor shall provide such temporary support as is necessary to carry road and rail traffic, and in the case of railway tracks, to prevent horizontal or vertical misalignment. Should the Contractor plan temporary support that requires special permission from the service authority, the Contractor shall provide notice of the intention to do so as early as possible, but not less than 40 days prior to the commencement of construction. The detail of the planned support shall also be submitted as early as possible, but not less than 21 days prior to the commencement of construction. The Engineer will facilitate the communication with the service authority in compliance with Clause 10.7.1.1.

10.7.5 Restriction on Blasting

No blasting shall be carried out without the prior written permission of the Engineer, and with the necessary approval or clearance being obtained from the relevant authority obtained by the Contractor.

10.7.6 Excavation

10.7.6.1 General

Subject to the provisions of Clause 10.7.5, the requirements of Section 9 – Bulk Surface Excavations and Trenching, shall apply.

10.7.6.2 Thrust Pit

The Contractor shall be responsible for excavation of the thrust and reception pits at each end of the section of sleeve that is to be jacked. These pits shall be of dimensions at least equal to the minimum dimensions needed for the Contractor's equipment and for safe and efficient working. The approximate dimensions of the pits that the Contractor intends to excavate shall be agreed upon with the Engineer before work commences. The excavated material shall be stockpiled for later backfilling. Surplus material shall be disposed of as specified in Clause 10.7.8.

The Contractor shall be responsible for the thrust pit support design and submit the design to the Engineer for approval. The Contractor shall ensure that no movement occurs as a result of vibration caused by rail or road traffic.

The Contractor shall ensure that, at all times, each pit is provided with barriers and lighting (in terms of this specification and the applicable regulation of the Occupational Health and Safety Act, Act 85 of 1993) and is a safe place within which to work.

10.7.6.3 Jacking Excavation of Sleeve

(a) General

Excavation shall be such that overbreak is kept to a minimum. No material shall be removed in advance of the leading edge where the leading edge is in unstable or loose material. If the material at the face starts to slip, the excavation shall be stopped immediately and the Contractor shall take such action as is necessary to stabilise the material before excavation is resumed.

The following jacking excavation classification shall apply to the tunnelling section of the work:

**TABLE 10/1
EXCAVATION CLASSIFICATION**

CLASS OF EXCAVATION	DEFINITION	ANTICIPATED METHOD OF EXCAVATION
Soft	Non cohesive sand, soil or stiff clays	Hand Tools
Intermediate	Weathered soft to medium hard rock closely fractured	Jack hammers withmoil point attachments
Hard	Hard rock within a soft matrix to full face hard rock, massive or lightly fractured	Blasting techniques

PART C3.1 - SPECIFICATION

The Contractor can use any method he wishes for excavating any class of material, but the method of excavating the material used by the Contractor shall not dictate the classification of the excavation. The Engineer will decide under which one of the above classes any excavation is classified for purpose of payment. Overbreak shall be kept to a minimum.

Surplus excavated materials shall be disposed of as specified in Clause 10.7.8.

(b) Prevention of Subsidence during Jacking

- i) To ensure that overbreak is kept to a minimum, the Contractor shall ensure that the first sleeve pipe used is so rebated that there is no substantial difference between the outside diameters of the shield and the sleeve.
- ii) The Contractor shall ensure that excavations within the pipe are under such continuous expert supervision that ensures that conditions at the front of the shield are always safe.
- iii) The Contractor shall take every reasonable precaution to ensure that no slips or runs develop at the face such as will endanger personnel or cause cavities beyond the circumference of the lead pipe.
- iv) If necessary, the Contractor shall suitably de-water the material in the vicinity of the leading edge of the pipe.
- v) Should any cavity occur around the outside of a pipe during the jacking process, such cavity shall be filled immediately by the injection of suitable, approved process grout through holes drilled in the pipe walls.
- vi) Any subsidence occurring above the jacked pipe and arising from any cause related to these jacking operations shall be repaired and made good to the satisfaction of the Engineer and at the Contractor's expense.

(c) Boarding up

At the conclusion of each day's work the sleeve shall be jacked up to the face and boarded up where necessary.

(d) Drainage

The Contractor shall ensure that the head of each excavation is drained at all times.

(e) Jetting

Jetting will not be permitted.

10.7.6.4 Unidentified Obstructions

Provision has been made in the Bill of Quantities for payment for penetrating/removing unidentified obstructions and where obstructions not described are encountered. Such obstructions shall be classified as unidentified obstructions and the penetration/removal of such obstructions, as well as the proven cost of delays and disruption of the pipe jacking operations shall be paid for.

10.7.6.5 Dealing with Water

The Contractor shall adequately deal with and dispose of water to ensure that the Works are kept sufficiently dry for their proper execution.

The Contractor shall provide adequate protection against flooding and damage by storm water, flow from springs and seepage, and shall repair, at his expense, any damage to the Works that may arise as a result of the inadequacy of the protection provided by him.

For this purpose he shall provide, operate and maintain such pumping equipment, well points, pipes and other equipment as may be necessary, and he shall also provide any sumps, furrows and other temporary works as may be necessary to minimise damage, inconvenience or interference with the Works or other infrastructure.

Refer also Section 8 – Dealing with Water.

10.7.7 Jacking Procedure**10.7.7.1 Jacking of Sleeve**

Each pipe shall be advanced by means of one or more hydraulic jacks of adequate capacity that bear(s) against a suitable thrust plate so that the thrust of the jack(s) is distributed evenly over the end face of the pipe.

The rear end of each jack shall bear against a suitable structure such that the force is transferred to the surrounding material and evenly distributed over an area sufficient to ensure that the bearing capacity of the soil is not exceeded and that no structure in the vicinity of the thrust pit is disturbed.

10.7.7.2 Lubrication of Sleeve during Jacking

The Contractor may, with the written permission of the Engineer, inject a suitable lubricant through preformed holes in the sleeve or at the cutting edge of the shield.

10.7.7.3 Thrust and Reception Pits

Thrust and reception pits will in general be permitted only at positions where manholes or junctions are required, as indicated on the Drawings. Thrust pits shall be of sufficient size to allow jacking operations to be conducted with maximum efficiency.

10.7.8 Backfilling and Disposal of Excavated Material

When jacking has been completed and the jacking frame and shield dismantled, the thrust and reception pits shall be backfilled to the extent necessary and in the manner indicated on the Drawings or laid down in the Specifications.

Surplus excavated materials shall be disposed of as specified in Section 14 - Spoil, Borrow and Excavated Materials.

10.7.9 Grouting and Plugging

When the jacked sleeve is in its final position a stabilised sand/cement grout shall be injected to fill all voids between the sleeve and the surrounding material. The grout shall have strength equal to or better than a grout consisting of one part cement and four parts sand and shall have a slump of minimum 120 mm. The volume of grout injected shall be carefully recorded for each application.

10.7.10 Installation of Service Pipe

The Contractor shall plan, schedule and coordinate the service pipe laying process within the sleeve. A site-specific external bolt-on bracing system is required for the installation of the service pipe to prevent floating and damage to the coating, and supply adequate support during installation. The Contractor is responsible for the design and manufacturing of the bracing and support system incorporating skids or roller elements. The bolt on skid system shall be electrically insulated from the pipeline. The bracing and support system design and application method shall be submitted for approval by the Engineer at least 14 days prior to the commencement of construction.

10.7.11 Annulus Grouting

When the service pipe is in its final position, brick end walls shall be constructed and a stabilised sand/cement grout shall be injected to fill the annulus between the service pipe and the internal wall of the jacked sleeve pipe. The grout shall be applied without risk of floating the service pipe. The Contractor shall select a grout design to suit his application method. The grout design and application method shall be submitted for approval by the Engineer at least 14 days prior to the commencement of construction. The annulus grouting shall only be completed after successful completion of the hydrostatic pressure testing.

10.7.12 Record Drawings

If an alternative design by the Contractor has been accepted or if the structure shown on the Tender Drawings has been modified to suit the jacking method, the Contractor shall, on completion of the work and before the final payment is made, supply to the Engineer record drawings showing details of the completed structure. Each drawing shall be certified by the Contractor to be an accurate reflection of the details of the work as constructed.

10.8 TOLERANCES

10.8.1 General

Subject to any requirements of the gradient(s) of the service pipeline for the purpose for which it is required, the sleeve pipes shall be placed into position within the tolerances given in Clause 10.8.2.

Should the difference between the actual and the specified position or alignment of the finished sleeve exceed the value of any said tolerance to an extent that additional costs are incurred in installing, supporting, or maintaining any service that has been designed to be laid through the finished sleeve, the Contractor shall bear such additional costs provided that the details of the work to be done to re-align, install, or support the said service, and the order of the work to be done have been given by the Engineer within 30 working days after the completion of the jacking operation.

10.8.2 Permissible Deviations

The position of any point of the finished sleeve shall be within 100 mm horizontally and 30 mm vertically of the designed position. Adjustment to line or level, or both, shall be gradual and the pipe manufacturer's stated maximum permissible draw or angular deflection shall not be exceeded at any joint. Misalignment between pipe units shall not exceed 10 mm.

10.8.3 Checking Alignment

The Contractor shall check line and level at least once during the installation of each pipe length, and, should it be necessary, he shall take such corrective action as is required to bring the pipe within tolerance. A copy of the final levels and line and a statement of any corrective measures taken shall be available for inspection on the Site, and a copy shall be given to the Engineer as soon as the jacking has been completed.

10.9 TESTING

Each sleeve pipe shall be delivered to site accompanied by its normal factory quality control pack to confirm compliance with the relevant requirements of SANS 677. The results of the specified two (or three) edge-bearing load tests shall also be made available. Each pipe shall have a unique number applied, clearly visible on the inside of the pipe by which it can be identified.

10.10 MEASUREMENT AND PAYMENT

10.10.1 Principles

10.10.1.1 General

The rates tendered under this Section shall not include for the general obligations, Contractor's Equipment and work deemed to be covered by the items provided in Section 1 – General.

The basis of payment for a jacked sleeve takes cognisance of the fact that, although the Engineer may design and specify the service pipeline, he cannot provide detailed drawings and dimensions for the jacking structure and its thrust and reception pits, because these depend on equipment and methods that the Contractor intends to use for carrying out the work.

10.10.1.2 Items for Pipe Jacking and Service Pipe Installation

- a) All items listed in the Bill of Quantities for pipe jacking will be applicable to all operations between the start of jacking in the thrust pit to the end of the operation in the reception pit (see Clauses 10.7.1 to 10.7.12) in respect of each sleeve to be jacked. Except as provided for in Clause 10.10.1.3, all such items will be measured and paid for in terms of Clause 10.10.2.
- b) Except as provided for in Clause 10.10.2, all operations on the Works up to the start of operations in the thrust pit, and after the end of jacking operations in the reception pit will be measured and paid for in terms of the requirements of the relevant Sections of the Specification.

10.10.1.3 Contractor's Priced Schedule

The Contractor shall be responsible for the complete design of the jacking sleeve and of the bolt on skids on the service pipeline (see Clause 10.7.1.3) and the rates in the Bill of Quantities shall include for all jacking operations, whether scheduled or not as well as for any part of any associated structure (temporary or permanent) required by his method statements. Such rates in the Bill of Quantities shall cover the cost of:

- a) The design and the preparation and submission for approval of all drawings;
- b) All labour, Plant, tools, operation of equipment, materials, transport, consumable stores, services, samples, temporary excavations, shotcreting and everything of a temporary or permanent nature required to carry out the work; and
- c) Any modifications to the structure to suit the proposed method of jacking.

The quantities shown in the Bill of Quantities are re-measurable.

10.10.2 Scheduled Items

10.001 Design, supply and deliver pipes to be jacked Unit: metre (m)

(Type, designation, diameters and overall length to be jacked are stated).

Each jacked sleeve will be measured between ends of the completed sleeve, continuously through intermediate jacking stations and may include intermediate jacking pipes. The rate shall cover the cost of designing the sleeve and jacking process, manufacturing and factory testing of pipes, providing grouting holes, delivery, handling and storing of pipes, rubber rings, packing pieces and flexible sealing to joints between intermediate jacking pipes.

10.002 Jacking of pipes Unit: metre (m)

(Type, designation, diameters and overall length to be jacked are stated).

The rate shall cover the cost of the handling and positioning of the pipes, the jacks and associated materials, the labour necessary for jacking the pipes through all materials foreseen in the specification or as scheduled, sealing grouting holes in the pipe barrels, bentonite injection (if necessary), intermediate jacking pipes and the operation of ancillary jacking equipment (or, alternatively, intermediate jacking stations, in which case the rate shall cover the construction of junction boxes as closures between pipe ends at these stations).

10.003 Excavation for jacking Unit: cubic metre (m³)

(Class of material stated - Excavation classification Table 10/1).

Excavation for jacking will be measured in an in-situ condition calculated from the length of the pipe jacked in terms of payment items 10.001 and 10.002 and the external diameter of the jacked pipe.

The rate shall cover the cost of digging at the face through all materials foreseen in the Specifications or as scheduled or encountered, transporting excavated material through the pipe, lifting to ground level, loading and spoiling the material, ventilation, de-watering and lighting within the pipe.

PART C3.1 - SPECIFICATION

Overhaul will be measured and paid for in terms of Section 9 – Bulk Surface Excavations and Trenching for material transported outside the free haul limits on the written instruction of the Engineer.

10.004 Pit excavation**Unit: lump sum (Sum)**

The Contractor's rate will include for the excavation of the jacking (thrust) and receiving pits.

The rate shall cover the cost of digging through all materials foreseen in Section 9 – Bulk Surface Excavations and Trenching or as scheduled or encountered, transporting excavated material, lifting to ground level, loading and spoiling the material, ventilation, de-watering and wall stabilisation.

Overhaul will be measured and paid for in terms of Section 9 – Bulk Surface Excavations and Trenching for material transported outside the free haul limits on the written instruction of the Engineer.

10.005 Extra-over items 10.003 and 10.004 for excavation for jacking through unidentified obstructions**Unit: Provisional Sum (PS)**

A provisional sum is allowed in the Bill of Quantities for covering the cost of this work.

10.006 Stabilisation of unstable areas and grouting**Unit: lump sum (Sum)**

The rate shall include the operation of the equipment, materials labour, measurement and testing. The Contractor's rate shall be determined by the estimated grouting based on his over break allowance as part of the jacking design.

10.007 Supply and install wheel/skid pipe supports and install service pipe**Unit: lump sum (Sum)**

The rate shall include the design, manufacture, deliver, insulate, bolt on and installation of the steel service pipeline.

10.008 Grouting of annulus**Unit: cubic metre (m³)**

The rate shall include the operation of the equipment, materials labour, measurement and testing. It shall also include for stage grouting and the cost of the end partitions.