

TECHNICAL SPECIFICATION

CB: STORMWATER DRAINAGE

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CB 01 SCOPE

This specification covers the materials, equipment, methods, testing and work required for the corrective maintenance and servicing of existing stormwater drainage systems. It covers both surface and underground drainage systems.

CB 02 STANDARD SPECIFICATIONS

CB 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

PW 371	-	Specification of Materials and Methods to be used
SANS 1200 DB	-	Earthworks (pipe trenches)
SANS 1200 DK	-	Gabions and pitching
SANS 1200 G	-	Concrete (structural)
SANS 1200 LB	-	Bedding (pipes)
SANS 1200 LE	-	Stormwater drainage
SANS 1200 MK	-	Kerbing and channelling

CB 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CB 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CB 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall

be adhered to unless otherwise specified.

CB 03 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CB 04 EXECUTION OF REPAIR WORK

CB 04.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter indicate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems and installations shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the stormwater drainage systems shall be categorised under the following headings:

- (a) Prefabricated culvert installation and repair of existing culverts and structures;
- (b) Cleaning of prefabricated culverts;
- (c) Concrete channel construction and repair of existing channels;
- (d) Cleaning of concrete drains and channels;
- (e) Cleaning of earth channels;
- (f) Construction and repair of brickwork inlet structures;
- (g) Provision of lockable storm water grid inlets;

- (h) Cleaning of pipelines.

CB 04.02 **PREFABRICATED CULVERT INSTALLATION AND REPAIR OF EXISTING CULVERTS AND STRUCTURES**

This section covers the work in connection with the construction of prefabricated pipe and portal culverts and stormwater structures such as manholes, grid inlets and the like.

It also covers the removal and replacement of damaged and broken prefabricated culverts, as well as repairs to existing culverts and stormwater structures.

CB 04.02.01 **Construction**

Prefabricated culverts shall be constructed or replaced in accordance with the specifications at the locations indicated by the Engineer.

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of culverts. The widths of the excavation for each type and size of culvert shall be as set out in SANS 1200 DB.

The depth of the excavation for each type and size of culvert shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the culvert and shall be sufficient to allow the type and thickness of bedding material instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Excavations shall commence from the outlet end of culverts to be installed.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers, and boulders exceeding 0,10 m³ shall be classified as hard material.

Where more than 40 % of any material (by volume) consists of boulders each exceeding 0,10 m³ in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site and disposed of.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged culverts

Where indicated by the Engineer damaged sections of prefabricated culverts shall be completely removed and replaced with new units.

Excavation shall be carried out as described for new culvert installation and the excavated material shall be, if suitable, preserved for backfilling. The damaged culvert units shall be disposed of.

(e) Laying of concrete pipe culverts

Concrete pipe culverts shall be laid on class A or B bedding as directed by the Engineer. The inside of the culverts shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

(i) Class A bedding - see SANS 1200 LB

(ii) Class B bedding - see SANS 1200 LB

(iii) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(iv) Concrete casing

Where ordered by the Engineer a pipe shall be encased in concrete according to the Engineer's instructions.

(f) Laying of concrete portal culverts

Portal culverts shall be laid on prefabricated floor slabs. A layer of fine-grained material of at least 75 mm thick shall be placed on the bottom of the excavation, levelled, compacted and trimmed to line and grade to form a bed to receive the precast slabs.

The portal portions of portal culverts shall be placed accurately and symmetrically on the floor slabs with a thin layer of mortar of one part of cement and six parts of sand between the contact surfaces to ensure a firm and uniform support.

(g) Extension of existing culverts

Where existing culverts require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where it joins the existing structure, at the same level as the existing structure.

Any sections of existing wing walls, approach slabs and head walls which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new inlet and outlet structures shall be paid for under the relevant sections in the specification.

(h) Construction of culverts in half widths in existing roads

To allow the free flow of traffic at all times the culverts shall be constructed in half widths. The downstream section shall be constructed first and the end of the excavation adjoining the traffic lane shall be properly supported to prevent displacement from occurring.

(i) Repairing of cracks and joints

Where instructed by the Engineer cracks in existing culverts and culvert joints which have opened shall be caulked with material specified in the Particular Specification.

(j) Backfilling of prefabricated culverts

The backfill material shall be material selected from the excavation mixed with 80 kg Portland cement with every cubic metre of excavated material.

Generally the backfill material shall be a sandy material, but may contain larger particles up to 38 mm and shall have a plasticity index not exceeding 12.

In the case of concrete pipe culverts on class B bedding the backfilling material shall be tamped in under the flanks of the culverts to provide a uniform bedding, all to the satisfaction of the Engineer.

Backfilling alongside and over the culverts to the underside of the pavement layers shall be placed at optimum moisture content and compacted to a minimum of 90 % of modified AASHTO density in layers not exceeding 150 mm after compaction. Where approved by the Engineer, testing may be done with a dynamic cone penetrometer (DCP). The average penetration rate recorded after every 5 blows for each layer shall not exceed 50. The full depth of a layer shall be tested.

Backfilling shall be carried out simultaneously and equally on both sides of a culvert to prevent unequal lateral forces from occurring and the ends of culverts shall be protected to prevent the backfill material from spilling beyond the required levels.

(k) Reinstatement of pavement layers

Unless otherwise instructed by the Engineer the pavement layers shall be reinstated as follows:

- (i) Selected layers shall be of at least a G5 quality and shall be compacted to at least 93 % of modified AASHTO density.
- (ii) Material for the subbase layers shall be stabilized with 3 % cement and compacted to 95 % of modified AASHTO density, and shall be at least a G5 quality.
- (iii) The material for the base layer shall be stabilized with 5 % cement and compacted to at least 97 % of modified AASHTO density, and shall be at least a G3 quality.

- (iv) The surfacing layer shall consist of a medium continuously graded asphalt compacted to 94 % of Marshall density. The thickness of the surfacing layer shall be at least 25 mm. A 60 % cationic emulsion shall be applied at 0,4 litre/m² to the top of the base layer before the surfacing layer is placed.

The soil cement shall be mixed on site with suitable concrete mixers and the water and cement contents shall be carefully controlled.

- (l) Repair of stormwater manholes, grid inlets and the like

Repair work will be undertaken on the structures indicated on the drawings, or as directed by the Engineer. All repair work will comply with the construction and quality requirements of SANS 1200 LE.

CB 04.02.02 Quality standard

Culverts shall be constructed true to lines and levels with the inside smooth and without any displaced joints.

CB 04.02.03 Materials

The prefabricated culvert units shall be factory produced by a reputable manufacturer of these units and shall comply with the following requirements:

- (a) Prefabricated concrete pipe culvert units

Prefabricated concrete pipe culvert units shall comply with the requirements of SANS 677. Pipes with ogee joints shall be provided, unless otherwise specified. Pipes subjected to traffic loadings shall be class 100 D; all other pipes shall be class 50 D.

- (b) Portal prefabricated concrete culvert units

Portal prefabricated concrete culvert units shall comply with the requirements of SANS 986.

- (c) Other types of prefabricated culverts

If required, other types of prefabricated culverts will be specified in the Particular Specification.

- (d) Manhole covers, grid inlets, etc

Manholes, grid inlets, etc, shall have covers and frames complying with SANS 558.

CB 04.03 CLEANING OF PREFABRICATED CULVERTS

The work involved under this section is the removal of silt and debris from prefabricated culverts including the cleaning of inlet and outlet structures.

CB 04.03.01 Construction

Prior to cleaning any prefabricated culverts, the Contractor shall arrange with the Engineer for an inspection of the stormwater network. The Contractor shall provide adequate equipment, such as torches, lights, mirrors, etc, to enable a basic visual inspection of all the culverts. Based on this inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Material removed from the culverts shall be disposed of where instructed by the Engineer. Rubble and waste material shall be disposed of at the nearest appropriate solid waste disposal site, unless otherwise directed by the Engineer.

The Contractor must ensure that all material being removed is removed before or at the nearest accessible downstream structure. No additional payment will be made for the removal of material which, as a result of cleaning operations, find its way into a previously clean section of the culvert network.

CB 04.03.02 Quality standard

Prefabricated culverts shall be cleaned of all silt and debris such that all surfaces are clearly visible and accessible for inspection.

All spoil material shall be spread neatly and shall not wash back into drainage trenches.

The size of the culverts for the different categories will be determined as follows:

- (a) For pipe culverts - diameter
- (b) For portal culverts - width.

CB 04.04 CONCRETE CHANNEL CONSTRUCTION AND REPAIR OF EXISTING CHANNELS

This section covers the construction of new concrete lined drains where required and the maintenance of existing concrete drains. It includes the construction of kerb and channel combinations and repairs where required.

CB 04.04.01 Construction

The Engineer will indicate the locations where new drains are to be constructed to improve drainage and shall instruct where repairs to existing drains are to be carried out.

Construction of the following type of concrete drains may be required:

- (a) Concrete lining to open drains
- (b) Concrete pipes
- (c) Kerbing channeling combination.

Concrete drains shall be constructed in accordance with the details shown on the drawings or as directed by the Engineer.

(a) Excavation and preparation of bedding

The excavations shall be neatly trimmed to lines and levels so as to permit the accurate construction of the concrete linings. All loose material shall be well rammed at the optimum moisture content for the material used.

Where excavations are in hard material, overbreak shall be backfilled with concrete of the same class as specified for the lining.

In the case of kerbs and channels the trenches shall be excavated to the required depths and the bedding material shall be well rammed before placing the concrete.

Where wash-aways have occurred, any cavities or voids in the foundation material must

be backfilled in layers not exceeding 150 mm in thickness and compacted to 90 % of modified AASHTO density.

(b) Concrete linings

Concrete lining of open drains shall be cast in situ only and the exposed surfaces shall be given a class U2 (wood-floated) surface finish.

Sealed joints in concrete shall be in accordance with the details indicated on the drawings and joints shall be painted with a coat of approved bituminous emulsion containing 60 % of pure bitumen by mass.

Expansion joints shall be made in accordance with the drawings.

(c) Half-round channels

Cast in situ half-round channels shall be constructed in accordance with the drawings, or to fit existing sections.

(d) Kerbing and channeling

Kerbing shall include barrier kerbs, mountable and semi-mountable types. All the elements shall be prefabricated units with cast in situ channeling unless otherwise specified by the Engineer.

Kerbing and channeling shall be laid on the approved bedding with close joints filled with 3:1 sand: cement mortar not exceeding 10 mm in thickness and neatly pointed with a pointing trowel. Kerbing shall be propped with class 15/19 in-situ concrete at each joint (size: 300 mm long x 200 mm wide x 80 % of kerb height).

(e) Concrete cast against existing surfaced edges

Where concrete lining or concrete channeling in kerb and channel combinations is to be cast against existing surfacing the edge shall first be cut, before excavation, with approved sawing equipment to provide a neat straight edge. Care shall be taken during the placing of the concrete not to spill concrete onto the adjacent surfacing. Any concrete stains shall be removed by the Contractor at his own expense.

(f) Reinstatement of damaged existing structures

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris shall be spoiled.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

Provision shall be made for the reinstatement of existing damaged prefabricated concrete half round channels.

(g) Inlet and outlet structures

The structures shall be constructed in accordance with the requirements specified in the relevant section in this specification.

CB 04.04.02 Quality standard

The drains shall be constructed neatly to the dimensions shown on the drawings and within the specified dimensional and alignment tolerances.

Repairs to drains shall be in uniformity with existing structures.

CB 04.04.03 Materials

(a) Concrete

Concrete for the various structural components shall comply with the class detailed on the drawings. Concrete in channel linings shall be class 20/19.

(b) Steel reinforcement

(i) Steel bars

Steel reinforcing bars shall comply with the requirements of SANS 920.

(ii) Welded steel mesh

Welded steel mesh shall comply with the requirements of SANS 1024.

CB 04.05 CLEARING OF CONCRETE DRAINS AND CHANNELS

This section covers the work in connection with the removal of silt, debris and vegetation causing obstruction to flow in drains and channels constructed from any type of material excluding earth drains and channels.

CB 04.05.01 Construction

Concrete channels shall be cleaned where instructed by the Engineer. Generally, channels shall be cleaned when depth of silt in invert exceeds 100 mm, or when other foreign matter is present.

Material removed from channels shall either be loaded and removed from the site or disposed of adjacent to channels where it cannot be washed back into the channel as directed by the Engineer.

Where material is spoiled adjacent to channels the Contractor shall ensure that the material is spread neatly and well clear of the top of the channels where it will not wash back. Material removed from kerb and channel combinations, side drains or from other channels where directed by the Engineer shall be transported to spoil.

Vegetation growing in channel joints and cracks shall be removed with roots to prevent regrowth.

Vegetation growing over channels from the edges shall be slashed at the concrete edges and disposed of. Undesirable vegetation shall be removed with roots and spoiled where directed by the Engineer.

CB 04.05.02 Quality standard

Concrete drainage channels shall be clear of any obstruction such that the concrete surfaces are clearly visible.

CB 04.06 CLEANING OF EARTH CHANNELS

This section covers the work involved in cleaning of all earth drains and channels, repairs to damaged earth drains and channels, as well as construction and repairs of banks and dykes.

CB 04.06.01 Execution of work

(a) Drains

Earth side drains and channels shall be cleaned of all debris, silt and vegetation when instructed by the Engineer.

Silt and debris excavated from the drains shall be deposited and spread neatly in close proximity of the drains where it will not wash back.

Scoured and eroded sections of drains shall be backfilled with suitable material obtained from the side of the road or from suitable sources indicated by the Engineer. The backfill material shall be compacted at the optimum uniform moisture content in layers not exceeding 100 mm after compaction. The Contractor shall use suitable compaction equipment to produce repairs that will not erode or scour again.

If in the opinion of the Engineer drains require protective covering against scouring and erosion, such work shall be executed in accordance with the relevant section of this specification.

(b) Construction and repair of banks and dykes

Material for the construction and repair of banks and dykes shall be an approved soil or gravel obtained from sources approved by the Engineer. It shall be positioned in such a way that water will flow on the natural ground and against the bank.

Banks and dykes shall be properly compacted in layers not exceeding 150 mm in thickness. If approved by the Engineer, mitre banks may also be constructed of hand-packed stone, provided that the interstices are filled with an approved cohesive soil.

CB 04.06.02 Quality standard

Drainage channels shall be clear of any obstructions and no scouring, erosion or pooling shall be evident.

Existing fill and cut slopes and invert grades of drains shall be maintained.

CB 04.07 CONSTRUCTION AND REPAIR OF BRICKWORK INLET STRUCTURES CB

04.07.01 Reinstatement of damaged existing structures

Damaged existing structures shall be demolished to the extent indicated by the Engineer on site and the resulting debris spoiled.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

CB 04.07.02 Lowering of inlet structures

Existing structures which are not functional due to the inlet being above the surrounding pavement level or ground level shall be demolished to the extent indicated by the Engineer and reinstated at the correct level to the same standard prescribed for new construction.

CB 04.08 PROVISION OF LOCKABLE STORMWATER GRID INLETS

Stormwater inlet structures within the Port of Entry fence shall be provided with lockable grids. These shall be in the form of a steel bar secured to the base of the catch pit and long enough to just protrude through the inlet grid. There shall be a hole in the end of the bar to allow a padlock to be positioned such that the grid will be immovable.

The steel bar shall be treated to avoid corrosion.

Padlocks shall be provided for all grid inlets. They shall be of a type suitable for outdoor use, or as specified in the Project Specifications.

CB 04.09 CLEANING OF PIPELINES

The work under this section involves the removal of silt and debris from pipelines, including the cleaning of inlet and outlet structures.

CB 04.09.01 Construction

Before cleaning any pipelines, the Contractor shall arrange with the Engineer for an inspection of the stormwater network. The Contractor shall provide adequate equipment such as torches, lights, mirrors and TV surveillance equipment, etc, to enable a basic visual inspection of all pipes. Based on this inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning and where detailed inspections are required.

Material removed from the pipes shall be disposed of where instructed by the Engineer. Rubble and waste material shall be disposed of at the nearest appropriate solid waste disposal site, unless directed otherwise by the Engineer.

The Contractor shall ensure that all material is removed at the nearest accessible structure. No additional payment will be made for the removal of material from previously cleaned sections of the network.

CB 04.09.02 Quality standard

Pipes shall be cleaned of all silt and debris.

All spoil material shall be spread neatly to ensure that it will not return to the drainage trenches.

The pipe sizes for the different categories will be determined by diameter.

CB 05 MAINTENANCE

This specification must be read in conjunction with Additional Specification: General Maintenance.

All components of the stormwater drainage infrastructure, including surface as well as

underground components, shall be maintained during the maintenance phase of the Contract.

The scope of the maintenance work for the stormwater drainage infrastructure comprises the following:

- (i) Maintenance of approximately 4500 m of concrete-lined channels of varying sizes.
- (ii) Maintenance of approximately 900 m of concrete-lined channel 2m deep with a 2m base width and sloping sides outside the perimeter fence.
- (iii) Maintenance of approximately 60 m of rectangular precast concrete culverts of varying sizes.
- (iv) Maintenance of approximately 400 m of concrete storm water pipes of varying sizes.

The above description of the stormwater drainage infrastructure to be maintained is not necessarily complete and shall not limit the maintenance work to be carried out by the Contractor under this contract.

Maintenance shall include all repair work, replacing of components, fixing of defects, cleaning, or any other actions or rectifying measures necessary for complete and safe functioning of the stormwater drainage infrastructure.

Maintenance on the stormwater drainage infrastructure shall also include all other actions related to maintenance, such as temporary drainage features and temporary accommodation of traffic.

Remuneration for maintenance of the stormwater drainage infrastructure shall be deemed included in the tendered monthly payment for maintenance thereof and shall be paid as detailed in Additional Specification SA: General Maintenance.

CB 05.01

STORMWATER DRAINAGE SYSTEM

Routine maintenance on the storm water drainage system shall be done as described in table CB 05.01/1.

TABLE CB 05.01/1

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation.	Monthly
2	Check, inspect, repair or replace all manhole or inlet covers, grids and frames and builder's work to manholes.	Four-monthly
3	Check, inspect and repair manhole and inlet benching.	Four-monthly
4	Check, inspect, report and unblock any blockage that occurs.	Monthly

CB 06 MEASUREMENT AND PAYMENT

CB.01 PREFABRICATED CULVERT INSTALLATION AND REPAIR OF EXISTING CULVERTS AND STRUCTURES

CB.01.01 Excavation:

(a) Excavation of soft material within the following depth ranges below the surface level:

- (i) 0 m up to and including 1,5 m Unit: cubic metre (m³)
- (ii) Exceeding 1,5 m up to and including 3,0 m Unit: cubic metre (m³)
- (iii) Exceeding 3,0 m up to and including 4,5 m Unit: cubic metre (m³)
- (iv) Etc in increments of 1,5 m

(b) Excavating hard material irrespective of depth Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated within the specified dimensions, authorised by the Engineer in each case. Excavation in excess of widths specified or authorised shall not be measured for payment.

Irrespective of the total depth of the excavation, the quantity of material in each depth range shall be measured separately.

When measuring excavation for the removal of existing culverts, the volume occupied by the culvert shall not be subtracted from the calculated volume of excavation.

The tendered rates shall include full compensation for all excavation (including around structures), levelling, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the culvert beds, the disposal of unstable material unsuitable for backfilling, keeping the excavation safe, dealing with any surface or subsurface water and for any other operations necessary for completing the work as specified.

Payment shall distinguish between soft and hard material.

CB.01.02 Backfilling and reinstatement of pavement layers:

- (a) In situ fill or cut material compacted to 90 % of modified AASHTO density Unit: cubic metre (m³)
- (b) Selected layers compacted to 93 % of modified AASHTO density Unit: cubic metre (m³)
- (c) Cement stabilized subbase layers compacted to 95 % of modified AASHTO density Unit: cubic metre (m³)
- (d) Cement stabilized base layers compacted to 97 % of modified AASHTO density Unit: cubic metre (m³)

The unit of measurement for CB.01.02(a) and (b) shall be the cubic metre of gravel material placed and compacted according to authorised dimensions on drawings.

The unit of measurement for CB.01.02(c) and (d) shall be the cubic metre of stabilized material placed and compacted according to authorised dimensions.

The tendered rates shall include full compensation for procuring and furnishing, placing, compaction and finishing of materials, labour, tools and equipment for executing the work to the satisfaction of the Engineer.

CB.01.03 Prefabricated culverts:

- (a) On class A bedding (type and diameter indicated)Unit: metre (m)
- (b) On class B bedding (type and diameter indicated)Unit: metre (m)
- (c) Portal culverts with prefabricated floor slabs.
(type and size indicated) Unit: metre (m)

The unit of measurement for prefabricated culverts shall be the metre of culvert laid. The length shall be measured along the soffit of the culvert.

The tendered rates shall include full compensation for providing, testing, loading, transporting and unloading the culverts, for providing and placing the bedding material where required, and for the installation, laying and jointing of the culverts as specified including cutting them on the site and removing any waste.

CB.01.04 Cast in situ concrete and formwork in stormwater structures:

- (a) Class 20 concrete Unit: cubic metre (m)
- (b) Class 25 concrete Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete in place. Quantities shall be calculated from the dimensions shown on the drawings or as authorized.

The tendered rates shall include full compensation for procuring and furnishing all the materials, storing the materials, providing all plant, mixing, transporting, placing and compacting the concrete, forming the inserts, construction joints and contraction joints, curing and protecting the concrete, repairing defective surfaces and finishing the concrete surface as specified.

CB.01.05 Replacement of manhole covers, grid inlets, etc

- (a) SANS 558 Type 4 - covers, grids, etc:
 - (i) Maximum dimension up to and including 300 mm Unit: number
 - (ii) Maximum dimension 301 mm to 600 mm Unit: number
 - (iii) Maximum dimension 601 mm to 900 mm Unit: number
 - (iv) Maximum dimension over 900 mm Unit: number
- (b) SANS 558 Type 4 - frames only for covers, grids, etc:
 - (i) Maximum dimension up to and including 300 mm Unit: number
 - (ii) Maximum dimension 301 mm to 600 mm Unit: number

(iii) Maximum dimension 601 mm to 900 mm Unit: number

(iv) Maximum dimension over 900 mm Unit: number

(c) SANS 558 Type 2A - covers, grids, etc:

(i) Maximum dimension up to and including 300 mm Unit: number

(ii) Maximum dimension 301 mm to 600 mm Unit: number

(iii) Maximum dimension 601 mm to 900 mm Unit: number

(iv) Maximum dimension over 900 mm Unit: number

(d) SANS 558 Type 2A - frames only for covers, grids, etc:

(i) Maximum dimension up to and including 300 mm Unit: number

(ii) Maximum dimension 301 mm to 600 mm Unit: number

(iii) Maximum dimension 601 mm to 900 mm Unit: number

(iv) Maximum dimension over 900 mm Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames.

CB.02 CLEANING OF PREFABRICATED CULVERTS

CB.02.01 Cleaning of prefabricated culverts and inlet structures (average depth of material removed not more than 100 mm):

(a) Prefabricated concrete pipes and portal culverts with maximum cross sectional dimension of:

(i) Up to and including 500 mm Unit: metre (m)

(ii) 501 mm to 750 mm Unit: metre (m)

(iii) 751 mm to 950 mm Unit: metre (m)

(iv) 951 mm to 1250 mm ... Unit: metre (m)

(v) 1251 mm to 1500 mm .. Unit: metre (m)

(vi) 1501 mm to 2100 mm Unit: metre (m)

(b) Prefabricated corrugated metal culverts with maximum cross sectional dimension of:

- (i) Up to and including 500 mmUnit: metre (m)
- (ii) 501 mm to 750 mm Unit: metre (m)
- (iii) 751 mm to 950 mm Unit: metre (m)
- (iv) 951 mm to 1250 mm Unit: metre (m)
- (v) 1251 mm to 1500 mm Unit: metre (m)
- (vi) 1501 mm to 2100 m Unit: metre (m)

The unit of measurement shall be the metre of culvert cleaned (depth of material removed is on average not more than 100 mm), measured once along the soffit of the culvert. For multiple culverts each individual culvert shall be measured separately.

The tendered rates shall include full compensation for removing the material, for disposing of the material in an appropriate manner and ensuring that the material will not wash into drainage trenches.

CB.02.02

Cleaning of prefabricated culvert and inlet and outlet structures (average depth of material removed is more than 100 mm):

(a) Prefabricated concrete pipes and portal culverts with maximum cross sectional dimension of:

- (i) Up to and including 500 mmUnit: metre (m)
- (ii) 501 mm to 750 mm Unit: metre (m)
- (iii) 751 mm to 950 mm Unit: metre (m)
- (iv) 951 mm to 1250 mm ... Unit: metre (m)
- (v) 1251 mm to 1500 mm . Unit: metre (m)
- (vi) 1501 mm to 2100 mm .. Unit: metre (m)

Prefabricated corrugated metal culverts with maximum cross sectional dimension of:

- (i) Up to and including 500 mm Unit: metre (m)
- (ii) 501 mm to 750 mm Unit: metre (m)
- (iii) 751 mm to 950 mm Unit: metre (m)
- (iv) 951 mm to 1250 mm Unit: metre (m)
- (v) 1251 mm to 1500 mm Unit: metre (m)
- (vi) 1501 mm to 2100 mm Unit: metre (m)

The unit of measurement shall be the cubic metre of material removed (depth of material removed is on average more than 100 mm). The quantity of material to be removed shall be measured in place for each individual culvert.

The tendered rates shall include full compensation for removing the material from the culvert, for loading the material onto trucks, for transporting the material within a free-haul distance of 1,0 km and for spoiling the material as specified.

CB.02.03 **Provision of equipment for visual inspection of.....**
underground culvert network Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as torches, lights and mirrors, etc, to enable a basic visual inspection of the culvert network.

CB.02.04 **Visual inspection of underground culvert network** Unit: metre (m)

The tendered rate shall include full compensation for all processes necessary to complete a thorough check of the culvert network, including lifting and replacing manhole covers, using relevant equipment and any clearing necessary to allow the visual inspection to proceed.

CB.03 **CONCRETE CONSTRUCTION AND REPAIR**

CB.03.01 **Excavation:**

(a) Soft material Unit: cubic metre (m³)

(b) Hard material Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated in accordance with the authorised dimensions measured in place.

The tendered rates shall include full compensation for all plant, labour and tools necessary for excavating the material to the required dimensions, including trimming the excavation before placing concrete, disposing of the material from the site.

CB.03.02 **Cast in situ concrete:**

(a) Class 20 concrete Unit: cubic metre (m³)

(b) Class 30 concrete Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete placed in situ. The quantity shall be calculated in accordance with the authorised dimensions.

The tendered rates shall include full compensation for procuring and furnishing all material and for all work necessary for mixing, placing and finishing the concrete to the authorised dimensions, including providing and erecting of formwork, for sawing of asphalt layers and for providing expansion and contraction joints as included on drawings or as instructed by the Engineer.

CB.03.03 **Backfill below channels** Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of backfill as may be instructed by the Engineer to be placed below channels.

The tendered rate shall include full compensation for furnishing, procuring, placing and compacting concrete.

CB.03.04 Precast concrete kerbing:

- (a) Supply and install (type indicated) Unit: metre (m)
- (b) Install only (type indicated) Unit: metre (m)

The unit of measurement shall be the metre of precast kerbing complete as constructed, measured along the face of the kerb.

The tendered rate for CB.03.04(a) shall include full compensation for preparing of bedding, furnishing and installing all materials and supporting the kerb with in situ concrete, for backfilling behind kerbs, all complete as specified.

The tendered rate for CB.03.04(b) shall include full compensation for preparing of bedding, furnishing and installing all materials and reinstalling existing kerbing, all complete as specified.

CB.03.05 Steel reinforcement:

- (a) Mild steel bars Unit: ton (t)
- (b) High-tensile steel bars Unit: ton (t)
- (c) Welded steel mesh Unit: kilogram (kg)

The unit of measurement for steel bars shall be the ton of reinforcing, and kilogram of welded steel in place in accordance with the drawings or as authorised. Ties, stools and other steel used for positioning the reinforcing steel shall be measured as steel reinforcement.

The tendered rate shall include full compensation for supplying, delivering, cutting, bending, welding, trial weld joints, placing and fixing the steel reinforcement including all tying wire, spacers and waste.

**CB.03.06 Sealed joints in concrete lining open drains.....
(type indicated)**

Unit: metre (m)

The unit of measurement shall be the metre of completed joint of each size and type.

The tendered rate shall include full compensation for supplying all material and for all labour, tools, formwork and incidentals necessary for sealing the joint as shown on the drawings or specified in the Project Specifications.

CB.03.07 Demolition and removal of damaged existing structures:

- (a) Plain concrete Unit: cubic metre (m³)
- (b) Reinforced concrete Unit: cubic metre (m³)

The unit of measurement for CB.03.07(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material from the site.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

CB.03.08 Concrete side beams Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete in side beams constructed as instructed.

The tendered rate shall include full compensation for furnishing all material and labour including formwork as necessary, placing concrete and shaping all surfaces and all excavations required.

CB.03.09 Overhaul on material for haul in excess of 1,0 km:

(a) Excavated material to spoil Unit: cubic metre kilometre (m³-km)

(b) Existing structures demolished Unit: cubic metre kilometre (m³-km)

The unit of measurement shall be the cubic metre of loose material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

CB.04 CLEANING OF CONCRETE DRAINS AND CHANNELS

CB.04.01 Removal and dispose of material from:

(a) Drains and channels within the following invert width ranges:

(i) Less than 1,0 m Unit: metre (m)

(ii) 1,0 m up to and including 2,0 m Unit: metre (m)

(iii) Exceeding 2,0 m up to and including 3,0 Unit: metre (m)

(iv) Exceeding 3,0 m Unit: metre (m)

The unit of measurement shall be the metre of channel cleaned, measured once along the invert of the channel.

The tendered rates shall include full compensation for all labour and equipment required for removing the material from channels irrespective of the depth of silt and debris and for loading, off-loading and spreading when material removed is intended for spoiling at designated spoil sites. The tendered rates shall also include full compensation for the removal of vegetation in channels and growing over the edges of channels.

The tendered rates shall also include for transporting the excavated material to spoil sites.

Where material is disposed of adjacent to the channels, the tendered rate shall include full compensation for removing the material from the channels, irrespective of the depth of silt and debris, spoiling and spreading the material adjacent to the channel where it cannot be washed back in to the channel.

CB.04.02 Overhaul of material hauled in excess of the.....
free-haul distance of 1,0 km Unit: cubic metre kilometre (m³-km)

The unit of measurement shall be the cubic metre of material hauled to spoil, the volume to be determined from the rated capacity of the truck multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material the average overhaul distance to the designated spoil site.

CB.05 CLEANING AND MAINTENANCE OF EXISTING EARTH CHANNELS

CB.05.01 Cleaning earth drains and channels Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material cleaned out of the drain.

The tendered rate shall include full compensation for all labour and equipment required for removing the obstruction from drains, irrespective of depth of silt and debris and disposal of the excavated material as described.

CB.05.02 Repairing of earth drains and channels Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of compacted material calculated from the dimensions measured in place.

The tendered rate shall include full compensation for trimming the eroded area to firm surrounding material, for procuring, transporting placing and compacting the backfill material.

CB.05.03 Banks and dykes Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of in place in banks or dykes, calculated in accordance with authorised dimensions.

The tendered rate shall include full compensation for procuring, transporting furnishing, placing, watering, compacting, shaping and trimming of material in the banks and dykes.

CB.05.04 Cleaning of vegetation at inlet and outlet.....
structures (5 m x 5 m) Unit: square metre (m²)

The unit of measurement shall be the area measured in square metres, cleared of all vegetation blocking the inlet and outlet structures.

The tendered rate shall include for labour, clearing of vegetation, removing to spoil of vegetation and tools to complete the work to the approval of the Engineer.

CB.05.05 Overhaul of material in excess of the
free-haul distance of 1,0 km Unit: cubic metre kilometre (m³-km)

The unit of measurement shall be the cubic metre of imported material, nett volume of material compacted in place, multiplied by the average overhaul distance in excess of 1,0 km.

The tendered rate shall include full compensation for hauling the material the distance from the designated source in excess of 1,0 km.

CB 06 **REPAIR AND CONSTRUCTION TO EXISTING BRICKWORK INLETS**

CB.06.01 **Demolition and removal of existing structures** Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of existing material demolished. The tendered rates shall include full compensation for all labour, equipment and slabs for the removal of the section, trimming the bedding and for loading, transporting and disposing of the material from the site.

CB 06.02 **Repair of brickwork inlet structures** Unit: number

The unit of measurement shall be the number of inlet structures repaired.

The tendered rate shall include full compensation for furnishing all material and labour necessary for restoring the inlet structure to an as new state.

CB.06.03 **Reconstruction of brickwork inlet structures** Unit: number

The unit of measurement shall be the number of inlet structures completely rebuilt.

The tendered rate shall include full compensation for furnishing all material and labour necessary for rebuilding the inlet structure to a complete state.

CB.07 **LOCKABLE GRID INLETS**

CB.07.01 **Provision of lockable grid inlets**..... Unit: number

The unit of measurement shall be the number of grid inlets fitted with a steel bar suitable for locking the inlet cover down.

The tendered rate shall include full compensation for all labour, equipment and tools, rust protection and any other function necessary for the secure installation of the bar.

CB.07.02 **Provision of padlocks** Unit: number

The unit of measurement shall be the number of padlocks provided for lockable grid inlets.

The tendered rate shall include purchasing and installation of all padlocks, as well as providing a full set of labeled keys to the User Client.

CB 08 **CLEANING OF PIPELINES**

The cleaning of pipelines will be measured and paid for under the payment items listed under CB.02 cleaning of prefabricated culverts. Pipelines and related structures will be regarded as pre-fabricated culverts and related structures for this purpose.

TECHNICAL SPECIFICATION

CC: WATER DISTRIBUTION NETWORKS

CONTENTS

CD 01	SCOPE
CD 02	STANDARD SPECIFICATIONS
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CD 08	MEASUREMENT AND PAYMENT

CD 01 SCOPE

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of existing water distribution networks. Such distribution networks may comprise:

- (a) Primary and secondary distribution pipelines
- (b) Irrigation pipe networks and sprinklers
- (c) Valves
- (d) Bulk water meters
- (e) Domestic water meters
- (f) Chambers
- (g) Pumping stations
- (h) Borehole installations
- (i) Reservoirs.

This specification shall form an integral part of the maintenance and servicing contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

The Contractor shall at all times adhere to this specification, unless otherwise specified in the Particular Specification.

CD 02 STANDARD SPECIFICATIONS

CD 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 1200 D - Earthworks
- SANS 1200 DB - Earthworks (pipe trenches)
- SANS 1200 G - Concrete (structural)
- SANS 1200 L - Medium-pressure pipelines
- SANS 1200 LB - Bedding (pipes)

CD 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CD 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CD 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CD 03 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CD 04 EXECUTION OF REPAIR WORK

CD 04.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance Contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over if the satisfaction of the Engineer has been obtained.

Repair work items for the water distribution systems shall be categorised under the following headings:

- (a) Repair of existing pipelines
- (b) Cleaning of existing pipelines
- (c) Repair of fittings
- (d) Repair of existing structures.

CD 04.02 REPAIR OF EXISTING PIPELINES

This section covers the requirements for the repair of the water distribution pipelines for defects such as pipe breaks and leakage for distribution pipelines.

CD 04.02.01 General

Repair work to the water distribution system is detailed in the Particular Specification and may include but not be limited to the following:

- (a) Replacement of damaged, broken, leaking, corroded surface and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing manhole covers and frames;
- (c) Repair work to damaged manholes;
- (d) Initial unblocking and clearing of all water distribution pipes and manholes;
- (e) Repair and upgrading of the water distribution system where necessary;
- (f) Introduction of additional connections to the water distribution system;
- (g) Removal of unauthorised connections;
- (h) Reinstatement and making good of walls, concrete, road surfaces, etc, to an approved acceptable level where any repair, upgrade and/or service work has been executed;
- (i) Video surveying of all underground drainage pipework to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (j) Test pipe system for leakage;
- (k) Repair, replace and service valves, which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (l) Where valves do not close properly, all these valves shall be refurbished, descaled and if necessary replaced;

CD.4

- (m) Repair, clean and service all strainers, including the replacement of strainer elements where corroded and installation of new gaskets;
- (n) Repair, service, test and readjust pressure-reducing valves. Pressure gauges are to be recalibrated and checked. Up and downstream pressures are to be logged. Downstream pressure has to be adjusted to an acceptable level, taking into account the allowable working pressure of the system and its components;
- (o) Repair, service and check the proper functioning of all non-return valves;
- (p) Repair, service, readjust and calibrate all safety and expansion relief valves;
- (q) Repair, service and clean out all air release valves and vacuum breakers;
- (r) Repair, service and log readings of water meters including cleaning of integral strainers;
- (s) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float and/or filling valves to these tanks are to be serviced and repaired where required;
- (t) Water pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be followed if the outcome of this sampling requires attention;
- (u) Water supply has to be sampled and chemically analysed for the suitability to the systems and materials it serves;
- (v) Pressure test and sterilise repaired new installation and equipment;
- (w) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair, upgrade and/or service work have been executed.

CD 04.02.02 Construction

The Engineer will indicate the pipeline sections in need of repair and shall instruct the Contractor with regard to the repair work to be done.

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of the pipelines. The width of the excavation for each type and size of pipeline shall be as set out in SANS 1200 DB.

The depth of the excavation for each type and size of pipeline shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the pipeline and shall be sufficient to allow the type and thickness of bedding material instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Cutting, breaking out and replacing of concrete pavements will be paid under Sub clause CA.02.

Excavations shall extend such that, where possible cut in may be reduced by lifting adjacent pipes.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting or with the use of pneumatic tools or mechanical breakers and boulders exceeding 0,10 m³ shall be classified as hard material.

Where more than 40 % of any material (by volume) consists of boulders each exceeding 0,10 m³ in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged pipelines

Where indicated by the Engineer damaged sections of pipelines shall be completely removed and replaced.

(e) Pipe couplings

Repair sections will be joined, utilising existing pipe sockets and collars where possible.

Repair couplings shall be used with the approval of the Engineer.

(f) Laying of uPVC pipelines

New sections of uPVC pipelines shall be laid on a granular bed suitable for flexible pipelines as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

Refer to SANS 1200 LB: Bedding (pipes), for the specification on bedding.

(g) Laying of asbestos cement, concrete or galvanised mild steel pipelines

New sections of the pipelines shall be laid on class A or B bedding as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and

all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

Refer to SANS 1200 LB: Bedding (pipes), for the specification on bedding.

(h) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(i) Concrete encasement

Where instructed by the Engineer pipes shall be encased in concrete. All such encasing shall be done in accordance with the Engineer's instructions and sufficient allowance shall be made for movement joints.

(j) Extension of existing pipelines

Where existing pipelines require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where they join the existing service, at the same level as the existing pipeline.

Existing chambers or other structures which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new structures shall be paid for under the relevant sections in the specification.

(k) Construction in existing roads

Road crossings shall either be constructed utilising sufficient provision of bypass roads or utilising the half width of the road. At all times a through route shall be maintained for all traffic.

(l) Repairing of leaks

Where leaks occur at pipe sockets or collars the affected section shall be cut from the pipeline and repaired using repair couplings.

Where obvious leaks occur due to displaced sealing rubbers, the rubbers shall be replaced if the replacement can be done economically by lifting adjacent pipes.

(m) Replacement of pipes damaged by exposure to extensive ultraviolet light

Pipes damaged as a result of excessive exposure to sunlight shall be replaced where indicated by the Engineer.

CD 04.02.03 Quality standard

Pipelines shall be laid at even gradients within the points of correction, to the satisfaction of the Engineer and the applicable specifications.

CD 04.02.04 Materials

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Supercast cast-iron pipes and fittings

Supercast cast iron pipes can be used for underground and above ground installations. Plain ended cast iron pipes and fittings shall be used, manufactured from 150, Grade A, grey iron in accordance with SANS 1034. Fittings and pipes shall be free of pinholes, blowholes, blemishes, flash and foundry sand and have a smooth bore. All pipes and fittings shall be sand blasted and coated on the inside and outside by submersion in a corrosion inhibiting oxide primer or bitumen paint.

The pipes and fittings shall be joined by means of stainless steel neoprene couplings as supplied by the manufacturer's of the pipe system. The coupling shall be installed according to the manufacturer's specification and is to be tightened with a torque wrench to a torque of 6,8 Nm.

(b) uPVC pipe and fittings under ground

uPVC pipes and fittings can be used for above ground installations.

For pipe sizes larger than 160 mm diameter, uPVC class 6 pressure pipe to SANS 966 shall be used with prefabricated uPVC bends and junctions. Prefabrication shall be done by means of hot-air welding of fittings to be covered with three layers of fibreglass reinforced lining over welded sections. The resin to be used shall be as specified by the manufacturer for usage with PVC. Bends shall be manufactured out of 3 to 4 sections per bend. Pipe joints shall be done by means of couplings fixed with solvent cement for PVC piping. This joint shall be reinforced with a fibreglass lining of three layers.

Piping is to be supported and bracketed with properly sized and designed brackets consisting of two half sections clamped over the pipe and hung with two hanger rods.

Pipes are to be pressure tested in sections as specified in this specification.

(c) Prefabricated galvanised steel piping and fittings above ground

The pipe to be used shall be plain-ended medium gauge uncoated pipe to SANS 62, galvanised to SANS 763 and shall be approved by the Galvanising Association of South Africa. All fittings are to be manufactured out of the same material, welded with flanged ends or rolled ends to fit clambon fittings. Fittings are only to be galvanised after manufacturing. All joints are to be either flanged or equipped with clambon couplings. All fittings and junction to be 45 sections.

The pipe system must be properly secured and bracketed at regular intervals with correctly sized and designed galvanised brackets.

Pipes are to be pressure tested in sections as specified in this specification.

(d) HDPE pipe and fittings

HDPE pipes and fittings can be used for underground and above ground installations where specified in accordance with SANS 8770:2008 only pipes manufactured using an extrusion process and tempered in a hot bath shall be used. Pipes shall be plain ended and only moulded HDPE bends and fittings shall be used. Jointing of pipes and fittings shall be done by butt welding, electro-sleeve couplings and/or flanged joints. Pipes and fittings shall only be installed by industry approved installers and the Contractor shall furnish a certificate to this effect. Pipes and fittings shall be installed strictly according to the manufacturer's application technique.

Pipes are to be pressure tested in sections as specified in this specification

(e) Galvanised steel pipe installations

- (i) All galvanised steel pipes shall be medium gauge mild steel screwed and socketed pipes to SANS 62 and shall be normalised and marked as such by the manufacturer. Pipes shall be hot-dipped galvanised to SANS 763 and shall be approved by the Galvanising Association of South Africa.
- (ii) All fittings shall be malleable cast-iron fittings to SANS 509 and galvanised to SANS 763 and shall be approved by the Galvanising Association of South Africa.
- (iii) All 80 diameter and larger pipes shall be joined with Class 16 flanged couplings to SANS 1123/1600. The bolts, nuts and spring washers to be used on these joints shall be cadmium plated.
- (iv) In pipe ducts and elsewhere pipes shall be fixed onto walls, soffits, etc, with approved type of supports, holderbats, clamps, etc. Brackets shall be designed to structurally support and fix the pipe system and shall have enough clearance from walls, soffits, etc, to insulate hot-water pipes and maintain equipment.
- (v) Pipes shall be supported according to the manufacturer's specifications with approved brackets at the following maximum intervals:

NORMAL SIZE (mm)	HORIZONTAL (mm)	VERTICAL (mm)
15 dia to 20 dia	1 200	1 830
32 dia to 40 dia	1 830	2 450
50 dia to 150 dia	2 450	3 050

- (vi) Pipes shall be installed in such a manner as to prevent airlocks. A minimum rise of 1:250 shall be maintained to high points, which shall be fitted with suitable air release valves.
- (vii) All pipes shall be marked according to SANS 10140 or as specified by the Engineer. All surface pipes shall be painted.
- (viii) Pipes shall be installed flush unless otherwise instructed by the Engineer.
- (ix) Provision shall be made for thermal contraction and expansion.
- (x) The type of pipe joint compound shall be approved by the Engineer and used sparingly with good quality hemp. For pipes larger than 80 mm diameter a jointing compound such as Epidermix 32 shall be used.
- (xi) Any pipes buried shall have at least 900 mm cover and be coated and wrapped to SANS 11 17 and tested in the presence of the Engineer.
- (xii) All exposed hot-water pipes shall be lagged as specified.
- (xiii) All pipework and fittings shall be pressure tested and sterilised as specified.
- (xiv) Valves shall be installed on all branch pipes and ball-o-stop valves on all connectors to basin pillar cocks, sink mixers, cistern type WCs and other fittings.
- (xv) Approved type expansion bellows shall be installed where required for expansion and contraction to prevent excessive stain on fittings and pipe joints.

(f) uPVC underground pipe installations

- (i) uPVC piping shall conform to SANS 966 with rubber ring type joints.
- (ii) All bends shall be uPVC type fittings with rubber ring joints.
- (iii) All other fittings such as T-pieces, reducers, flanges, etc, shall be bitumen-dipped cast iron rubber ring jointed fittings to SANS 546.
- (iv) No solvent weld type fittings will be allowed.
- (v) All cast iron fittings shall be coated and wrapped to SANS 1117.
- (vi) All pipes shall be laid on a 100 mm sand-bedding cradle and covered with 300 mm sand before backfilling.
- (vii) All backfilling shall be to the Engineer's specification and approval.

(viii) Pipe trenching and bedding shall be as follows:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900	SANS 1200 LB	90% of modified AASHTO density

- (ix) All thrust blocks shall be cast between the pipe and the undisturbed trench material.
- (x) No concrete shall come into direct contact with the uPVC pipe. At the thrust blocks the bend shall be wrapped with Densopol 80 HT Tape or approved equivalent.
- (xi) DPE pipe connections to uPVC pipes up to 50 mm diameter can be done by means of SG iron manufactured saddles with the appropriate gaskets and cadmium-plated bolts and nuts.
- (xii) All pipe crossings under traffic areas shall be backfilled with soilcrete and compacted as specified.
- (xiii) All pipework shall be pressure tested with all joints uncovered, to the satisfaction of the Engineer.
- (xiv) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(g) HDPE underground pipe installations

- (i) HDPE piping shall be Type 4 HDPE pipe to SANS 533.
- (ii) All fittings shall be of Plasson compression type, conforming to ISO/DIS 3458.
- (iii) All pipes shall be laid on a 100 mm sand bedding cradle and covered with 300 mm of sand of selected material.
- (iv) All backfilling shall be to the Engineer's specification and approval.
- (v) Pipe trenching and bedding shall be as follows:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SANS 1200	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900	LB	90% of modified AASHTO density

- (vi) No concrete shall come into direct contact with the HDPE pipe. At these points the fittings shall be wrapped with a Densopol 80 HT tape or approved equivalent.
- (vii) All pipe crossings under traffic areas shall be backfilled with soilcrete and compacted as specified.
- (viii) All pipework shall be pressure tested with all joints uncovered to the satisfaction of the Engineer.
- (ix) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(h) Valves

- (i) Gate valves underground in valve chambers to connect to uPVC piping (65 mm NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SANS 936 Grade 42, cast-iron nitrile butadine rubber-covered gate, stainless steel spindle, nitrile butadine rubber O-rings and seals, cast iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SANS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valve shall be fitted with a square key spindle top to close the valve in a clockwise direction and socket ends to SANS 665 to fit into uPVC Class 12 pipe and installed to detail.

- (ii) Gate valves underground in valve chamber to connect to HDPE piping

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SANS 776 Class 125. The valve shall be able to withstand a working pressure of 1 600 kPa. The valve shall be fitted with a hand wheel on an extended spindle shaft of 700 mm to close in a clockwise direction and installed to detail.

- (iii) Gate valves above ground for temperatures up to 40 °C to connect to steel piping (65 mm NB and larger)

Gate valves to be equipped with non-rising spindle, spherical graphite iron body to SANS 936 Grade 42, cast-iron nitrile butadine rubber-covered gate, stainless steel spindle, nitrile butadine rubber O-rings and seals, cast iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SANS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with flanged ends to SANS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or side ways to a maximum 90° from upright.

- (iv) Gate valves above ground for temperatures above 40 °C to connect to steel piping (65 mm NB and larger)

Gate valve shall be equipped with non-rising spindle, spherical graphite iron body to SANS 963 Grade 42, cast-iron gate, gunmetal seat and gate rings, high-tensile bronze spindle, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2. The valve shall conform to SANS 665 and shall be capable of withstanding a working pressure of 1 600 kPa and a temperature of 90 °C.

The valve shall be fitted with flanged ends to SANS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

- (v) Gate valves above-ground to fit to copper pipes (65 mm NB and larger)

Gate valves shall be equipped with non-rising spindle, gunmetal bronze or dezincified brass body, gunmetal or dezincified brass gate, graphite asbestos packing in the gland.

The valve shall be fitted with a hand wheel to close in a clockwise direction and installed in an upright position or sideways to maximum 90° from upright.

The valve shall be equipped with flanges to SANS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

- (vi) Gate valves above-ground for temperatures up to 100 °C (up to 50 mm NB)

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SANS 776-1965 Class 125.

The valve shall be able to withstand a working pressure of 1 600 kPa.

The valve shall be equipped with a hand wheel to close in a clockwise direction.

The valve shall be installed in an upright position or sideways to a maximum 90° from upright and shall be so placed with other fittings to be removable without cutting the pipework.

- (vii) Ball-O-Stop valves (15 mm diameter - 25 mm diameter)

This valve shall be a full-way ballcock type with BSP threaded ends. This valve shall conform to SANS 1056 Part 3, 1985, shall be rated for a test pressure of 2 000 kPa, and shall be chrome-finished where exposed.

- (viii) Angle regulating valves

This valve shall be a 15 mm diameter chromium-plated angle regulating valve with a 350 mm chromium-plated copper tube and cap nuts where required.

- (i) Strainers

- (i) Strainers for connection to steel or uPVC pipes (65 mm NB and larger)

These strainers shall be of the Y-type with cast iron body, stainless steel or bronze strainer element and shall be equipped with flanged ends to SANS 1123/1600. The whole size of the strainer element shall be maximum 1 mm diameter and be removable without dismantling of pipework. The strainer shall be suitable for a temperature of up to 90 °C at a 1 000 kPa pressure rating and installed with the element facing downwards or a maximum of 45° sideways.

- (ii) Strainers for connection to steel and copper pipes (up to 50 mm NB)

The strainers shall be of the Y-type with bronze or dezincified brass body, stainless steel strainer element and must be equipped with BSP threaded socket ends. The whole size of the strainer element shall be maximum 0,8 mm diameter. The strainer shall be suitable for a temperature of up to 90 °C at a pressure rating of 1 000 kPa and installed with the element facing downwards or a maximum of 45° sideways.

- (j) Non-return valves

- (i) Non-return valves for cold water (65 mm NB and larger)

The non-return valve shall be of the spring-loaded dual flap plate type fitted between two flanges (wafer).

The non-return valve shall be equipped with a cast-iron body, aluminium bronze plates, stainless steel springs and neoprene seals on the plates. The valves shall be suitable for a working pressure of 1 000 kPa.

- (ii) Non-return valves for hot water (up to 100 mm diameter) and cold water (up to 50 mm NB)

The non-return valve shall be of the spring-loaded piston type, with bronze or dezincified brass body, stainless steel spring and bronze disc with neoprene seal fitted with BSP threaded socket ends. The valve shall be suitable for a working pressure of 1 000 kPa and a temperature of up to 90 °C. All valves shall be installed as to be removable without extensive pipework removal.

(k) Air release valves and vacuum breakers

- (i) Double orifice double-acting air release valves with sizes from 50 mm NB to 200 mm NB

The air release valve shall be fitted with small and large orifice. The air release valve shall be fitted with a cast-iron or stainless steel body, stainless steel or fibreglass balls, integral shut-off valve and flanged ends to SANS 1123/1600. The valve shall be equipped with an anti-shock facility.

The valve shall be suitable for maximum pressure of 1 600 kPa.

- (ii) Single orifice air release valves for main water lines with sizes from 25 mm NB to 50 mm NB

The air release valve shall be fitted with a small orifice, cast-iron or stainless steel body, fibre glass or stainless steel ball float and BSP threaded inlet.

When the valve is installed a shut-off valve shall be installed on the inlet side. The valve shall be equipped with an anti-shock facility.

The valve shall be suitable for maximum pressure of 1 600 kPa.

- (iii) Single orifice double purpose air release valves for domestic water lines up to 15 mm NB

The air release valves shall be fitted with a stainless steel float, brass or cast steel body with an integral shut-off valve fitted.

The valve shall be capable to withstand a working pressure of 1 000 kPa at 110 °C.

- (iv) Vacuum breaker up to 40 mm diameter

The vacuum breakers shall be fitted with neoprene seal, spring-loaded disc in a dezincified brass or bronze body. The valve shall seal watertight and shall be designed to withstand a working pressure of 1 000 kPa and a temperature of 90 °C.

(l) Pressure-reducing valves

- (i) Combination pressure reducing stations

Where a high peak flow can occur as well as a small flow and the small flow is out of the range of the large pressure-reducing valve, a small pressure-reducing valve shall be installed in parallel with the large pressure-reducing valve. The two pressure-reducing valves in parallel shall be set according to the manufacturer's specification.

(ii) Large pressure-reducing valves (65 mm NB and larger)

The pressure reducing valve shall be equipped with a cast iron body, neoprene-nylon reinforced diaphragm, bronze seal disc washer, stainless steel shaft and flanged ends. The valve shall be pilot operated and shall be designed to handle high flows at a minimum head loss.

The valve must be adjustable to handle a wide range of incoming pressure at a constant downstream pressure.

The valve shall be equipped with flanged ends to SANS 1123/1600.

(iii) Small pressure-reducing valves (15 mm NB - 50 mm NB)

The pressure-reducing valve shall be equipped with brass body, balanced single seat and integral strainer. The valve shall be able to handle a wide range of incoming pressure while the downstream pressure stays constant with maximum inlet pressure of 1 000 kPa and a maximum water temperature of 40 °C.

The valve shall be equipped with BSP male threaded brass union couplings.

(m) Water meters

(i) Combination water meters

Where high peak flow as well as a low flow can occur, and the low flow is out of the registration range of large water meter, a small diameter water meter shall be installed in parallel with the large water meter to cater for the low flows with integral automatic change-over valves. These valves shall be designed to have a minimum pressure drop at the operating point.

(ii) Water meters (50 mm NB and larger)

These water meters shall be of the dry type with all gears and transmission and roller counters in a dry head, and shall be equipped with flanged ends to SANS 1123, cast-iron body with high quality corrosion proof coating. The meter must be protected from magnetic fields and sealed to prevent tampering with adjustments. The meter must be able to work up to a pressure of 1600 kPa under a maximum water temperature of 40 °C. The scale of meter must be in cubic metre (m³) and equipped with needle indicators reading in litres. The accuracy of the meter shall be not less than 98 %.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturer's specification.

(iii) Water meters (up to 50 mm NB)

The meter shall be of the volumetric rotary piston type with brass body equipped with union couplers. The meter reading must be in kilolitres. The meter shall have

an accuracy of not less than 98 %. The meter must be able to operate up to a water pressure of 1000 kPa at a water temperature of 40 °C.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturers specification.

CD 04.03 FIRE WATER PIPED RETICULATION NETWORKS

CD 04.03.01 General

Repair work to the fire water piped reticulation networks is detailed in the Particular Specification and shall include but not be limited to the work described below. This specification only covers the water piped reticulation for the fire water protection system, whereas the equipment to this installation, such as fire hydrants, hose reels and extinguishers, are covered and detailed in Technical Specification JC: Conventional Fire Fighting Equipment. This specification must be read in conjunction with the afore-mentioned specification.

Repair work to the fire water piped reticulation networks may include the following:

- (a) Replacement of damaged, broken, leaking, corroded above-ground and underground pipe work, fittings and equipment;
- (b) Repair, replace and service valves which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (c) Where valves do not close properly, all these valves are to be refurbished, descaled and if necessary replaced;
- (d) Repair, service and check the proper functioning of all non-return valves and backflow preventers;
- (e) Repair, service, readjust and calibrate all pressure gauges;
- (f) Repair work to bracketing systems including fixing and repair of existing brackets and the introduction of additional brackets where required;
- (g) Report all related problems to fire fighting equipment to the Engineer;
- (h) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float or/and filling valves to these tanks are to be serviced and repaired where required;
- (i) Pressure test and sterilise repaired new installation and equipment;
- (j) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where any repair, upgrade and/or service work have been executed;
- (k) Record pressure readings on supply to installation.

CD 04.03.02 Material and equipment specification for fire water piped reticulation networks

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the relevant specification.

CD 04.04 **CLEANING OF PIPELINES**

The work under this section involves the removal of silt, debris and lime deposits from within the pipelines and the general cleaning in areas resulting from leakage.

CD 04.04.01 **Construction**

Prior to the cleaning of any pipeline sections, the Contractor shall arrange with the Engineer for an inspection of the pipe route. Based on the inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Visual inspections utilising check circuit TV cameras will not be required unless deemed essential on large diameter pipelines.

Sections of the pipeline may be removed for a more detailed inspection. Such sections will be repaired as specified in Sub clause CD 04.02. Sections will only be cut from the pipeline where specifically instructed by the Engineer.

The method to be applied for the cleaning of the pipelines will be chemical or mechanical and shall be followed by disinfection of the related section. The method to be applied for each section of the pipeline will be instructed by the Engineer.

Material removed from the pipelines shall be disposed of as instructed by the Engineer. The Contractor shall discuss the method proposed for the scouring of the pipelines where insufficient scour valves are present with the Engineer prior to implementation.

CD 04.04.02 **Quality standard**

Pipelines shall be cleaned such that head losses along the pipe route are negligible under simulated fire flow, when measured at convenient points along the route.

CD 04.05 **REPAIR OF FITTINGS**

CD 04.05.01 **Construction**

The Engineer will indicate the fittings that are to be repaired.

The repair of the following fittings may be required:

- (a) Gate valves
- (b) Fire hydrants
- (c) Viking Johnson couplings
- (d) Pressure-reducing valves
- (e) Ferrules
- (f) Domestic water meters
- (g) Bulk water meters
- (h) Stop-cocks
- (i) Tees
- (j) Bends
- (k) End caps
- (l) Saddles
- (m) Sprinklers.

CD 04.06 **REPAIR OF STRUCTURES**

The Engineer will indicate the structures that are to be repaired or cleaned from debris.

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris and other debris spoiled at designated sites.

The reinstatement of damaged structures shall be carried out to the same standards prescribed for new construction.

CD 05 **TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK**

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

CD 06 **QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

CD 07 MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT

CD 07.01 GENERAL

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance as described in Additional Specification SA: General Maintenance.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in the Particular Specification and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

The maintenance work and items are categorised for each maintenance activity under the following headings:

- (a) Repair of water distribution pipelines (see table CD 07.02/1)
- (b) Cleaning of existing pipelines (see table CD 07.02/2)
- (c) Repair of fittings (see table CD 07.02/3)
- (d) Repair of existing structures (see table CD 07.02/4)
- (e) Fire water piped reticulation structures (see table CD 07.02/5).

The scope of the external water network and bulk water network is indicated in the drawings in the Contract.

CD 07.02 ROUTINE PREVENTATIVE MAINTENANCE

This routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the following items listed in the tables below under each heading.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE CD 07.02/1 REPAIR OF WATER DISTRIBUTION PIPELINES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Log all water meter readings	Monthly
3	Log all pressure gauge readings	Monthly
4	Check, inspect, report and repair leaks/replace rotten pipes where required	Monthly
5	Sample water supply and chemical analyses to be provided by approved company	Monthly
6	Bulk Water storage tanks to be emptied, cleaned out, inspected, repaired and resealed where necessary	Annually
8	Clean out all strainers	Monthly
9	Check, inspect, repair or replace all bracketing systems	Four-monthly
10	Paint repairs to piping, fittings and equipment	Annually

TABLE CD 07.02/2 CLEANING OF EXISTING PIPELINES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Remove silt, debris and loose lime deposits from within pipelines where required by scouring	Annually
3	Do general cleaning in areas where leakage has occurred	Six-monthly

TABLE CD 07.02/3 REPAIR OF FITTINGS

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Replace all valve gaskets, gland packings and seals	Annually
2	Check, inspect, service, repair and readjust all pressure reducing valves	Annually
3	Check, inspect and test operation of all valves on site	Four-monthly
4	Check, inspect, service, test and repair/replace all safety and expansion release valves	Six-monthly
5	Check, inspect, service, test and repair/replace all air release valves and vacuum breakers	Four-monthly
6	Check, service, repair or replace all ball float valves	Six-monthly
7	Check, inspect, test, service and repair/replace all non-return valves	Four-monthly

TABLE CD 07.02/4 REPAIR OF EXISTING STRUCTURES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on all water distribution related structures	Monthly
2	Clean out structures of debris	Six-monthly

TABLE CD 07.02/5 FIRE WATER PIPED RETICULATION STRUCTURES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Report any failures/breakage of fire fighting equipment to the Engineer	Monthly
3	Log all pressure gauge readings	Monthly
4	Replace all valve gaskets, gland packings and seals	Annually
5	Clean out water storage tanks and reseal/repair if necessary	Annually
6	Check, inspect, service, repair/replace all non-return valves and backflow preventers	Four-monthly
7	Check, inspect, report and repair all leaks/replace rotten pipes where required	Monthly
8	Inspect, service, readjust and calibrate all pressure gauges	Four-monthly
9	Paint repairs to piping, fittings and equipment	Annually
10	Check, inspect, repair or replace all bracketing systems	Four-monthly

CD 07.03 CORRECTIVE MAINTENANCE

This corrective maintenance of the installations, systems and equipment to be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

CD 07.04 BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance specification.

All breakdown maintenance shall be done in accordance with the related specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

CD 08 MEASUREMENT AND PAYMENT

CD.01 WATER DISTRIBUTION PIPELINES

CD.01.01 Repair of existing pipelines Unit: metre (m)

The unit of measurement shall be per metre length of pipe replaced. In each case the Contractor shall agree on the length of pipe to be replaced and the method of coupling the pipes.

The tendered rate shall include full compensation for cleaning and grubbing, excavation, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, logging and backfilling of replacement pipeline, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench, disposal of surplus materials.

Separate items will be scheduled for house connections and distribution pipes.

The provision of the materials will be measured separately under CE 01.02.

CD.01.02 Provision of materials

(a) Pipelines Unit: metre (m)

The unit of measurement shall be the metre of pipe replaced.

(b) Fittings Unit: number

The unit of measurement shall be the number of fittings installed.

The tendered rates shall include full compensation for all transport to the place of installation, storage, labour costs.

Separate pay items shall be listed for the pipe materials and fittings per diameter and class.

CD.01.03 Replacement of manhole covers, grid inlets and the like

(a) SANS 558 Type 4 - covers, grids, etc. only:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(b) SANS 558 Type 4 - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(c) SANS 558 Type 2A - covers, grids, etc. only:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(d) SANS 558 Type 2A - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames from the site.

CD.01.04 Repair of corrosion protection

Corrosion protection of pipes with diameters of:

- (a) Up to 100 mm dia Unit: metre (m)
- (b) 101 to 200 mm dia Unit: metre (m)
- (c) 201 to 300 mm dia Unit: metre (m)
- (d) 301 to 400 mm dia Unit: metre (m)

The unit of measurement shall be meter length of pipe painted with corrosion protection in accordance with Specification LB: Corrosion protection.

The tendered rate shall include full compensation for preparation of pipe fittings, application of corrosion protection and curing of corrosion protection.

Separate items shall be scheduled for different types of pipework.

CD.01.05 New Pipelines: Preparation and Finishing Unit: metre (m)

The unit of measurement shall be per metre length of pipe being replaced. In each case the Contractor shall agree on the length of pipe to be replaced.

The tendered rate shall include full compensation for cleaning and grubbing, all excavations to the specified depth, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, logging and backfilling of replacement pipeline, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench, disposal of surplus materials and pressure testing of the completed pipeline.

The provision of the pipeline materials will be measured separately under CD 01.02.

CD.02 REPAIR OF FIRE WATER PIPE RETICULATION NETWORK

Measurement and payment items from CD.01, CD.03, CD.04 and CD.05 will be utilised for work done on the external fire water pipe reticulation. Additional payment items for specialist fittings shall be paid under Specification JC.

CD.03 CLEANING OF PIPELINE

CD.03.01 Cleaning of deposits in pipeline by mechanical means for pipes of diameters of:

- (a) Up to 100 mm dia Unit: metre (m)
- (b) 101 to 200 mm dia Unit: metre (m)
- (c) 201 to 300 mm dia Unit: metre (m)
- (d) 301 to 400 mm dia Unit: metre (m)

CD.03.02 Scouring of pipeline to remove trapped debris for pipes of diameters of:

- (a) Up to 100 mm dia Unit: metre (m)
- (b) 101 to 200 mm dia Unit: metre (m)
- (c) 201 to 300 mm dia Unit: metre (m)
- (d) 301 to 400 mm dia Unit: metre (m)

The unit of measurement shall be metre length of pipe cleaned or scoured.

The unit rate of measurement for item CA.03.01 shall include full compensation for the emptying of the pipeline, cleaning, refilling and reporting on the condition of the pipe after cleaning. The rate shall also include the disposal of waste material in and appropriate manner.

The unit of measurement for item CA.03.02 shall include full compensation for the scouring of the pipeline and refurbishing of the pipeline. The unit of measurement shall be the total length of filled pipeline from which the water is scoured. The length shall be agreed with the Engineer prior to scouring.

The provision of additional scour points shall also be included in the rate.

CD.04 REPAIR OF FITTINGS

CD.04.01 Servicing of valves Unit: number

The unit of measurement shall be the number of valves serviced.

The tendered rate shall include full compensation for cleaning, removing rust, scale or other solids from surfaces or moving parts, proper greasing of all moving parts, preparation for corrosion protection coating and painting of valves.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

CD.04.02 Recondition valves Unit: number

The unit of measurement shall be the number of valves reconditioned.

The tendered rate shall include full compensation for dismantling, cleaning, removing rust, removing scale or other solids from surfaces and moving parts, replacing components such as hinges, spindles, hard wheels or gates, swing axles, swing gates, replacing or repair of seals, skimming of seal surfaces, proper greasing of all moving parts, preparation for corrosion protection, painting or any other action or cost necessitated to recondition a valve to a perfect functional drop tight condition.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

CD.04.03 Decommission and remove valves Unit: number

The unit of measurement shall be the number of valves decommissioned and removed.

The tendered rate shall include full compensation for all labour and equipment required to decommission and remove valves, such as installation of temporary isolating valves or blank flanges, removal of unserviceable valves, loosening and removal of bolts and nuts, or any other related action required. Excavation to exposed partially buried valves shall also be included in the rate.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of valves.

CD.04.04 **Repair of house connections**Unit: number

The unit of measurement shall be the number of house connections repaired.

The tendered rate shall exclude the provision of new fittings measured under CE. 01.02 but shall otherwise include full compensation for appurtenant fittings, excavation, backfilling and other necessary work to repair existing house connections.

All connections to the distribution pipelines, up to a diameter of 32 mm shall be measured as "house connections".

CD.05 **REPAIR OF STRUCTURES AND CONSTRUCTION OF NEW BRICKWORK**

CD.05.01 **Demolition, removal of damaged existing structures and construction of new brickwork**

- | | |
|--|--------------------------------------|
| (a) <u>Plain concrete</u> | Unit: cubic metre (m ³) |
| (b) <u>Reinforced concrete</u> | Unit: cubic metre (m ³) |
| (c) <u>Brickwork</u> | Unit: square metre (m ²) |
| (d) <u>Precast concrete manhole sections</u> | Unit: number |

The unit of measurement for CE.05.01(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

The unit of measurement for CE.05.01(c) and (d) shall be the square metre length of brickwork and the number of precast concrete manhole sections.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material. Excavation and backfill shall also be included for constructing the precast concrete manholes inclusive of all work required to complete the work as shown on the drawings.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

CD.05.02 **Cleaning of existing manholes, chambers..... and other structures** Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of debris and other material to be disposed, removed from manholes, chambers and other structures.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the material, trimming the bedding and for loading, transporting and disposing of the material.

CD.05.03 **Overhaul on material for haul in excess of 1,0 km**

- | | |
|---|--|
| (a) Excavated material to spoil | Unit: cubic metre kilometre (m ³ -km) |
| <u>Existing structures demolished</u> | Unit: cubic metre kilometre (m ³ -km) |

The unit of measurement shall be the cubic metre of loose material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

CD.05.04 Repair of structures

- (a) Brickwork Unit: square metre (m²)
- (b) Concrete Unit: cubic metre (m³)
- (c) Precast concrete manhole sections Unit: number

The unit of measurement shall be the cubic metre of brickwork or concrete constructed.

The tendered rate shall include full compensation for the provision of materials, transport, preparation and placing of foundations, labour and all other associated work to complete the work required.

Separate items will be scheduled for specific installations.

CD.05.05 Marker posts Unit: number

The unit of measurement shall be the number of marker posts installed.

The tendered rate shall include full compensation for the manufacture and installation complete as shown on the drawings.

CD.05.06 Sample testing

- (a) Extract sample to determine lime deposition, corrosion and general condition for pipes of:
 - (i) Up to 100 mm dia Unit: number
 - (ii) 101 to 200 mm dia Unit: number
 - (iii) 201 to 300 mm dia Unit: number
 - (iv) 301 to 400 mm dia Unit: number

The unit rate of measurement shall be the number of sample tests carried out.

The tendered rate shall include full compensation for cutting into pipe and extraction of sample, visual inspection and reporting on condition of pipe. The tendered rate shall also include full compensation for the appropriate disposal of the sample and for the repair of the section pipeline.

Compensation for provision of new pipes and fittings, shall be measured under CD 01.

CD.05.07 New structures

Precast concrete manhole sections Unit: number

The unit of measurement shall be the number of new pre-cast manholes constructed complete with precast top, manhole frame, cover and finishing.

The tendered rate shall include full compensation for the provision of materials, transport, preparation and placing of foundations, labour and all other associated work to complete the work required.

CD.06 TESTS AND INSPECTIONS OF REPAIR WORK

CD.06.01 Pressure testing

(a) Pressure test pipeline in sections of pipes with diameter of:

- (i) Up to 100 mm dia Unit: metre (m)
- (ii) 101 to 200 mm dia Unit: metre (m)
- (iii) 201 to 300 mm dia Unit: metre (m)
- (iv) 301 to 400 mm dia Unit: metre (m)

The unit of measurement shall be the metre length of pipe tested.

The tendered rate shall include full compensation for isolation of test section, filling of section with water, testing for required duration and reporting on performance of pipes, the provision of any additional water shall also be included in the rate. The rate shall also include the provision of all equipment, labour and supervision necessary for the completion of the pressure test.

CD.06.02 Provision of equipment for visual inspection of.... underground pipeline network

Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as torches, lights and mirrors, etc, to enable a basic visual inspection of the pipeline network.

CD.06.03 CCTV inspection of underground pipework

(a) Pipes of diameter:

- (i) Up to 300 mm dia Unit: metre (m)
- (ii) 301 to 600 mm dia Unit: metre (m)

The unit of measurement shall be the metre length of pipe inspected.

The tendered rate shall include full compensation for all inter-pipe relocations required to conduct a thorough check of the pipework where indicated by the Engineer.

CD.07 LOCATE AND CONNECT INTO THE EXISTING WATER NETWORK

(a) Locate and connect into the existing water network pipeline Unit: number

The tendered rate shall include the provision of all equipment, labour, fittings and material required to locate the existing water network pipeline, excavate and expose the existing pipe, blank off any unnecessary connections, and connect to the new pipeline.

TECHNICAL SPECIFICATION

CF: SEWERAGE NETWORKS

CONTENTS

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CF 01 SCOPE

This specification covers all aspects regarding the general maintenance of sewerage networks which may include the following installations:

- (a) Sewer pipelines and manholes
- (b) Open sewerage channels
- (c) Conservancy tanks.

This specification shall form an integral part of the maintenance and servicing contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

CF 02 STANDARD SPECIFICATIONS

CF 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 1200 D - Earthworks
- SANS 1200 DB - Earthworks (pipe trenches)
- SANS 1200 L - Medium-pressure pipelines
- SANS 1200 LB - Bedding (pipes)
- SANS 1200 LC - Cable ducts
- SANS 1200 LD - Sewers

CF 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CF 02.03 **MANUFACTURER'S SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

CF 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CF 03 **OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CF 04 **EXECUTION OF REPAIR WORK**

CF 04.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all Additional and Particular Specifications included in this document.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

CF 04.02 **REPAIR OF EXISTING PIPELINES AND STRUCTURES**

This section covers the work in connection with the construction of sewerage networks and associated sewerage structures such as manholes, cleaning eyes and the like. It also covers the removal and replacement of damaged and broken pipes and sewerage structures, as well as repairs to existing pipes and structures.

CF 04.02.01 **General**

Repair work to the soil and wastewater drainage system shall be detailed in the Particular Specification and may include the following:

- (a) Replacement of damaged, broken, leaking, corroded above-ground and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing gully gratings, manhole covers and frames, cleaning eye covers, screws and bolts, inspection of eye covers, screws and bolts, end caps and vent cowls;
- (c) Repair work to damaged manholes, gullies, cleaning eyes, etc, including builder's work and benching;
- (d) Initial unblocking and cleaning of all drainage pipework, traps and gullies;
- (e) Repair of sewerage system where necessary;
- (f) Provision of additional connections to the sewerage system;
- (g) Reinstatement and making good of walls, concrete, road surfaces, etc, to an approved acceptable level where any repair and/or service work have been executed;
- (h) Video surveying of all underground drainage pipework to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (i) Test pipe system and equipment for leakage;
- (j) Sewerage pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be followed if the outcome of this sampling requires attention;
- (k) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair and/or service work have been executed.

CF 04.02.02 **Construction**

The Engineer will indicate the location at which sections of pipeline are in need of repair after the appropriate surveys have been completed by the Contractor.

CF.4

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of the pipelines. The width of the excavation for each type and size of pipeline shall be as specified in SANS 1200 DB.

The depth of the excavation for each type and size of pipeline shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the pipeline and shall be sufficient to allow for the type and thickness of bedding material as instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Excavations shall extend such that, where possible, cut in may be reduced by lifting adjacent pipes.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers and boulders exceeding 0,10 m³ shall be classified as hard material.

Where more than 40 % of any material (by volume) consists of boulders each exceeding 0,10 m³ in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged pipelines

Where indicated by the Engineer damaged sections of pipelines shall be completely removed and replaced.

Excavation shall be carried out as described for new pipeline installation and the excavated material shall be, if suitable, preserved for backfilling. The damaged pipe materials shall be disposed of where instructed by the Engineer.

(e) Pipe couplings

Repair sections shall be joined utilising existing pipe sockets and collars where possible.

Repair couplings shall be used with the approval of the Engineer.

(f) Laying of vitrified clay pipes and fittings

New sections of vitrified clay pipes shall be laid on granular bed as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

(g) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(h) Concrete encasement

Where instructed by the Engineer pipes shall be encased in concrete. All such encasing shall be done in accordance with the Engineer's instructions and sufficient allowance shall be made for movement joints.

(i) Extension of existing pipelines

Where existing pipelines require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where they join the existing service, at the same level as the existing pipeline.

Existing chambers or other structures which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new structures shall be paid for under the relevant sections in the specification.

(j) Construction in existing roads

Road crossings will either be constructed utilising sufficient provision of bypass roads, or they will be done utilising the half width of the road. At all times a through route shall be maintained for all traffic.

(k) Repairing of leaks

Where leaks occur at pipe sockets or collars the effected section will be cut from the pipeline and repaired using repair couplings.

Where obvious leaks occur due to displaced sealing rubbers they will be replaced if the replacement can be done economically by lifting adjacent pipes.

(l) Sewer manholes

All manhole cover frames shall be cast into the concrete cover slabs.

Manholes in trafficable areas shall be provided with heavy duty covers and frames and surrounded by concrete slabs.

(m) Steep sewers

Sewer pipes in the ground with a slope steeper than 1:5 and under surface beds shall be encased in concrete.

(n) External sewers

The sewer outside the boundary of the building complex shall be constructed strictly in accordance with the details and specifications of the Local Authority.

(o) As-built services

Existing drainage invert levels and positions are to be checked against invert levels given on the drawings before work commences. The Engineer must be informed immediately of any discrepancy.

The Contractor shall be responsible for the compilation of as-built plans of sewerage network, showing all pipes, pipe diameters, invert levels and associated structures.

All existing services are to be located and opened before the proposed work commences.

(p) Testing

The drainage system shall be tested according to the specifications laid down by the NBRI. This test shall be carried out in the presence and to the satisfaction and approval of the Engineer.

(q) Ingress of foreign material

During construction all pipe ends are to be suitably plugged to prevent any ingress of dirt, rubble, etc.

(r) CCTV surveys

Modern technology video surveying equipment and detection equipment shall be utilised to establish blockage problems and positions of such problems.

(s) Proximity to buildings

Any drainage pipe within the 45° range below building foundations shall be encased in concrete or soilcrete as specified.

(t) Repair to existing structures

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris shall be spoiled at designated sites.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

Provision shall be made for the reinstatement of existing damaged prefabricated concrete half round channels.

(u) Repair to existing channels

Existing channels shall be cleaned. Broken sections of lined channels shall be repaired. Such repair work shall comprise patching of concrete and replacement of precast sections.

CF 04.02.03 Quality standard

Pipelines shall be laid at even gradients to the satisfaction of the Engineer and the applicable specifications.

CF 04.02.04 Materials

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Manhole covers

Manhole covers, etc, shall have covers and frames complying with SANS 558.

(b) Vitrified clay pipe and fittings

Vitrified clay pipe shall only be used for underground installations. The pipes and fitting shall strictly conform to SANS 559. The pipes and fittings shall have a minimum crushing strength of 45 kN/m:

The joining method to be used shall be polypropylene couplings with integral rubber seal similar or equal to Vitrosleeve in accordance with SANS EN 295: Vitrified clay pipes and fittings and pipe joints for drains and sewers, allowing up to 2,5° angular movement per joint and 5 mm line displacement per joint. The joint shall retain an affective water seal with respect to above conditions with a 6 m water head.

Pipes shall be cut using an approved pipe cutter and the end shall then be trimmed by means of a pipe trimmer to remove any sharp edges.

All fittings underground shall consist of vitrified clay and shall comply with SANS 559.

The piping system shall be tested according to the NBRI information sheet X/BOU 2-34.

CF 04.02.05 Air test for sewer and drains

The following air test as specified in the NBRI information sheet X/BOU 2-34 shall be applicable to all air tests on new sewers and drains installed under the repair Contract, and shall be executed by the Contractor and witnessed by the Engineer.

(a) Method of air testing

All openings in the pipeline are plugged by means of sewer testing plugs. The sewer plug at the lowest end of the pipeline is connected to an air supply hose, which is attached to a mechanically driven air blower, compressor or hand pump. Air is pumped into the pipeline at a pressure of approximately 375 mm water gauge. The pressure is held at this level for a period of two minutes to allow the air temperature to become constant. Subsequently the air supply is closed off and the time recorded for the air pressure to drop from 250 to 125 mm water gauge. If the

CF.8

recorded time is less than the value given in the table below, it means that the pipeline is leaking and does not comply with the required standards of tightness. The apparatus required for the air test is commercially available.

The following requirements have to be taken into account when performing the air test:

- (i) Air-permeable pipelines such as vitrified clay or asbestos cement should preferably be tested when moist or wet.
- (ii) The trench shall be partially backfilled before the test is carried out. This is required to stop possible temperature variations and to prevent damage to the pipeline during subsequent backfilling operations.
- (iii) The testing equipment shall be shielded from the direct rays of the sun.
- (iv) Flexible joints are recommended for sewer and drain pipelines. Good quality flexible joints are superior to cement caulked joints and they also provide the pipeline with flexibility to prevent cracking due to subsequent soil movement.
- (v) The test method is very sensitive to flaws in the pipeline, such as cracks or leaking joints. The actual positions of flaws along the pipeline can be determined by using the specialised equipment.
- (vi) If the pipeline is below the water table and subjected to external water pressure, the test method should be modified by the Engineer to ensure that the final pressure value is higher than that of the external water pressure acting on the lowest part of the installation.

The minimum times for pressure drop of 250 mm to 125 mm water gauge are given in table CF 04.02.05/1 below.

TABLE CF 04.02.05/1

PIPE DIAMETER (mm)	MINIMUM TIME (min - s)	CRITICAL LENGTH OF PIPELINE (m) (58 m ² internal surface area)	MINIMUM TIME(s) FOR LONGER LENGTH (L) OF PIPELINE
100	1 to 58	184,6	0,640 L
150	2 to 57	123,1	1,439 L
200	3 to 56	92,3	2,559 L
225	4 to 26	82,1	3,239 L
250	4 to 55	73,8	3,998 L
300	5 to 54	61,5	5,757 L
375	7 to 23	49,2	8,996 L
450	8 to 51	41,0	12,954 L
525	10 to 20	35,2	17,632 L
600	11 to 49	30,8	23,030 L

CF 04.03 **CLEANING OF SEWERAGE NETWORK**

The work involved under this section is the removal of silt, debris and vegetation from within the pipelines and manholes and the general cleaning of areas where leakage has occurred. This can be done either mechanically or chemically according to the more appropriate method as specified by the Engineer.

CF 04.03.01 **Construction**

The Contractor shall arrange with the Engineer for an inspection of the pipe route before the cleaning of any pipeline sections is carried out.. Based on the inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Visual inspections utilising closed-circuit TV cameras will not be required unless deemed essential and will be specifically requested by the Engineer.

Sections of the pipeline may be removed for a more detailed inspection. Such sections shall be repaired as specified in Subclause CF 04.02.02. Sections shall only be cut from the pipeline where specifically instructed by the Engineer.

The method to be applied for the cleaning of the pipelines shall be chemical or mechanical. The method to be used for each section of the pipeline will be instructed by the Engineer.

Material removed from the pipes shall be disposed of as instructed by the Engineer.

Where insufficient scour values are present, the method for scouring of the pipelines shall be discussed and agreed with the Engineer prior to implementation.

CF 04.04 **REPAIR OF FITTINGS**

CF 04.04.01 **Construction**

The Engineer will indicate the fittings that are to be repaired, but these fittings shall not be limited to those specifically indicated by the Engineer,

Repair of the following fittings may be required:

- (a) Cleaning eyes
- (b) Permanent plug stoppers
- (c) Channel sections.

CF 05 **TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK**

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

CF 06 **QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

CF 07 **MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT**

CF 07.01 **GENERAL**

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance, as described in Additional Specification SA: General Maintenance, for the specified installations described under the Clause CF 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in the Particular Specification and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised for each maintenance activity under the following headings:

- (a) Sewerage network systems
- (b) Wastewater treatment systems.

CF 07.02**ROUTINE PREVENTATIVE MAINTENANCE**

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed in table CF 07.02/1. The tendered rate shall include full compensation for all material, plant and labour required in order to perform such maintenance to the satisfaction of the engineer.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE CF 07.02/1 – SEWERAGE NETWORK SYSTEM

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation	Monthly
2	Check, inspect, repair or replace all manhole covers and frames and builder's work to manholes	Four-monthly
3	Check, inspect and repair manhole benching.	Four-monthly
4	Check, inspect, repair or replace all inspection eye, end caps and cleaning eye covers	Four-monthly
5	Check, inspect, report and unblock any blockage that occurs	Monthly
6	Check, inspect, repair/replace and clean out all equipment traps	Monthly
7	Paint repairs to surface piping and equipment	Annually
8	Survey and resultant repairs and unblocking of all main sewer lines	At start of Contract
9	Check, inspect, repair/replace sewer pipes where necessary to maintain good working condition at all times	Four-monthly

CF 07.03**CORRECTIVE MAINTENANCE**

This corrective maintenance of the installations, systems and equipment to be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

CF 07.04**BREAKDOWN MAINTENANCE**

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance documents.

All breakdown maintenance shall be done in accordance with the related specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

CF 08 **MEASUREMENT AND PAYMENT**

CF.01 **SEWERAGE NETWORKS**

CF.01.01 **Repair of existing pipelines** Unit: metre (m)

The unit of measurement shall be per metre length of pipe replaced. In each case the Contractor shall agree on the length of pipe to be replaced and the method of coupling the pipes.

The tendered rate shall include full compensation for cleaning and grubbing, excavation, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, bedding and back filling of replacement pipeline, cutting to length, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench and disposal of surplus materials.

The tendered rate shall include full compensation for all material, plant and labour required to temporarily by-pass (if required) the pipe section being replaced.

The provision of the materials will be measured separately under CF. 01.02.

CF.01.02 **Provision of materials**

(a) Pipelines Unit: metre (m)

The unit of measurement shall be the metre of pipe replaced.

(b) Fittings Unit: number

The unit of measurement shall be the number of fittings installed.

The tendered rates shall include full compensation for all transport to the place of installation, storage, labour costs.

Separate pay items shall be listed for the pipe materials and fittings per diameter and class and for the class of bedding to be used.

CF.01.03 **Replacement of manhole covers, grid inlets and the like**

(a) SANS 558 Type 4 - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(b) SANS 558 Type 4 - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number

- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(c) SANS 558 Type 2A - covers, grids, etc. only:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(d) SANS 558 Type 2A - frames only for covers, grids, etc.:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the cover/unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames from the site.

CF.01.04 Manholes and inspection chambers

CF.01.04.01 Raising or lowering of existing manholes or inspection chambers of all types:

- (a) Raise/lower 0 m up to and including 0,5 m Unit: number
- (b) Raise/lower exceeding 0,5 m up to and including 1 m Unit: number

The unit of measurement shall be the number of manholes/inspection chambers raised/lowered within the specified dimensions.

The tendered rates shall include full compensation for all excavation (including around structures), levelling, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the manhole beds, the disposal of material, dealing with subsurface or surface water, benching and for other operations necessary for completing the work as specified.

Payment shall distinguish between soft and hard material. The tendered rates shall include full compensation for transporting the excavated material from the site.

CF.01.04.02 Breaking into existing sewer and building a new manhole

(a) Pre-cast concrete manhole:

- (1) Depth exceeding 0,5 m up to and including 1,0 m Unit: number
- (2) Depth exceeding 1,0 m up to and including 1,5 m Unit: number
- (3) Depth exceeding 1,5 m up to 2,0 m Unit: number

The unit of measurement shall be the number of manholes constructed within the specified dimensions.

The tendered rate shall include full compensation for excavation, building a new manhole over the sewer, breaking into the existing sewer, building the channelization under wet conditions, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material, all labour and equipment required to make the connection, and liaison with the local authorities. Provision for manhole covers shall be made under CF 01.03 payment.

CF.01.04.03 Connecting to existing sewer Unit: sum

The tendered sum shall include full compensation for excavation, making an opening in the existing manhole, installing new pipes in the new opening, for breaking out and modifying the channelization inside the manhole to suit the new pipe layout, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material and debris all labour and equipment required to make the connection, and liaison with the local authorities.

CF.01.04.04 Repair of channels Unit: metre (m)

The unit of measurement shall be the length of channel section repaired.

The tendered rate shall include full compensation for cleaning, patching, repairing of existing channels, irrespective of diameter and position. The rate shall also include all necessary materials, equipment and labour required.

CF.02 CLEANING OF SEWERAGE NETWORK

CF.02.01 Mechanical cleaning of sewer pipes and structures:

(a) <u>Up to 150 mm</u>	Unit: metre
(b) <u>151 mm to 300 mm</u>	Unit: metre
(c) <u>301 mm to 450 mm</u>	Unit: metre
(d) <u>More than 450 mm</u>	Unit: metre

The unit of measurement shall be the metre of pipe cleaned, measured once along the soffit of the culvert. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for removing the material, for disposing of the material in an approved manner and ensuring that the material will not wash into drainage trenches.

CF.02.02 Chemical cleaning of sewer pipes and structures:

(a) <u>Up to and including 150 mm</u>	Unit: metre
(b) <u>151 mm to 300 mm</u>	Unit: metre
(c) <u>301 mm to 450 mm</u>	Unit: metre
(d) <u>More than 450 mm</u>	Unit: metre

The unit of measurement shall be the metre of pipe cleaned, measured once along the soffit of the culvert. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for supply of chemical agents, equipment, labour and the effective application of the cleaning process.

CF.02.03 **Provision of equipment for visual inspection of underground pipe networks** Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as TV surveillance equipment, torches, lights and mirrors, etc, to enable a thorough visual inspection of the pipe network.

CF.02.04 **Use of CCTV surveillance equipment** Unit: metre (m)

The unit of measurement shall be the metre of pipe inspected.

The rate shall be fully inclusive of all associated equipment and interpipe moves and recording equipment.

CF.02.05 **Visual inspection of underground pipe network** Unit: sum

The tendered sum shall include full compensation for all processes necessary to complete a thorough check of the sewer network including lifting and replacing manhole covers, using relevant equipment and any clearing necessary to allow the visual inspection to proceed.

CF.02.06 **Demolition and removal of damaged existing structures:**

- (a) Plain concrete Unit: cubic metre (m³)
- (b) Reinforced concrete Unit: cubic metre (m³)
- (c) Kerbing and channelling Unit: metre (m)
- (d) Pipework Unit: metre (m)

The unit of measurement for CF.02.06(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rates cubic metre capacity of the truck used to remove the material.

The unit of measurement for CF.02.06(c) and (d) shall be the metre length of kerbing and channelling or pipework removed.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

CF.03 **TESTS AND INSPECTIONS**

- (a) Pressure testing of pipelines..... Unit: metre

The unit of measurement shall be the length of sewer pipeline tested.

- (b) Testing of manholes Unit: number

The unit of measurement shall be the number of manholes tested after repair.

The tendered rates shall include full compensation for all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out relevant tests as per SANS 1200. Submission of certificates from tests and equipment and any costs involved in obtaining such from relevant authorities shall also be included in the tendered sum.

TECHNICAL SPECIFICATION

CG: SOLID WASTE

CONTENTS

CG 01	SCOPE
CG 02	STANDARD SPECIFICATIONS
CG 03	OPERATING AND MAINTENANCE MANUALS
CG 04	DETAIL OF REPAIR WORK
CG 05	MAINTENANCE
CG 06	MEASUREMENT AND PAYMENT

CG 01 **SCOPE**

This specification covers the requirements for maintenance work related to solid waste site and solid waste management.

Monthly maintenance responsibilities for Solid Waste (which forms part of installation A4, Fencing, Cleaning and Site Keeping) including all units and components as specified, shall commence with access to the site (site handover).

CG 02 **STANDARD SPECIFICATIONS**

CG.02.01 **GUIDELINES**

This specification shall be read in conjunction with the guidelines on solid waste and landfill sites as stipulated by DWAF which shall be deemed to form part of these specifications.

CG 03 **OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CG 04 **DETAIL OF REPAIR WORK**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

Any work related to solid waste identified by the Contractor or during inspection by the Engineer shall be carried out on the instruction of the Engineer.

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to perform his duties.

CG.2

The work shall include the collection and removal of litter, rubble and other solid waste across the entire site.

Apart from informal dumps, the Contractor shall be responsible for removing all scattered waste in order to clean the entire site to a clean and healthy state. Collection of solid waste shall be performed under the guidance of the Engineer.

The Contractor shall transport solid waste collected across the entire site to a central container for removal to a disposal site off site. Removal of solid waste from the central container to a disposal site off site shall be the responsibility of the Contractor.

CG 04.01 **LITTER COLLECTION**

All litter and rubble shall be collected within the perimeter fences of the various Port of Entry and Border line bases (as reflected on the layout diagrams) and removed and disposed of as specified.

CG 04.02 **WASTE COLLECTION**

Waste bins shall be provided at each residential unit. Additional waste bins shall be provided at the offices and service buildings. The waste bins at all residential units shall be cleaned out on a weekly basis. Waste bins in public areas shall be cleaned out daily. The storage of the solid waste at the solid waste disposal area until such time as it is removed from site will be the responsibility of the Contractor in a skip at a central location within the site.

The disposal area shall be prepared and managed by the Contractor. The site shall be fenced-off (1,8 m high diamond mesh) and the entrance gate shall be locked at all times.

CG 04.03 **REMOVAL OF SOLID WASTE**

Removal of solid waste from the central solid waste container (skip) to a formal solid waste facility shall be the responsibility of the Contractor.

The existing waste disposal site shall be de-commissioned and backfilled. All waste located at the disposal site shall be relocated to the nearest off site waste disposal site. All waste collected at the Port of Entry shall be relocated to the nearest off site waste disposal site on a weekly basis.

CG 05 **MAINTENANCE**

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

The whole of the site within the perimeter fences of the Stockpoort and Groblersbridge Port of Entry (as reflected on the layout diagrams) shall be kept free of litter, rubble and other solid waste. Litter and rubble (solid waste) shall be collected, stored by the Contractor and removed from the site as frequently as necessary, but at least weekly by the Contractor.

Storage of the collected solid waste until such time as it is removed from site shall be the responsibility of the Contractor. Solid waste shall be removed from the residential units to the waste disposal site at least weekly. Solid waste shall be removed from the central

CG.3

solid waste container (skip) provided by the contractor as frequently as necessary, but at least weekly.

Removal of household solid waste to the municipal/approved dump site will still be carried out by the Contractor. The cleanliness of the site, excluding all areas included within residential fences, will be the responsibility of the Contractor.

Garden refuse are amongst the litter and rubble to be collected and disposed of by the Contractor.

Solid waste maintenance forms part of Installation A4. The tendered monthly payment for maintenance of Installation A4 as based on the point system and listed in the schedule of quantities, shall be deemed to include all labour, material, tools, equipment and transport required to continuously collect litter and rubble across the entire site, placing it in a central solid waste container (skip) provided by the contractor and removing it off-site to a formal solid waste facility at least weekly.

TABLE CG 05/1: SUMMARY OF MAINTENANCE RESPONSIBILITY

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Cleaning out of all waste bins in public areas	Daily
2	Cleaning out of all waste bins at residential units	Weekly
3	Collect litter, rubble and other waste across the entire site within the perimeter fences of the Port of Entry and place in central solid waste container (skip)	Continuously
4	Remove waste from skip to external approved waste disposal site	Weekly

CG 06 MEASUREMENT AND PAYMENT

CG.01 DISPOSAL OF LITTER Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of litter, building rubble and other waste material removed from the site, irrespective of the type of material. The quantity shall be determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

Only litter, building rubble and other waste removed on instruction from the Engineer shall be measured for payment.

The tendered rates shall include full compensation for all labour, equipment and tools for collecting, loading, transporting and disposing of the material from the site to an approved dumping site, off site.

CG.02 LEVELLING OF SITE Unit: square metre (m²)

The unit of measurement shall be the surface area of the site to be graded.

The importation of additional material shall be paid under CG.03.

CG.03 **IMPORTATION OF FILL MATERIAL** Unit: cubic metre (m³)

The unit of measurement shall be cubic metres of fill measured as the transported volume. The rate shall be inclusive of excavation, transport and the distribution of the material at the disposal site.

CG.04 **COVERING OF DUMPING SITE** Unit: square metre (m²)

(a) **Lime cover**

The unit of measurement shall be the square metre of area covered with lime.

The tendered rate shall include provision of lime, spreading and finishing of the lime to a minimum depth of 20 mm. Unit: square metre (m²)

(b) **Topsoil cover**

The unit of measurement shall be the square metre of area of topsoil placed.

The tendered rate shall include provision of topsoil, spreading and finishing of the material to a depth of 300 mm.

CG.05 **SUPPLY OF WASTE BINS** Unit: number

The unit of measurement shall be the number of waste bins supplied as described in the schedule of quantities.

The tendered rates shall include full compensation for the supply, transportation and placing of the waste bins.

CG.06 **WASTE COLLECTION SKIP** Unit: sum

The unit of measurement shall be a sum for the provision of a single skip at a central location within the site.

The tendered rate shall be fully inclusive of supply and installation of the skip to the site required including 1.8m high diamond fence around the skip with a lockable gate.

CG.07 **OVERHAUL ON MATERIAL FOR HAUL IN EXCESS OF 1.0 km:**

Unit: cubic metre per kilometre (m³-km)

The unit of measurement shall be the cubic metre of material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

TECHNICAL SPECIFICATION**CJ SITE KEEPING AND CLEANING****CONTENTS**

CJ 01	SCOPE
CJ 02	STANDARD SPECIFICATIONS
CJ 03	EXECUTION OF REPAIR WORK
CJ 04	MAINTENANCE
CJ 05	MEASUREMENT AND PAYMENT

CJ 01 SCOPE

This specification covers the cleaning and site keeping of the facilities at the various installations. The scope of work has been divided into:

- Site keeping; and
- Cleaning of offices and support facilities

CJ 01.01 SITE KEEPING

The area where site keeping is to be performed is the area included within the perimeter fence of the applicable installation and all areas falling within fenced-in residential properties (See Table CJ 01.01). Site keeping will include removal of rubble, removal of weeds, shrubs and other objects and cutting of the grass.

CJ 01.01.01 TABLE: OPEN AREAS

TABLE CJ 01.01.01: BUILDINGS AND AREAS

NO	LOCATION	AREA	DESCRIPTION
1	<i>Office Buildings:</i>		
1.1	One building used by Customs, SAPS and Immigration officials.	1154m ²	No. of rooms: 76 Vinyl floor tiles, screeds and ceramic floor tiles Exterior walls are plastered and painted with face brick areas Interior walls are plastered & painted approx. 160 m ² windows
1.2	One building used by SARS	786m ²	No. of rooms: 24 Vinyl floor tiles, screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered & painted approx. 120 m ² windows

CJ.2

1.3	One building used by SAPS and Agriculture	172m ²	No. of rooms: 16 Vinyl floor tiles, screeds and ceramic floor tiles Exterior walls are plastered & painted with face brick areas Interior walls are plastered & painted approx. 24 m ² windows
1.4	One building used by SAPS Vehicle Theft Unit	145m ²	No. of rooms: 13 Vinyl floor tiles, screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 20 m ² windows
1.5	One building used by SAPS Logistical Support	109m ²	No. of rooms: 8 Vinyl floor tiles; screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 16 m ² windows
1.6	One building used by SAPS Auxiliary	133m ²	No. of rooms: 7 Vinyl floor tiles, screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 19 m ² windows
1.2	<i>Generator rooms:</i>		
	1) Substation 1	59 m ²	No of rooms: 4 52 m ² floor screed with epoxy paint Exterior walls: Face Brick Interior walls: Plastered & painted
	2) Substation 2	28 m ²	No of rooms: 1 26 m ² floor screed with epoxy paint Exterior walls: Face Brick Interior walls: Plastered & painted
1.3	<i>Ablutions:</i>		
	1) Commercial Ablution	20 m ²	No. of rooms: 4 Floors include screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 3 m ² windows
	2) North Gate Ablution	47 m ²	No. of rooms: 6 Floors include screeds and ceramic

			<p>floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 7 m² windows</p>
	3) Ablution Outbound	56 m ²	<p>No. of rooms: 3 Floors include screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 8 m² windows</p>
	4) <i>Passenger Ablution</i>	34 m ²	<p>No. of rooms: 3 Floors include screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and painted Approx. 5 m² windows</p>
	5) <i>Pool Ablution</i>	11 m ²	<p>No. of rooms: 3 Floors include screeds and ceramic floor tiles Exterior walls are face brick Interior walls are plastered and Painted Approx. 2 m² windows</p>
1.4	<i>Light Vehicle Inspection: Two buildings</i>	56m ²	<p>No. of rooms: 4 Flooring: Vinyl and ceramic floor tiles and screed Exterior walls: face brick Interior walls: plastered, painted and tiled Approx. 7 m² windows</p>
1.5	<i>Pedestrian Inspection One building</i>	11 m ²	<p>No. of rooms: 1 Flooring: Screed face brick Interior walls: plastered, painted and tiled Approx. 10 m² windows</p>
1.6	<i>Water works building One building</i>	15 m ²	<p>No. of rooms: 2 Screed floor Exterior walls: face brick Interior walls: plastered & painted 2 m² windows</p>
1.7	<i>Sewer works building One building</i>	24 m ²	<p>No. of rooms: 2 Screed floor Exterior walls: face brick Interior walls: plastered & painted 2 m² windows</p>

CJ.4

1.8	<i>Cargo release building One building</i>	52 m ²	No. of rooms: 6 Screed floor Exterior walls: face brick Interior walls: plastered & painted 8 m ² windows
1.9	<i>Commercial Inspection Outbound One building</i>	216 m ²	No. of rooms: 6 Screed floor, carpet and vinyl floor tiles Exterior walls: face brick Interior walls: face brick with plastered & painted areas 8 m ² windows
1.10	<i>Commercial Inspection Inbound One building</i>	1020 m ²	No. of rooms: 6 Screed floor, carpet and vinyl floor tiles Exterior walls: face brick Interior walls: face brick with plastered & painted areas 8 m ² windows
1.11	<i>Commercial Warehouse One building</i>	1115 m ²	No. of rooms: 6 Screed floor, carpet and vinyl floor tiles Exterior walls: face brick Interior walls: face brick with plastered & painted areas 8 m ² windows
1.12	<i>Gate Houses Five separate buildings</i>	8 m ² each	No. of rooms: 1 each Exterior walls: face brick Interior walls: face brick with plastered & painted areas 2 m ² windows each
1.13	<i>Cell Block One building</i>	42 m ²	No. of rooms: 4 Screed floor Exterior walls: face brick Interior walls: face brick with plastered & painted areas 6 m ² windows
1.14	<i>Pool Building One building</i>	42 m ²	No. of rooms: 2 Screed floor Exterior walls: plastered & painted Interior walls: plastered & painted 4 m ² windows
1.15	<i>Bulk water Pump Room One building</i>	66 m ²	No. of rooms: 2 Screed floor Exterior walls: plastered & painted Interior walls: plastered & painted 5 m ² windows

1.16	<i>Barracks One building</i>	500 m ²	No. of rooms: 9 Screed floor Exterior walls: face brick Interior walls: face brick with plastered & painted areas 72 m ² windows
OPEN AREAS			
1	Beitbridge Port of Entry Open areas (Site Keeping)	263 000 m ²	All areas within the perimeter fence, including areas within residential fences. The areas between the vehicle and pedestrian bridges and the open area next to the Border line base.
HOUSES ON PORT			
	All repairs and maintenance at 29 Houses on Port		All areas within the perimeter fence, including areas within residential fences.
HOUSES IN TOWN			
	All repairs and maintenance at 28 Houses Musina Town		All areas within the perimeter fence, including areas within residential fences.
HOUSING IN MUSINA TOWN			
Road Name	House No	Road Name	House No
Kremetart	1	Kremetart	41
Kremetart	6	Van Zyl	17
Kremetart	7	Dominee Henrico	9
Kremetart	11	Sering Singel	4
Kremetart	33	Sering Singel	5
Kremetart	39	Sering Singel	18
Kremetart	48	Sering Singel	41
Kremetart	54	Paul Mills	44
Sering Singel	3		
Sering Singel	8		
Sering Singel	13		
Sering Singel	15		
Sering Singel	27		
Sering Singel	29		
Sering Singel	31		
Sering Singel	39		
Kerk	12		
Kerk	16		
Willem Smit	1		
Willem Smit	3		
Paul Mills	40		

**Note: Site Information list of areas/buildings for scope of works.
Scope of Work not limited to list above, other areas/ building can be included not listed.**

CJ 01.02 CLEANING OF OFFICES AND SUPPORT FACILITIES

All offices, ablutions and support buildings are to be cleaned and maintained in a sanitary condition at all times.

CJ 01.03 ABLUTION EQUIPMENT AND CLEANING AGENTS

All offices, ablutions and support buildings are equipped with sanitizing and abluion equipment which must be maintained at all times. The following indicates the equipment that must be maintained in working order as well as providing of consumables such as toilet paper, hand-wash soap, air fresheners refills, sanitizer refills and plastic refuse bags for all waste bins and sanitary bins which will be the responsibility of the Contractor.

CJ 02 STANDARD SPECIFICATIONS**CJ 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

CODE	DESCRIPTION
CKS 285-1971	Dispensers for paper towels
CKS 340-1979	Plastic Refuse Bags (Disposable)
SANS 1344:2009	Medium duty solvent detergent
SABS 1868	Gel detergent cleaner (non-abrasive)
SANS 1887-1:2008	Tissue paper Part 1: General requirements
SANS 1887-2:2008	Tissue paper Part 2: Toilet paper
SANS 1887-4:2008	Tissue paper Part 4: Paper towels
SANS 1924:2007	Toilet soaps intended for use in dispensers
SANS 60335-1:2007	Household and similar electrical appliances – Safety Part 1: General requirements
SANS 60335-2-67:2003	Household and similar electrical appliances – Safety Part 2-67: Particular requirements for floor treatment and floor cleaning machines, for industrial and commercial use

CJ 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CJ 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

CJ 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CJ 03 **EXECUTION OF WORK****CJ 03.01** **GENERAL**

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to accommodate the site keeping and cleaning of the facilities.

The Contractor shall be responsible for cleaning ablution facilities as frequently as necessary to maintain them in a clean and healthy condition. The actions outlined serve only as a benchmark for the cleaning and maintaining of the facilities.

The ablution facilities and operational buildings will be kept clean during the operational periods of the Port of Entry as indicated below:

- (i) Stockpoort and Groblersbridge Port of Entry is operational for 24 hours a day 7 days a week.

Cleaning activities will include providing all cleaning agents and equipment necessary for cleaning.

Providing of consumables such as toilet paper, hand-wash soap, air fresheners refills, sanitizer refills and plastic refuse bags for all waste bins and sanitary bins will be the responsibility of the Contractor.

CJ 03.02 **ABLUTIONS**

Each ablution facility shall be equipped with the following equipment:

- 1) Hand Dryer
- 2) Stainless steel air freshener
- 3) Stainless steel toilet paper dispenser units
- 4) Stainless steel she bins
- 5) Stainless steel hand soap dispensers
- 6) Stainless steel sanitizer
- 7) Stainless steel paper towel dispenser
- 8) Stainless steel wall bin

CJ 03.02.01 **Hand Dryer**

The hand dryer unit shall comply with at least the following specifications:

- Blower Output: 450 Watt @ 20,000 rpm
- Air Heater Output: 900 W
- Air Flow Rate: 81 metre per second @ 100 mm from the air outlet nozzle
- Air Temperature: 55 °C @ 100 mm from the air outlet nozzle.

The hand dryers units shall be of the wall mounted kind and shall be installed in accordance with the manufacturer's specifications.

CJ 03.02.02 **Air Freshener Doser**

The stainless steel air freshener dosing units shall be battery operated, wall mounted and lockable. The device shall possess an adjustable automatic timer between at least 5 to 30 minutes and the aerosol spray shall be metered.

CJ 03.02.03 **Toilet Paper Dispensing Unit**

The stainless steel toilet paper dispensing units shall be able to accommodate two standard size 500 sheet single-ply toilet paper rolls and shall be lockable. The device shall be wall mounted.

CJ 03.02.04 She Bin

One stainless steel she bin shall be supplied for each of the female ablutions. The she bins shall possess a self-closing lid and shall accommodate for plastic bag liners which can be removed and replaced with a new liner.

CJ 03.02.05 Hand Soap Dispenser

There shall be at least one stainless steel liquid hand soap dispenser per ablution. The liquid soap dispenser shall be of the wall mounted kind. The dispenser shall dispense a metered amount of liquid soap.

CJ 03.02.06 Urinal Sanitiser Dispenser

There shall be one stainless steel, battery operated, wall mounted, urinal sanitiser dispenser per urinal.

CJ 03.02.07 Paper Towel Dispenser

The paper towel dispenser shall comply with CKS 285-1971. The unit shall be a Type 2, closed dispenser designed to dispense paper towels in sheets.

There shall be at least one stainless steel wall mounted paper towel dispenser per ablution.

CJ 03.02.08 Wall Bin

There shall be one stainless steel wall bin per ablution. The wall bin shall possess a self-closing lid and shall accommodate for plastic bag liners which may be removed and replaced with a new liner. The device shall be wall mounted.

CJ 04 MAINTENANCE

CJ 04.01 GENERAL

The maintenance work to be performed under site keeping and cleaning shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this specification.

Maintenance implies and shall include routine cleaning (which is the equivalent of routine preventative maintenance), routine preventative maintenance of site keeping and cleaning equipment, corrective cleaning (which is the equivalent of corrective maintenance), corrective maintenance of site keeping and cleaning equipment as well as breakdown maintenance of all site keeping and cleaning equipment.

The maintenance scope in terms of site keeping is set out in table CJ 01.01.01.

The maintenance scope in terms of cleaning is set out in table CJ 01.02

The maintenance scope in terms of equipment is set out in table CJ 01.03.

Monthly maintenance responsibilities for site keeping and cleaning of installations shall commence with access to the site. The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

Remuneration for maintenance of site keeping and cleaning will be deemed included in the tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance and in accordance with installation: A4: Cleaning and Site Keeping.

CJ 04.02**ROUTINE PREVENTATIVE MAINTENANCE**

The tasks related to routine preventative maintenance work shall include but not be limited to the general actions listed in table CJ 04.02.01 and CJ 04.02.01 and CJ 04.02.03 below.

Please note that the operational times for the Port of Entry is from as follows

- (i) Stockpoort and Groblersbridge Port of Entry is operational for 24 hours a day 7 days a week.

TABLE CJ 04.02.01: SITE KEEPING

No	ROUTINE PREVENTATIVE MAINTENANCE TASKS	FREQUENCY
1.	Cleaning out of and supply of black refuse bags to all waste bins in public areas.	At least daily
2.	Watering of plants, shrubs, grass and trees	Weekly
3.	Removal of weeds	Weekly
4.	Clearing of weeds and grass along the edges of paved areas.	Weekly
5.	Cutting of grass. <i>No grass to exceed the length of 50 mm.</i>	Monthly
6.	Cutting of grass at residential units. <i>No grass to exceed the length of 30 mm.</i>	Weekly
7.	Restore lawns	Monthly
8.	Trimming of dense shrubs.	2 Monthly
9.	Fertilisation of lawns	Quarterly
10.	Fertilisation of flower beds and trees	Quarterly
11.	Removal of undesirable shrubs	Quarterly
12.	Trimming of trees where branches cause obstruction.	Quarterly
13.	Collecting of litter and foreign objects.	Continuous

TABLE CJ 04.02.02: CLEANING OF OFFICES AND SUPPORT FACILITIES

	ACTION	FREQUENCY
1.	Cleaning of floors in public areas and open plan offices	Daily (before opening of port of entry)
2.	Cleaning of counter tops and under counter shelves in public areas and open plan offices.	Daily (before opening of port of entry)
3.	Emptying of waste baskets in offices and service buildings	Daily
4.	Cleaning of office floors	Daily
5.	Vacuum carpets	Weekly
6.	Clean carpets	Six Monthly
7.	Washing of windows and dusting of window sills and ledges	Weekly
8.	Clean and polish all fittings	Weekly
9.	Washing of interior and exterior walls	Monthly
10.	Dusting of interior of the building to remove dust and spider webs	Weekly
8.	Clean and polish all vinyl floors	Monthly

TABLE CJ 04.02.03: CLEANING OF ABLUTION FACILITIES

	ACTION	FREQUENCY
1.	Cleaning and ensuring that the ablution facilities are in a sanitary condition	Continuous
2.	Washing and cleaning of floors	Daily
3.	Empty and clean all waste receptacles	Daily
4.	Clean all bowls, basins and urinals	Daily
5.	Clean and polish all fittings and mirrors	Daily
6.	Washing and cleaning out of the bins	Twice weekly
7.	Washing of windows and dusting of window sills, ledges, pipes and fittings	Weekly
8.	Washing of walls	Weekly
9.	Dusting of interior of the building to remove dust and spider webs	Weekly

CJ 04.03 SITE KEEPING AND CLEANING EQUIPMENT

All site keeping and cleaning equipment will be supplied by the Contractor and shall be maintained in a perfect working order for the duration of the Contract period. Remuneration for provision of cleaning equipment will be deemed included in the monthly tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance.

CJ 04.03.01 Grass, Shrub and Tree Cutting Equipment

Distinction will be made amongst 4 different types of grass, shrub and tree cutting equipment:

1. Light duty grass and shrub cutter (Weed Eater)

The light duty grass and shrub cutter shall be similar to a light duty Brushcutter and comply with the following:

Nylon or blade head;
Minimum displacement of 40.2 cm³;
Minimum power output of 1.6 kW; and
Length of 1.77 m.

2. Heavy duty shrub and tree cutter

The heavy duty shrub and tree cutter shall be similar to a heavy duty Brushcutter and comply with the following:

Blade head;
Minimum displacement of 51.7 cm³;
Minimum power output of 2.4 kW;
Length of 1.69 m.

3. Lawn mower for small lawns

The lawn mower for small lawns to be used at the residential areas shall comply with at least the following:

Walk behind 4 stroke petrol self propelled rotary mower; Power output of 4 kW;
422 mm cutting width;
200 mm heavy duty sealed ball bearing wheels; and
54 liter polymer catcher with metal lining.

4. Lawn mower for large lawns

The lawn mower for large lawns shall comply with at least the following:

Walk behind 4 stroke petrol self propelled rotary mower; Power output of 12 kW;
750 mm cutting width;
Rubber wheels.

CJ 04.03.02 Vacuum Cleaner

Vacuum cleaners shall be wet and dry and comply with at least the following:

Tank capacity: 25 litre
Cable length: 10 m
Airflow rate: 56 litre per second

CJ 04.03.03 Carpet Cleaner

Carpet cleaners shall comply with at least the following:

Tank capacity fresh water: 40 litre
Tank capacity dirty water: 25 litre
Cable length: 10 m
Suction motor: 2 x 1250 W;
Airflow rate: 2 x 60 litre per second
Pump delivery: 2.8 litre per minute @ 3 bar

Carpet cleaners shall be similar to Wetrok's Extravac 400.

CJ 04.03.04 Mop and bucket system

A two bucket mopping system shall be provided and be fitted with metal wringers. The mops provided shall be suitable for use with the buckets provided.

Mop and bucket systems shall be similar to Wetroks Socar L40.

CJ 04.03.05 Window cleaning kit

Window cleaners shall have a telescopic handle with a length of 0.5 to 3 m. It shall be possible to fit squeegees and brushes to the telescopic handle as required in order cleaning windows. A bucket with capacity of at least 10 litre shall be provided that is suitable for use with the window cleaning kit.

CJ 04.03.06 Sign boards

Sign boards shall be yellow in colour, free standing and printed on both sides. It shall clearly indicate the dangerous situation.

CJ 04.04 CONSUMABLES FOR SITE KEEPING AND CLEANING

Provision of consumables will be the responsibility of the Contractor. Remuneration for provision of consumables will be deemed included in the monthly tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance.

CJ 04.04.01 Refuse Bags

Refuse bags shall comply with CKS 340-1979.

CJ 04.04.02 Toilet Paper

Toilet paper shall comply with SANS 1887 Part 1 & Part 2.

Toilet paper provided shall be single-ply, soft with a nominal number of 500 sheets per roll and a nominal outside diameter of 125 mm.

CJ 04.04.03 Toilet soap for hand soap dispensers

Toilet soap shall comply with SANS 1924:2007 – Toilet soaps intended for use in dispensers.

Toilet soap shall be Type 1, liquid toilet soap and shall be perfumed. The toilet soap shall be suitable for use in the hand soap dispensers provided.

CJ 04.04.04 Biological detergent for urinal dispenser

The urinal dispenser detergent may not contain any disinfectants. A biological detergent shall be used. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign)

The biological detergent shall be similar to nu flush from innu-science.

CJ 04.04.05 Air freshener

Air freshener shall be supplied that is suitable for use in the air freshener doser.

Air fresheners shall be similar to Technical Concepts Neutrally Metered Aerosols (available from Steiner Hygiene or equivalent).

CJ 04.04.06 SHE bin liners

She bin liners shall be provided that is suitable for use in the she bins.

CJ 04.04.07 Paper towels

Paper towels shall comply with SANS 1887 Part 1 & Part 4.

Paper towels provided shall be supplied in packets of folded towels that can be dispensed from the supplied paper towel dispenser without sticking or other undue difficulty.

CJ 04.04.08 Wall bin liners

Wall bin liners shall be provided that is suitable for use in the wall bins.

CJ 04.04.10 Biological detergents for cleaning of ablutions and public areas

Disinfectants and Detergent-disinfectants shall not be allowed to clean ablutions and public areas. A biological detergent shall be used. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign)

The biological detergent shall be similar to nu kleen smell from innu-science.

CJ 04.04.11 Medium duty solvent detergent

Medium duty solvent detergents shall comply with SANS 1344:2009 Medium duty solvent detergent. It shall be used in cases where surfaces, walls and floors are soiled with oil, grease or similar soils.

A biological detergent may be used as an alternative where surfaces are soiled with oil, grease or similar soils. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign)

CJ 04.04.12 Other

Brooms, dusters and muslin cloths shall be seen as consumables.

The Contractor shall furthermore be responsible for the supply of batteries for all battery operated equipment, e.g. the urinal sanitizer and the air freshener dozer.

CJ 04.05 SOLID WASTE MANAGEMENT

All solid waste that is generated as a result of site keeping and cleaning shall be managed in accordance with specification CG Solid Waste.

CJ 05 MEASUREMENT AND PAYMENT

CJ.05.01	<u>HAND DRYERS</u>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.02	<u>AIR FRESHENER DOSERS</u>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.03	<u>TOILET PAPER DISPENSING UNITS</u>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.04	<u>SHE BINS</u>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.05	<u>HAND SOAP DISPENSER</u>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	

		<u>Unit</u>
CJ.05.06	<u>URINAL SANITIZER</u>	No

The tendered rate shall include full compensation for the supply, delivery, labour and installation and commissioning of the urinal sanitizer. The unit shall be installed in accordance with the manufacturer's instructions.

		<u>Unit</u>
CJ.05.07	<u>PAPER TOWEL DISPENSER</u>	No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

		<u>Unit</u>
CJ.05.08	<u>WALL BIN</u>	No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

CIVIL

WATERWORKS

TECHNICAL SPECIFICATIONS

SECTION DA- DW

TECHNICAL SPECIFICATION**DA: BOREHOLE PUMP SYSTEMS****CONTENTS**

DA 01	SCOPE
DA 02	STANDARD SPECIFICATIONS
DA 03	OPERATING AND MAINTENANCE MANUALS
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DA 01 SCOPE

This specification covers the decommissioning, removal, repair and reconditioning, installation, testing, commissioning and maintenance of borehole pumping equipment, motor control devices and low-voltage cables. It also includes the pump testing of all boreholes to determine the borehole yield and optimum use of each borehole. The function of borehole pump systems shall be delivery of raw water at a specified flow rate and head to the required location.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

DA 02 STANDARD SPECIFICATIONS**DA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- BS 5316, Part 1 - Acceptance tests for centrifugal, mixed flow and axial pumps
- SANS 948 - Three-phase induction motors
- SANS 1222 - Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
- BS 4999 - General requirements for rotating electrical machines
- ISO 281/1 - Rolling bearings – dynamic load ratings and rating life.

DA 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

DA 02.03 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

DA 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

DA 03 **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

DA 04 **EXECUTION OF REPAIR WORK**

DA 04.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The work required shall include, but not be limited to the following:

- (a) Removal of existing equipment;
- (b) Installation of temporary pumps;
- (c) Pump testing to determine safe yield;
- (d) Ground-water sampling;
- (e) Compilation of borehole recommendation report.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the borehole pump systems shall be categorised under the following headings:

- (a) Pump testing of boreholes
- (b) Repair of existing structures
- (c) Repair/replacement of electrical components.

DA 04.02 CLASSIFICATION OF BOREHOLES

The boreholes shall be inspected by the Contractor and the Engineer to confirm the classification of the boreholes in accordance with the guidelines below:

CLASS I	CLASS II	CLASS III	CLASS IV
Existing pump and motor in working order	Existing pump and motor require repair	Not equipped	Not equipped
Has connecting Pipework	Has connecting pipework	Has connecting pipework	No connecting pipework
REPAIR WORK			
Routine maintenance	Repair pump and motor	Pump Test Replace pump and motor	Abandon borehole

The above classification shall be used to determine the degree of repair work required.

DA 04.03 PUMP TESTING OF BOREHOLES

This section covers the requirements of the pump testing of the boreholes.

DA 04.03.01 Construction

It will be the responsibility of the Contractor to arrive on site with all equipment and materials required to complete the work without interruption.

The Contractor shall provide suitable plant to enable the installed pumping equipment to be removed and reinstalled. This includes the removal and reinstallation of motorised pumps and may also include the recovery of existing pumping equipment previously lowered into a borehole.

(a) Arrival-on-site actions

The Contractor shall firstly establish whether or not the borehole is equipped. If so, the Contractor will be required to:

- (1) Remove the equipment, taking care not to damage either the equipment or the installation,
- (2) Inspect the equipment for defects, and

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- (3) Note down all particulars regarding the equipment and the installation.

The latter shall include but not be limited to the make and type of pump (and motor if motorised), the depth to which the pump was installed, the power rating of the motor and the diameter, length and quantity of pump column sections.

The Contractor shall next establish whether there are any other boreholes in the vicinity that need to be tested. Should this be the case, the following information shall be gathered and recorded for each borehole:

- (1) The straight-line distance (in metres) between each such borehole to be tested;
- (2) Whether the borehole is equipped, open or sealed and, if equipped,
- (3) Whether the installation is operational or not.

Depending on the degree of access available to such a borehole, the Contractor shall improve the access until it is adequate to reach the borehole and establish whether there is water in the borehole and if so, measure and record:

- (1) The depth to the ground-water rest level;
- (2) The height of the borehole collar above ground level, and
- (3) The depth of the borehole.

The final activities to be carried out prior to the actual installation of the test pump into the borehole to be tested shall comprise measuring and recording:

- (1) The diameter of the borehole;
- (2) The depth of the borehole as determined by means of a weighted line or plumb bob, and
- (3) The depth to the ground-water rest level in the borehole, with reference to a date level.

(b) Test pump installation

The conduit tube shall be attached and secured to the first section of pump column behind the pump element and the test pump installed to the required depth, attaching and securing the conduit tube to the riser main every 2 to 3 metre. If the pump installation depth has not been specified by the Engineer beforehand, then the depth must be determined on the basis of the guidelines provided in table DA 04.02.01/1.

The Contractor will be remunerated for the installation of a test pump per linear metre of depth installed at the rate tendered as set out in the Schedule of Quantities.

TABLE DA 04.02.01/1 GUIDELINES FOR TEST PUMP INSTALLATION DEPTH IF
NOT SPECIFIED

DEPTH OF WATER IN BOREHOLE	TEST PUMP INSTALLATION DEPTH
Less than 5 m	Do not install the test pump
Between 5 m and 30 m	2 m above the bottom of the borehole
Between 30 m and 60 m	3 m above the bottom of the borehole
Between 60 m and 90 m	4 m above the bottom of the borehole
More than 90 m	5 m above the bottom of the borehole

NOTE:

1. Depth of water in borehole is calculated as the difference between the total depth of the borehole and the depth to the ground-water rest level as measured.
2. denotes a variation of not more than 0,5 m either way.

(c) Equipment set-up and pre-test actions

Where possible, the discharge pipe must be laid in a downhill direction from the borehole to be tested, provided this will take the pipe in the direction of or past another borehole located in the vicinity of the borehole to be tested. In such instances, lay the discharge pipe in a downhill direction that will take its furthest end as far as possible away from any other borehole in the vicinity.

In field situations where the terrain is extremely flat, the length of the discharge pipe shall be extended from 50 m to at least 300 m if any possibility exists that the discharged water may infiltrate to the ground-water resource within the radius of influence of the test. The dip meter should be inserted into the installed conduit tube and run down this tube to the bottom. Make sure that it passes freely down the full length of the tube. If the dip meter used is not graduated to an accuracy of 0,01 m, the position is to be marked on the dip meter cable indicating the depth to the ground-water rest level, and the end of the graduated tape attached at this position on the cable ensuring that the zero mark of the graduated tape corresponds exactly to this mark. Slowly lower the dip meter and graduated tape down the conduit tube, in the process securing the tape to the dip meter cable every 2 to 3 metre. Ensure that there is no slack between each point where the tape is secured to the dip meter cable. Also make sure that the dip meter cable and graduated tape combination passes freely along the full length of the conduit tube.

The Contractor will be remunerated for this work per set-up at the rate tendered for one such activity as set out in the Schedule of Quantities.

(d) Final pre-test measurements

The Contractor shall ensure that all the basic information required on the field data sheet is collected and recorded as completely as possible. The basic information data entry fields can be used as a checklist for information to be measured/collected and recorded. The Contractor shall not guess any information which has not been measured.

Payment for this work shall be incorporated into the payment for data recording as described below.

(e) Data recording

(i) Discharge measurements

The measurement of discharge (yield or pumping rate) must be consistently accurate and reliable and shall be appropriate to meet this requirement. Where volumetric calculation methods are applied, time will be measured using a stopwatch and the container volume must be accurately known. The volumetrically measured yields recorded on the field data sheets shall be based on the average obtained from a set of three sequential measurements. Guidelines for the number and periodicity of discharge rate measurements for each type of test are given in table DA 04.02.01/2.

TABLE DA 04.02.01/2 NUMBER OF PERIODICITY OF DISCHARGE RATE MEASUREMENTS

TYPE OF TEST	DISCHARGE RATE MEASUREMENTS	
	NUMBER	PERIODICITY
Calibration test	2 per step	At 5 and 10 minutes into each step
Stepped discharge test	5 per step	At 5, 15, 30, 60 and 90 minutes into each step
Constant discharge test	See periodicity column	At 5, 15, 30, 60, 90 and 120 minutes into test and every 60 minutes thereafter for the full duration of pumping

(ii) Water-level measurements

Rigid guidelines for the periodicity of water-level measurements for each type of test are given in table DA 04.02.01/3. This information can be found duplicated on the field data sheets which must be filled in as a record of all data collection activities carried out for a pumping test. The type of water-level measurement values required to be recorded on the field data sheets are the actual (or true) draw down values. These values represent measurements which reflect the depth of the water level below the ground-water rest level depth, ie which already take into account the ground-water rest level depth below the reference measuring point. It shall be noted that the more basic type of measurement which reports the depth of the dynamic water level as a distance below the reference measuring point, ie which combines the depth of the water level below the ground-water rest level depth and the depth of the ground-water rest level below the reference measuring point, gives only an apparent (or false) draw down value. All water-level measurements must be measured to an accuracy of at least 0,01 m (10 mm). The water-level data shall be plotted on the semi-logarithmic graph paper provided with each set of field data sheets. The plotting of the data shall be done as the test proceeds, ie each water-level measurement shall be plotted on the graph as soon as possible after measuring. The field data sheets and accompanying water-level graphs shall be shown to authorised supervisory personnel at request and shall be up-to-date at the time of such request.

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(iii) Other information

The Contractor shall also record any extraordinary observations made during the test. These may include:

- (1) Changes in the colour of the discharged water;
- (2) changes in the turbidity of the discharged water;
- (3) the presence of air in the discharged water, and
- (4) rainfall events which occur during a test.

Remuneration for all data collection and recording activities by the Contractor in the course of a pumping test shall be incorporated into an hourly rate as set out in the Schedule of Quantities.

TABLE DA 04.02.01/3 PERIODICITY (IN MINUTES) OF WATER-LEVEL MEASUREMENTS DURING PUMPING TESTS

CALIBRATION TEST	STEPPED DISCHARGE TEST	CONSTANT DISCHARGE TEST	RECOVERY TEST
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
7	7	7	7
9	9	9	9
12	12	12	12
15	15	15	15
	20	20	20
The above periodicity (measured in minutes after the start of each increased pumping rate) must be followed for each step of the calibration test	25	25	25
	30	30	30
	40	40	40
	50	50	50
	60	60	60
	70	70	70
	80	80	80
	90	90	90
	100	120	120
		150	150
	The above periodicity (measured in minutes after the start of each increased pumping rate) must be followed for each step of the stepped discharge test	180	180
		210	210
		240	240
		Every 60 minutes to end of pumping	Every 60 minutes to end of recovery

(f) Test pumping of boreholes

The Contractor may be required to test existing "older" boreholes which may or may not already be equipped with pumping installations.

Test pumping serves two primary objectives. The first of these is an assessment of the productive capacity (yield potential) of the borehole. The second objective addresses the productivity of the ground-water resource. These objectives are met by various types of borehole tests performed separately and often sequentially. These tests are identified as:

- (i) Slug test
- (ii) Calibration test
- (iii) Stepped discharge test
- (iv) Constant discharge test
- (v) Recovery test.

Factors determining which of these tests shall be performed include:

- The potential yield of the borehole, and
- The amount of water that it will be required to supply.

(i) The slug test

The slug test provides a rapid means of assessing the potential yield of especially low yielding (less than 1 litre/s) boreholes (Vivier *et al*, 1995). The results may indicate whether it is feasible and warranted to perform other tests on the borehole. As with any of the other tests, a slug test can be executed in any borehole and not necessarily only in newly drilled boreholes.

The test involves measuring the water-level response in a borehole to the rapid displacement of water therein. This displacement might cause either -

- (1) A rise in water level, as would result from the introduction of a slug below the rest water level, or
- (2) A drop in water level, as would be caused by the removal of a quantity of water from the borehole.

In instances where a slug is introduced, the water level will recede to its original level. The sudden removal of a quantity of water from the borehole will cause the water level to rise to its original level. The rate of recession or rise provides an indication of the yield of the borehole. In qualitative terms the more rapid this is, the higher the potential yield of the borehole.

(ii) The calibration test

A calibration test requires that water be pumped from the borehole at three or more different rates over short (15 minutes) sequential periods. The response of the water level to each known pumping rate is measured and recorded. The calibration test provides a means of assessing the yield potential of borehole according to the magnitude of the water-level decline associated with each pumping rate. This information is used to select appropriate pumping rates at which to perform a stepped discharge test or a pumping rate at which to perform a constant discharge test.

(iii) The stepped discharge test

Also known as a step draw down test, this test is performed to assess the productivity of a borehole. It also serves to more clearly define the optimum yield at which the borehole can be subjected to constant discharge testing if required. The test involves pumping the borehole at three or more sequentially higher pumping rates, each maintained for an equal length of time, generally not less than 60 minutes and seldom longer than 120 minutes. A step length of 100 minutes is recommended. The magnitude of the water-level draw down in the borehole in response to each of these pumping rates must be measured and recorded in accordance with a prescribed time schedule. The actual pumping rate maintained during each "step" must also be measured and recorded. As a rule, the rate of water-level recovery for a period of time immediately following the period of pumping should also be monitored according to the same time schedule as during pumping.

(iv) The constant discharge test

A constant discharge test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. This response can be analysed to provide information in regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. This test entails pumping the borehole at a single pumping rate which is kept constant for an extended period of time. The test duration shall not be less than 12 hours and, in some instances, might last up to 72 hours or more. The duration is generally determined by the importance which is attached to the borehole and ground-water resource not only in terms of its yield potential but also in terms of its intended application.

The pumping rate is set at a yield which it is considered the borehole and ground-water system will be able to maintain for the entire planned duration of the test and, in the process, utilising better than 70 per cent but not exhausting the available draw down. It is critical that the pumping rate during the entire duration of the test be kept as constant as possible. The draw down in water level in the borehole during the course of the test is again measured and recorded according to a prescribed time schedule. In the case of this type of test, it is imperative that water-level measurements be made during the recovery period following the end of pumping.

(v) The recovery test

This test provides an indication of the ability of a borehole and ground-water system to recover from the stress of abstraction. This ability can again be analysed to provide information with regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. Although referred to as a test, it rather represents a period of monitoring activity following a period of pumping. The rate at which the water level in the tested borehole (or any other borehole affected by the abstraction) recovers towards its starting level (the ground-water rest level before pumping started) is monitored in this period. The duration of this monitoring is generally equal to that of the preceding period of pumping unless the rate of recovery is sufficiently rapid so that the starting water level is reached in a shorter period of time.

(g) General approach and methodology

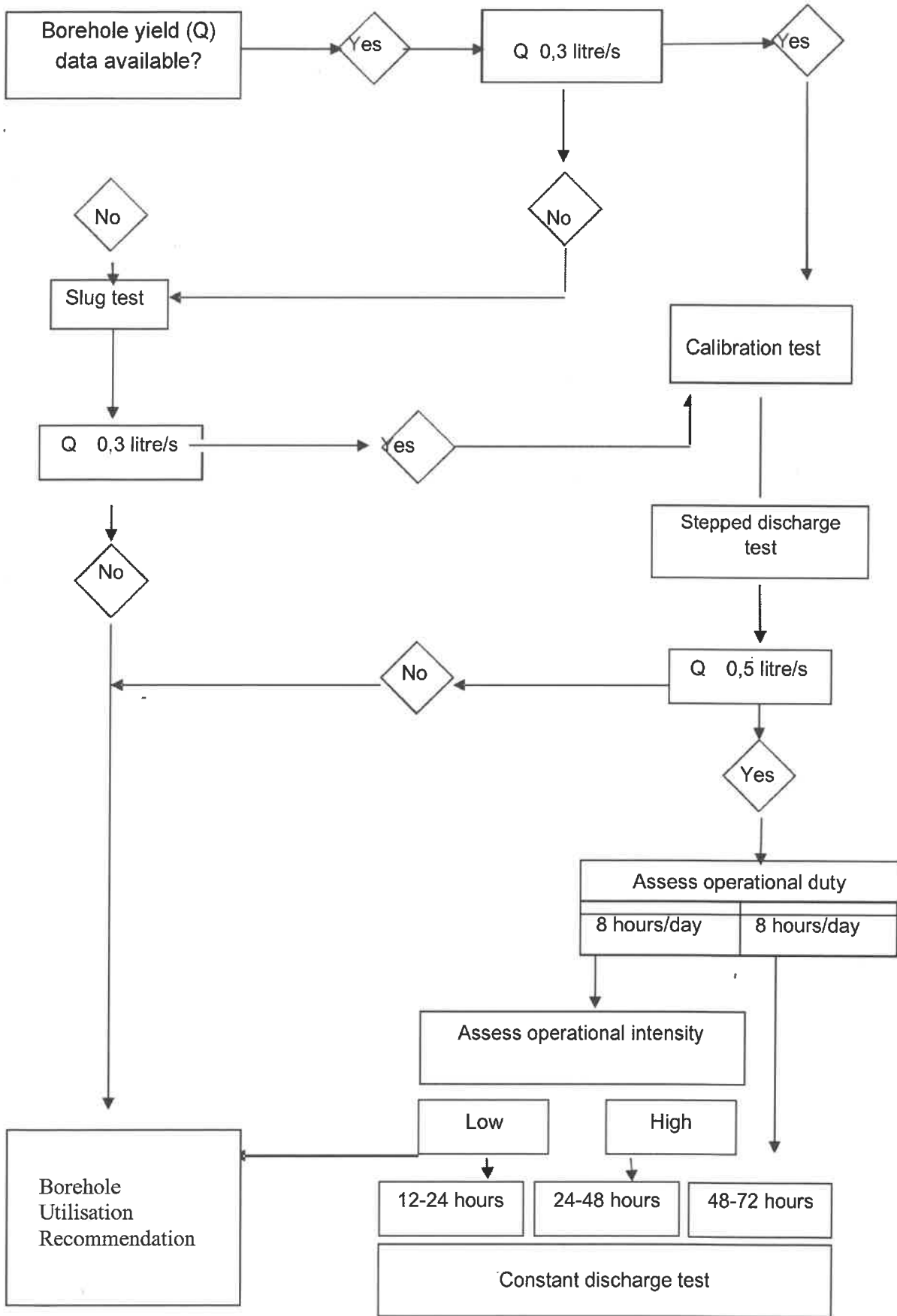
The Engineer will formulate a test pumping schedule for each borehole. The flow diagram presented overleaf provides an indication of the considerations which determine the scope of test pumping based on a logical decision-making process.

All project-related test pumping activities will also be carried out under the direct supervision of the Engineer. The execution of a pumping test in accordance with established scientific protocols must be undertaken by a suitably experienced and equipped testing contractor. The South African Bureau of Standards (SANS) is finalising a Standard Code of Practice titled *The test-pumping of water boreholes*. A draft of this Standard has been considered in the compilation of this document. It will be the task of the Engineer to evaluate and analyse the data, draw conclusions with regard to the productivity of the borehole and the aquifer, and make recommendations with regard to a suitable operating schedule for the borehole and the optimum exploitation of the ground-water resource.

Both the practical and analytical aspects of test pumping benefit greatly from prior information regarding the borehole and the aquifer which it taps into. This information is gleaned during the drilling and the construction of the borehole. It includes knowledge of:

- (1) The amount of water blown out of the borehole during drilling operations;
- (2) the depth(s) at which water was struck in the borehole;
- (3) the construction of the borehole in terms of the setting of especially perforated (slotted) casing, and
- (4) the nature of the rock formation at the depth(s) where water was struck.

This information will be communicated to the testing contractor by the Engineer prior to the testing of any borehole.



The Contractor shall keep a full record of the test pumping which is undertaken and submit the record on completion of the test. This record must include the following basic information:

- (1) The depth to water level before the start of testing;
- (2) The depth at which the test pump was installed;
- (3) The type, make and model of the test pump used;
- (4) The pumping rate as measured at regular intervals during the test, and
- (5) The water level in the borehole as measured according to a prescribed time schedule both during and after pumping.

The Contractor must be sufficiently well-equipped to gather this information with acceptable accuracy.

The rationale behind the flow diagram is explained as follows. A slug test should be performed on a borehole in instances where there is no prior indication of its possible yield. The result of the slug test will indicate whether additional test pumping is warranted. A slug test shall also be performed in instances where the possible yield of a borehole from prior information is indicated to be less than 0,3 litre/s. The result of the slug test will again indicate whether additional test pumping is warranted. In instances where the possible yield of a borehole from prior information is indicated to be equal to or greater than 0,3 litre/s, then a calibration test followed by a stepped discharge test shall be performed.

The result of the stepped discharge test will indicate whether further test pumping in the form of a constant discharge test is warranted or whether the borehole is judged to be sufficiently weak (potential production yield less than 0,5 litre/s) to make a utilisation recommendation without further testing. Should the result of the stepped discharge test indicate that a constant discharge is warranted, then the Engineer will need to make an assessment of the possible operational duty to which the borehole might be subjected.

The operational duty describes the number of hours per day for which the borehole must operate in order to meet the local water demand. By implication, the potential production yield of the borehole must be compared to the water demand. In qualitative terms, a lower yielding borehole would need to operate for a longer period per day to meet a given demand than a higher yielding borehole would need to. Further, the water demand is often too great for even a high yielding borehole pumping continuously to meet. The flow diagram indicates, however, that any borehole which reveals the potential to yield more than 0,5 litre/s and which will operate for a period in excess of 8 hours per day must be subjected to a constant discharge test of 48 to 72 hours duration. A borehole which does not fit this category requires an assessment of its possible operational intensity.

The operational intensity describes the yield at which a higher yielding borehole must operate in order to meet a water demand in a pumping period of eight hours or less per day. By implication, a high operational intensity requires the borehole to be pumped at a yield approaching its maximum, whereas a low operational intensity will place less stress on the borehole. These considerations will indicate whether a 24 to 48 hour or a 12 to 24 hour duration constant discharge test respectively will be performed.

The final step in the flow diagram requires the Engineer to make a borehole utilisation recommendation.

DA 04.02.02 **Equipment and materials**

This represents the test unit and all ancillary equipment and materials required to accurately and efficiently perform borehole testing. Details are provided below.

(a) Test unit

The test unit shall comprise a positive displacement (PD) type pump element and a pump head driven by a motor fitted with an accelerator, gearbox and clutch. The unit must be in good working order and capable of maintaining a minimum of 72 hours of continuous operation.

The unit must be capable of delivering water at a rate in excess of the expected maximum yield of the borehole to be tested. It may be acceptable under certain circumstances to employ a submersible pump for testing purposes. This must, however, be identified in the tender enquiry document. It is imperative that any submersible pump used for testing purposes be equipped with a non-return valve fitted at the bottom of the pump column (rising main).

(b) Discharge piping

Discharge piping comprises both the pipe (rising main or pump column) which brings the water to surface and the pipe (discharge hose) used to lead the pumped water away from the borehole being tested. The Contractor shall supply sufficient rising main to set the test pump at a depth of at least 100 m below the surface. It may, however, be required under certain circumstances to set the test pump at a greater depth in the borehole. Where necessary it shall be discussed with the Engineer prior to the installation of the test pump. The pump column must be of uniform diameter throughout. The Contractor shall also provide at least 50 m discharge piping. This must be free of leaks for its entire length. It may again, under certain circumstances, be required to discharge the pumped water at a point further away than 50 m (possibly in excess of 300 m) from the borehole being tested. In such instances, a similar procedure to that discussed above in regard to the rising main must be followed.

(c) Discharge measuring equipment/Instrumentation

This equipment/instrumentation must be adequate to accurately measure the pumping rate within the range of yields expected from successful project boreholes. If volumetric methods are used, a stopwatch for measuring time to an accuracy of at least one-tenth of a second is required. The full capacity of each container shall be determined accurately. The Contractor shall also ensure that a container stands level when used for discharge measurements. Guidelines regarding the use of different size containers for volumetric discharge rate measurements in specific yield ranges are given in table DA 04.02.02/1. Other acceptable instruments that may be used for discharge measuring are: (1) an orifice weir and (2) a flow meter. The use of these instruments is subject to various application criteria.

(i) Orifice weirs

These must be installed in a horizontal position at the end of the discharge pipe. The orifice plate opening must be sharp, clean, bevelled to 45 degrees

and have a diameter less than 80 per cent of the diameter of the approach tube to which it is fixed. The orifice plate must be vertical and centred on the end of the approach tube. There must be no leakage around the perimeter of the orifice plate mounting. The piezometer tube must not contain entrained air bubbles at the time of pressure head measurement. The latter measurement must be at least three times the diameter of the orifice.

TABLE DA 04.02.02/1 YIELD RANGE VERSUS CONTAINER SIZE
FOR VOLUMETRIC MEASUREMENTS

YIELD RANGE	CONTAINER SIZE
Less than 2 litre/s	20 litre
2 litre/s to 5 litre/s	50 litre
5 litre/s to 20 litre/s	210 litre
20 litre/s to 30 litre/s	500 litre
30 litre/s to 50 litre/s	1000 litre
More than 50 litre/s	Other suitable methods

The orifice weir equipment must be calibrated for various combinations of approach tube and orifice diameters so that pressure head readings can be converted to accurate discharge measurements.

(ii) Flow meters

Flow meters must be calibrated and of similar diameter to that of the discharge pipe. The latter must be straight and of uniform diameter for a distance of four times the diameter of the pipe before the position of the meter. There must be no turbulent flow or entrained air in the discharge pipe before the meter. The discharged water must be free of solid material carried in suspension.

It is recognised that some water leakage will generally occur especially at the borehead during pumping. This is acceptable provided that: (1) such leakage does not interfere with any water-level monitoring and (2) the total amount of leakage to the end of the discharge pipeline does not exceed one per cent of the pumping rate as measured at the end of this pipeline.

(d) Water-level measuring equipment/instrumentation

The Contractor shall provide at least three water-level measuring devices which are each capable of providing an accuracy of at least 0,01 m (10 mm) and are of sufficient length to match the pump installation depth. If ungraduated electrical contact meters (dip meters) are used for this purpose, each such instrument must be equipped with a measuring tape of an acceptable length and approved standard and which is graduated to an accuracy of at least 0,01 m (10 mm). These instruments must be in good working order and number at least one spare for each two on site.

The Contractor shall further provide conduit tubing of sufficient length to match the pump installation depth. The diameter of this tube must be large enough (minimum 15 mm) to allow free movement of the dip meter probe and cable therein. The tubing must be made of material strong enough to withstand reasonable pressure on its sidewall which might cause a constriction. The tube must be open at its

lower end to allow the free entrance of water into the tube. This is facilitated by perforating the bottom section of the conduit tube sidewall. Precautions shall also be taken to prevent the dip meter probe from passing beyond the bottom end of the conduit tube and, as a result of entanglement, not able to be withdrawn.

(e) Other materials

No pumping test should commence without field data sheets on which to record all data and information relevant to the test pumping activities in an acceptable format. These can either be provided by the Contractor or the Engineer.

DA 04.02.03

Ground-water sampling

(a) Sampling for macro-element analysis

The Institute for Water Quality Studies of the DWAF, in conjunction with the Department of Health, commenced in May 1996 with the compilation of guidelines addressing all aspects of water sample collection aimed at routinely establishing the quality thereof for drinking purposes. Until such time as these guidelines become available, the following recommendations in this regard should be followed.

A water sample shall be collected from the end of the discharge pipeline no sooner than 15 minutes before the scheduled end of a pumping test, whether of a calibration, stepped discharge or constant discharge nature. This will ensure that a water sample is collected in case testing does not proceed to include either one or both of the latter two types of test. The standard amount of sample normally collected is in a clean, sterilised plastic bottle of capacity 240 millilitre or larger and equipped with a watertight screw-on cap. This is the standard issue sample bottle provided by the DWAF. Depending on the analysing laboratory's requirements, however, a sample of up to two litres in volume may have to be collected. The Engineer will advise on this matter in instances where the Contractor is required to collect samples, in which case the Engineer will provide ampoules containing preservative chemicals if required. All other materials such as sample bottles, tie-on labels and sample custody forms are to be provided by the Contractor. The mandatory sample custody form DW45 must be completed for each sample collected. Note that the code MACRO1 in Instruction 8 ("analyse for") of form DW45 defines the macro-element analysis.

(i) Sampling procedure

Wash hands thoroughly and rinse the sample bottle three times with the water to be sampled, ie the water being pumped from the borehole. Fill the bottle so that a space of five to ten millimetres is left at the top. Add the preservative as instructed in (ii).

(ii) Sample preservation

Gently tap the bottom of an ampoule of preservative on a firm surface so that all the chemical flows to below the constriction. Hold the ampoule firmly upright with thumbs placed either side of the constriction, flex the neck, turn the ampoule upside down and place it in the bottle together with the broken-off neckpiece. Firmly screw on the cap of the sample bottle after rinsing it well with water from the borehole. Shake the capped sampled bottle well. **Caution shall be exercised when handling the preservative, since this chemical is poisonous.**

(iii) Sample custody

Fill in the information requested on the tie-on label and attach this securely to the neck of the sample bottle. Place the sample bottle in a cooler or ice-box and keep it stored under chilled conditions. Complete the sample custody form (DWAF form DW45). The water sample and its custody form will be collected by the Engineer. The above procedures shall be adhered to and complied with to the satisfaction of the Engineer.

(b) Sampling for environmental isotope analysis

Use a new, clean, one-litre polyethylene bottle with watertight screw-on cap for routine stable (hydrogen and/or oxygen) isotope and tritium analysis. Take the same basic precautions as for macro-element analysis. Ensure that the water is as clean as possible, but do not filter or add anything. Turbidity does not matter. Rinse the bottle three times with the water to be sampled, fill till overflowing and tighten cap well. Turn bottle upside down and squeeze to test for tightness. Clearly label the bottle by waterproof marking pen on the bottle shoulder or tie-on label.

In special cases of confined to semi-confined (older) water, where tritium values 0,5 TU are observed, or where it is specifically requested, samples for radiocarbon analysis may be required. Since this involves special procedures of field extraction of larger quantities of water, the Engineer shall contact experts in this field for the procedures and materials required.

This test shall only be conducted when requested by the Engineer.

The standards of isotopic measurement for hydrological applications are defined as follows:

(i) Minimum detectable values

Tritium: 0,3 TU (tritium units)

Radiocarbon: 2 pMC (per cent modern carbon)

(ii) Maximum analytical error

Tritium: 0,3 TU (0 - 3 TU); otherwise 10 %

Radiocarbon: 2 pMC (40 pMC); 1 pMC (40 pMC)

Oxygen-18: 18O; 0,15 ‰

Deuterium: 2H; 1,5 ‰

DA 04.02.04**Aborted tests and breakdowns**

The Engineer may at any stage during the execution of a pumping test request the testing contractor to abort a test if, in the opinion of the Engineer, continuation of the test is not in the interests of the project. Factors which may contribute to such a decision by the Engineer are:

- Sufficient data having been collected for an adequate scientific evaluation thereof;
- The execution of the test not meeting project criteria and requirements (such as for constancy of yield, accuracy of yield measurements or accuracy of water-level measurements, sufficiency of discharge line length, etc), or
- A mechanical breakdown occurring during pumping which causes a test to be interrupted or aborted.

(a) Tests aborted due to sufficiency of data

The Engineer will fully motivate his decision to abort the test in a written statement to the User Client. In such instances, the testing contractor will be remunerated for the actual duration of testing (including recovery testing) at the hourly rates set out in the Schedule of Quantities.

(b) Tests aborted due to incorrect execution

The testing contractor will be required to remedy the cause(s) for an abort decision by the Engineer. The test shall be restarted, as if it were the first attempt, after the water-level has recovered to within five per cent of the pre-test rest water-level or the contractor is instructed thereto by the Engineer. The testing contractor shall not be entitled to remuneration for any test which is aborted under these circumstances irrespective of the time elapsed up to receipt of the instruction to abort.

(c) Tests aborted due to breakdowns

The following procedures are recommended when a mechanical breakdown occurs during pumping which causes a test to be interrupted or aborted.

(i) Calibration test

Start immediately with the measurement and recording of the water-level recovery rate according to the periodicity given in table DA 04.02.04/1. Irrespective of how long after the start of pumping the breakdown occurs or how rapidly the breakdown can be fixed, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level or, at the discretion of the Engineer, may be discontinued. Restart the calibration test as if it is the first attempt. The Testing Contractor shall not be entitled to remuneration for a calibration test which is aborted under such circumstances.

(ii) Stepped discharge test

Record the time of the breakdown and start immediately with the measurement and recording of the water level recovery according to the periodicity given in Table 4-9. If the breakdown occurs during the first or second steps of the test, continue with water-level recovery measurements until the water-level is within five per cent of the start rest water level and then restart the stepped discharge test as if it is the first attempt. If the breakdown occurs during the third step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump. Only one such breakdown event is allowed.

If a second breakdown occurs, proceed as described for a first step breakdown. If the breakdown occurs during the fourth or later step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test and complete it at this yield after measuring and recording the water level immediately before restarting the pump. If a breakdown at this stage can not be fixed within five minutes, continue with water-level recovery measurements as if the test has been fully completed. The Contractor shall not be entitled to remuneration for a stepped discharge test which is aborted: (1) within the first or second step, or (2) within the third step and can not be restarted within the time allowed for repair.

(iii) Constant discharge test

Note the time of the breakdown and start immediately with the measurement and recording of the water-level recovery according to the periodicity given in table DA 04.02.04/1. If the breakdown occurs within the first two hours after the start of pumping, continue with water-level recovery measurements until the water-level is within five per cent of the pre-test (start) rest water level and then restart the test. If the breakdown occurs later than two hours into the test, can be fixed and the pump restarted to produce the same yield as before the breakdown within the time periods (after the breakdown occurring) given in table DA 04.02.04/1, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump.

If the breakdown can not be fixed and the pump started within one hour of the breakdown occurring, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level and then restart the constant discharge test as if it is the first attempt unless the following condition has been met. If the breakdown occurs after approximately 80 per cent of the planned duration of the constant discharge test has been successfully completed, continue with water-level recovery measurements as if the test has been fully completed. The allowable elapsed time (in hours) with regard to selected constant discharge test total durations in order for this specification to be acceptable is given in table DA 04.02.04/2.

TABLE DA 04.02.04/1 PERIOD ALLOWED FOR BREAKDOWN REPAIR AND CONTINUATION OF TESTING

TIME BREAKDOWN AFTER START OF TEST	PERIOD ALLOWED FOR REPAIR
2 hours to 4 hours	6 minutes
4 hours to 6 hours	12 minutes
6 hours to 8 hrs hours	18 minutes
8 hours to 10 hours	24 minutes
10 hours to 12 hours	30 minutes
12 hours to 14 hours	36 minutes
14 hours to 16 hours	42 minutes
16 hours to 18 hours	48 minutes
18 hours to 20 hours	54 minutes
Longer than 20 hrs	60 minutes

TABLE DA.04.02.04/2 PERIOD AFTER WHICH A CONSTANT DISCHARGE TEST
MAY BE CONSIDERED COMPLETED IN THE EVENT OF A
BREAKDOWN

CONSTANT DISCHARGE TEST DURATION	ALLOWABLE TIME ELAPSED TO BREAKDOWN
24 hours	20 hours (equivalent to 80 % of total time)
36 hours	30 hours (equivalent to 83 % of total time)
48 hours	38 hours (equivalent to 79 % of total time)
72 hours	60 hours (equivalent to 77 % of total time)

The Contractor shall not be entitled to remuneration for a constant discharge test which is aborted under circumstances which preclude its restart within the time allowable for repair and continuation. The contractor will, however, be entitled to remuneration for a constant discharge test which is aborted after approximately 80 per cent of the planned duration of the constant discharge test (refer to table DA.04.02.04/2) has been successfully completed, payment being made for the actual duration of the test (including the recovery test) at the hourly rates set out in the Schedule of Quantities.

DA 04.03 **REPAIR OF EXISTING STRUCTURES**

This section covers the requirements for the repair of the associated structures at the borehole installation.

DA 04.03.01 **General**

The work required shall include but not be limited to the following:

- (a) Repair existing concrete base slabs around boreholes;
- (b) Cast concrete base slabs at boreholes without base slabs;
- (c) Clear around the borehole an area 20 m x 20 m.

DA 04.03.02 **Detail of work**

(a) **Brickwork structures**

Where instructed by the Engineer, existing minor brickwork buildings shall be renovated.

(b) **Concrete base slabs**

Where instructed by the Engineer, existing concrete base slabs shall be broken up and removed from existing boreholes.

Concrete base slabs shall be constructed as instructed by the Engineer.

(c) **Clear area**

An area of 20 m x 20 m shall be cleared of bushes, building rubble and other foreign matter as instructed by the Engineer. The area shall in addition be levelled.

DA 04.04 **REPAIR/REPLACEMENT OF ELECTRICAL AND MECHANICAL EQUIPMENT**

This section covers the requirements for the repair of the mechanical equipment associated with the boreholes.

The requirements for the repair of the electrical equipment associate with the boreholes are specified in Technical Specification GB: Electrical installation for mechanical and pumping equipment.

DA 04.04.01 **General**

The work required shall include but not be limited to the following:

- (a) Reconditioning of MCC panel and housing
- (b) Testing of electrical mechanical equipment
- (c) Reconditioning of borehole pumping equipment
- (d) Borehole information register
- (e) Commissioning.

DA 04.04.02 **Detail of work**

(a) Testing electrical and mechanical equipment

All electrical and mechanical equipment shall be inspected and tested at the start of the Contract to establish which items need to be repaired, reconditioned or replaced.

(b) Borehole pumping equipment

The Contractor shall remove or extract the submersible pumps and inspect. Reconditioning or repair of pumps shall be carried out if necessary on the instruction of the Engineer. The difference between reconditioning and repair is defined in the payment items.

(c) Borehole information register

A data register containing the following information shall be compiled during the repair contract and further developed during the maintenance contract:

- (i) Borehole pumping equipment and maintenance tasks, records, etc
- (ii) Borehole utilisation (rate of discharge and duration of discharge)
- (iii) Borehole water-level.

(d) Commissioning

All components at each borehole will be fully commissioned after reconditioning or replacement as described in Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

DA 04.05 **SUBMERSIBLE CENTRIFUGAL PUMPS**

This Specification covers the supply, delivery and installation of submersible centrifugal pumps. Testing and commissioning is covered in Clause DA 05 and in Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

DA 04.05.01 **General**

Centrifugal pumps supplied under this Contract shall be suitable for vertical installation in submerged conditions, shall consist of a submersible motor coupled directly to a multistage centrifugal pump and shall be suitable for pumping water for domestic use.

The details of the existing installation were unknown at the time of tender. Allowance has been made for the servicing of pumping equipment.

Should it become apparent during the servicing that components need to be replaced such as bearings, shafts, etc., a payment item for the reconditioning of the pumping equipment has been allowed. The "reconditioning" payment item will replace the "servicing" payment item in this event.

No orders shall be placed for any pumping equipment until the boreholes have been tested and the report submitted to the Engineer. The Engineer shall then provide the pump requirements to the Contractor for ordering of equipment.

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.

Preference will be given to locally manufactured pumps and motors, with a reliable and efficient after sales service and readily available spares.

DA 04.05.02 **Depth of installation**

The most suitable depth of installation and safe pumping rate shall be confirmed by an experienced borehole contractor by virtue of the supplied borehole record, test and calculated information. All costs involved in confirming the most suitable depth of installation and safe pumping rate shall be deemed included in payment item DA.01.

DA 04.05.03 **Material**

All parts of the pump shall be manufactured from material most capable of withstanding wear. Full specification in this respect shall accompany the Tender and the Tenderer's advice in this respect will be considered.

DA 04.05.04 **Speed**

The pump shall have a rotational speed not exceeding 1 450 rpm. If a higher rotational speed is required, this shall be motivated in a covering letter or in the technical data sheets.

DA 04.05.05 **Design**

All working parts of the pumps shall be removable and serviceable and shall under no circumstances be integrated into the body of the pumps.

DA 04.05.06 Turbine bowls

Turbine bowls shall be manufactured from high-grade cast steel and shall be finished off smoothly before a high-quality corrosion protection system is applied. Grey Iron No 30 turbine bowls may be approved by the Engineer, or if so stated in the Project Specifications. The bowls shall be selected for a minimum of 2 500 kPa or 1,5 times the maximum discharge pressure, whichever is the greater. The casing, suction strainer, cable shield and all fastenings, nuts and bolts shall be manufactured from stainless steel.

DA 04.05.07 Pump shaft

The shaft shall be manufactured of stainless steel. Where the shaft passes through stuffing boxes it shall be fitted with renewable sleeves of high-quality, wear-resistant alloy.

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.

The rotating elements shall be accurately balanced statically and dynamically to eliminate noise and vibration when running.

DA 04.05.08 Pump impellers

Impellers shall be manufactured of stainless steel or bronze and shall be carefully bored and keyed. All parts inaccessible to machining shall have a smooth finish. Balancing of impellers shall not be done by means of drilling balancing holes, but rather by accurate and careful machining of impellers.

DA 04.05.09 Seals and bearings

Pumps shall be fitted with mechanical seals with sand deflectors. Pump bearings and thrust collars shall be bronze and shall be lubricated by the fluid handled. The pump and motor shall not be adversely affected by suspended sand concentrations of up to 25 g/m³.

DA 04.05.10 Rising pipe

The rising pipe shall have threaded or approved bolted couplings at a spacing of approximately 6 m intervals. The rising pipe shall have a minimum internal diameter of 50 mm and shall internally and externally be protected against corrosion by a fusion-bonded powder epoxy coating to a minimum thickness of 250 micron. All bolts used shall be stainless steel. The couplings shall not totally obstruct the borehole, but shall allow for sufficient clearance between the coupling and borehole casing to prevent any damage to the drop cable set and earth wire. The pump and rising pipe shall be centered in the borehole by means of approved centralisers at a preferred spacing of not more than 3 m. The centralisers shall be manufactured of an approved corrosion-resistant material and shall assist in eliminating any vibration that may occur in the borehole/rising pipe installation.

DA 04.05.11 Borehole vents

The borehole shall be adequately vented to prevent the build-up of pressure or vacuum. All borehole vent openings shall be piped watertight to the atmosphere outside of any enclosure and not less than 200 mm above any low ground level or the highest recorded flood level. Such vent openings shall be at least 12 mm in diameter. The terminal of the vent shall be suitably shielded and screened so as to prevent the entrance of foreign matter and insects.

DA 04.05.12 Pump motor

Unless otherwise specified, each pump shall be supplied complete with an electrical motor. Each electrical motor shall comply with the requirements as specified in Specification GB: Electrical installation for mechanical and pumping equipment and Clause DA 05 of this specification and Specification PF: Acceptance tests for pumps.

The depth setting shall be such that an up-flow of water past the motor is created. If insufficient up-flow of water past the motor is available, a suitable flow induced tube shall be fitted to the pump and motor to ensure sufficient cooling of the motor.

DA 04.05.13 Base plate

A suitable base plate shall be used to effectively close the top of the borehole to prevent any foreign matter from entering. The rising pipe shall be effectively bolted to the base plate. The base plate shall further be provided with the necessary openings for the drop cable site, earth wire and water-level monitoring device.

DA 04.05.14 Accessories

Over and above any reflux valves installed and specified above ground level, the pump shall be fitted with a non-slam type reflux valve situated at the pump outlet. The reflux valve shall be a matched component supplied and tested by the pump manufacturer for efficient and troublefree operation.

DA 04.05.15 Pump technical details

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, 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 flow rate at 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 operating head.

The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected duty point. The efficiency of the pump at the selected duty point as stipulated in table DA 04.05.01/1 shall not be less than 75 %.

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 heads are to be based on an atmospheric pressure above mean sea level of approximately 1 410 m, which is the site elevation of the borehole site.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in "as new" condition at start up.

Details of the equipment shall include the following:

- (a) Operating, testing and commissioning instructions
- (b) Trouble analysis guide.

Full details of periodic and annual maintenance and service to be undertaken by the maintenance staff in accordance with a preventive maintenance programme shall be submitted.

The Contractor shall state in the technical data sheets the minimum selected service life for which the pump has been engineered and the components selected when operated under normal working conditions with optimum servicing and maintenance.

The minimum acceptable service life is 15 years with 8 500 operating hours per annum.

The Engineer reserves the right to call for -

- (a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SANS, 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.

DA 04.06 SUBMERSIBLE PROGRESSING CAVITY PUMPS

This Specification covers the supply, delivery and installation of belt-driven submersible progressing cavity pumps. Testing and commissioning is covered in Clause DA 05 and Additional Specification SC: General decommissioning, testing and commissioning procedures.

DA 04.06.01 General

The pumps supplied under this Contract shall be of the progressing cavity type with a stator and a rotor, similar to Mono, Orbit or approved equivalent pumps.

The pumps shall be belt-driven and suitable for vertical installation in submerged conditions and shall be suitable for pumping water for domestic use.

Preference will be given to locally manufactured pumps, with reliable and efficient after sales service and readily available spares.

DA 04.06.02 Depth of installation

The most suitable depth of installation and safe pumping rate if not required in the detail specification shall be confirmed by an experienced borehole contractor by virtue of the supplied borehole record, test and calculated information. All costs involved in confirming the most suitable depth of installation and safe pumping rate shall be deemed included in payment item DA.01.

DA 04.06.03 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 to ensure that the components are resistant to corrosion.

All parts of the pump shall be manufactured from material most capable of withstanding wear. Full specification in this respect shall accompany the Tender and the Tenderer's advice in this respect will be considered.

DA 04.06.04 Pump speed

The pump shall have a rotational speed not exceeding 1 500 rpm. If a higher rotational speed is required this shall be motivated in a covering letter or in the technical data sheets.

DA 04.06.05 Design

All working parts of the pumps shall be removable and serviceable and shall under no circumstances be integrated into the body of the pumps.

DA 04.06.06 Pump shaft and rotor

The pump shaft and rotor shall be manufactured from stainless steel.

The shaft shall be so designed that the running speed is well below the first critical speed.

The rising shaft shall be supported by a bobbin bearing every 1,5 metres.

The shaft supporting bearings shall be made of stainless steel with a vulcanised rubber outer sleeve and rubber linings with bushes of a synthetic material and shall be lubricated by the fluid handled.

DA 04.06.07 Pump stator

The stator 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, shall be indicated in the covering letter at tender stage.

DA 04.06.08 Rising pipe

The rising pipe shall withstand a 1 600 kPa working pressure.

The rising pipe shall have threaded or approved bolted couplings at a spacing of approximately 3 m intervals. The rising pipe shall have a minimum internal diameter of 50 mm and shall internally and externally be protected against corrosion by a fusion-bonded powder epoxy coating to a minimum thickness of 250 micron. All bolts used shall be stainless steel. The pump shaft shall run inside the rising pipe.

The pump and rising pipe shall be centred in the borehole by means of approved centralisers at a preferred spacing of not more than 6 m. The centralisers shall be manufactured of an approved corrosion-resistant material and shall assist in eliminating any vibration that may occur in the borehole/rising pipe installation.

DA 04.06.09 Borehole vents

The borehole shall be adequately vented to prevent the build-up of pressure or vacuum. All borehole vent openings shall be piped watertight to the atmosphere outside of any enclosure and not less than 200 mm above any low ground level or the highest recorded flood level. Such vent openings shall be at least 12 mm in diameter. The terminal of the vent shall be suitably shielded and screened so as to prevent the entrance of foreign matter and insects.

DA 04.06.10 Pulley head and base plate

A pulley head which includes the pulleys, shaft seals, bearings and pump delivery flange shall be mounted on a suitable base plate.

The pulley head and base plate shall effectively close the top of the borehole to prevent any foreign matter from entering.

The rising pipe shall be effectively bolted to the pulley head.

A double bearing configuration shall be installed where the shaft exits the pulley head frame. The bearing configuration shall consist of a lower thrust bearing and an upper sealed ball or roller locating bearing.

The pulley head shall be fitted with a stuffing box and shall have gland packings of adequate depths for sealing around the shaft, where the shaft exits the pump casing.

The gland 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.

DA 04.06.11 Belt drives

This clause only deals with V-belts, but full details of alternatives may be submitted to the Engineer for approval.

The Contractor shall install at least two belts per coupling.

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 operate up to a rotational speed of 150 % of the nominal duty speed.

The motor/engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60 % of the safe allowable limits specified by the supplier of the driving and/or driven equipment. Radial run-out on pulleys shall not be more than 1 % of the pulley diameter.

If the driving and driven pulleys are not in the same plane a maximum of a quarter twist turn between the driving and driven pulleys is allowed with a suitable belt length to prevent damage to the V-belts or pulleys.

Keys and keyways for load transfer to and from shafts shall comply with BS46 Part 1 and BS 4235 Part 2.

Suitable and accessible methods for adjusting the tension of the belts shall be provided.

The driving and driven pulleys and belts shall be enclosed in a single sturdy guard which allows visual inspection of the belt condition with the guard fitted. The guard shall be easily removable for belt maintenance.

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.

The arc of contact on the small pulley shall be more than 120°. The pulley ratio shall not be less than 2,25:1, unless prior approval is obtained from the Engineer.

Belts shall be easily removed and installed for maintenance purposes and shall be to the approval of the Engineer.

The required belt tension to transfer the required load, including starting, shall not result in side thrusts in the prime mover and pump head pulley bearing which exceed 60 % of the manufacturer's specified maximum allowable side thrusts.

DA 04.06.12 Accessories

Each pump discharge line shall be fitted with the fittings and accessories as indicated by the Engineer.

Each pump shall be fitted with a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange.

Each pump shall be fitted with a non-slam type reflux valve situated at the pump outlet. The reflux valve shall be a matched component supplied and tested by the pump manufacturer for efficient and trouble-free operation.

DA 04.06.13 Pump efficiency

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.

DA 04.06.14 Pump technical details and installation

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, 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 Contractor shall state in the technical data sheets, the minimum selected service life for which the pump has been engineered and the components selected when operated under normal working conditions with optimum servicing and maintenance.

The minimum acceptable service life is 15 years with 8500 operating hours per annum.

The pumps required shall be determined by the Engineer after the borehole yield testing to ensure the optimum use of each borehole.

The Engineer or his representative reserves the right to call for -

- (a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SANS, 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.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in "as new" condition at start up.

Details of the equipment shall include the following:

- (a) Operating, testing and commissioning instructions
- (b) Trouble analysis guide.

Full details of periodic and annual maintenance and service to be undertaken by the maintenance staff in accordance with a preventive maintenance programme shall be submitted.

DA 04.06.15 Prime mover

The pump shall be belt-driven by either an electric motor or diesel engine as specified in the schedule of quantities.

The prime mover and the pump pulley head shall be mounted on separate base frames.

DA 05 GENERAL SPECIFICATION FOR ELECTRIC MOTORS

DA 05.01 SCOPE, REFERENCE SPECIFICATIONS, STANDARDS AND CODES

This specification covers all aspects related to electric motors that may be incorporated in any of the items of equipment to be supplied under the contract.

DA 05.02 GENERAL REQUIREMENTS

- (a) Electric motors shall be manufactured in South Africa and shall comply with the requirements of SANS 948.
- (b) Where imported motors are offered they shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SANS 948 and the Engineer shall be provided with the appropriate certificate obtained from the South African Bureau of Standards stating that such motors do comply, prior to the installation of the motors. However, where tests reveal that motors do not comply, it shall be the responsibility of the Contractor to supply alternative motors which comply with the requirements of SANS 948 and which are acceptable to the Engineer. Where imported motors are not normally kept in stock in South Africa, written proof shall be provided of the availability of replacement parts as well as the delivery period of the parts after placing the orders.
- (c) All motors shall be standard catalogue models and shall be readily available.

- (d) 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.

DA 05. 03 WORKING VOLTAGE AND SUPPLY SYSTEMS

- (a) The motors shall be capable of operating within $\pm 10\%$ of the nominal voltage supply without risk of damage. All motors shall be suitable for operating continuously at the specified 3-phase voltage under actual service conditions, including the $\pm 10\%$ system voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.
- (b) 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.
- (c) 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, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

DA 05.04 TEMPERATURE RISE

The temperature rise, as determined by resistance, of all motors, shall not exceed the following derated values:

Insulation class	E	B	F	H
Temperature rise (K)	50	60	80	100

DA 05.05 EFFICIENCY AND POWER FACTOR

- (a) The efficiency of all motors shall be guaranteed by the Contractor. Deviations from the guaranteed efficiency shall be within the limits specified in SANS 948.
- (b) The guaranteed efficiency of each size and rating of motor shall be as determined in accordance with BS 4999: Part 102. 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.
- (c) The power factor of motors with a capacity of 20 kW or more shall not be less than 0,9 under all operating conditions.

DA 05.06 VIBRATION

- (a) Motors shall be statically and dynamically balanced.
- (b) All motors shall be checked for vibration without load, and at full rated voltage at the manufacturer's works, and the vibration amplitude as measured shall be in accordance with BS 4999: Part 142, quality grade 'Normal'.
- (c) The ratio of axial to radial vibration shall not exceed 0,5.

DA 05.07 NOISE LEVEL

Unless otherwise specified motors shall be of 'normal sound power', in compliance with BS 4999.

DA 05.08 **ENCLOSURE AND FRAME**

- (a) 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.
- (b) Notwithstanding the requirements of DA 05.08 above, the minimum degree of protection shall be IP55 to SANS 1222 and, unless otherwise required, motors shall preferably be of the totally enclosed fan-cooled (TEFC) type.
- (c) All motors of the vertical-spindle type and exposed to the weather, shall be provided with a robust canopy of approved design.
- (d) Medium-length motors are preferred but short-length motors may be accepted where space is limited and written permission has been granted by the Engineer.

DA 05.09 **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.

DA 05.10 **RATING AND STARTING REQUIREMENTS**

- (a) 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.
- (b) 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 BS 4999 part 41, 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 BS 4999: Part 69 will not be accepted and shall be limited to -10 per cent.

- (h) Documentation shall include performance curves to suit the expected working conditions.

DA 05.11 **BEARINGS**

- (a) All motors shall, wherever possible, be provided with prelubricated sealed bearings.
- (b) Regreasable 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 BS 1486: Part 2, Nos. 21A or 21B (industrial type).
- (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 life of 100 000 hours at B10 rating.

DA 05.12 **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, which is located on one side between the mounting feet.

DA 05.13 **HEATERS AND DRAINAGE**

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 220V AC supply if considered advisable by the manufacturer.

Where specified in the project specifications, motors shall be supplied with anti-condensation heaters to keep the motor temperature at 23 °C when the motor is not operational to prevent moisture from condensing in the motor.

Heater terminal boxes shall be fitted on the motor frame and shall be of robust design, liberally sized and complete with suitable terminal block and mechanical cable gland or conduit entry.

DA 05.14 **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 designed to exclude the ingress of dust and moisture and sealed from the internal circuit of the motor, and shall be manufactured from sand-cast metal. The wall thickness of the terminal boxes and the dimension of the cable inlet shall be as specified in SANS 948. The terminal box shall 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 and shall allow 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 BS 4999.
- (g) Terminal markings shall be clear and permanent and shall comply with BS 4999. 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.

DA 05.15**MOTOR/LOAD COUPLING**

- (a) Motors shall be coupled direct to the equipment to be driven, by means of approved couplings. Vee-belt and chain drives shall be considered only if direct coupling of the motor to the equipment is impossible or impracticable. 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.

DA 05.16**SUBMERSIBLE MOTORS**

The following additional requirements apply specifically to all submersible motors:

- (a) 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 project specifications.
- (b) All submersible motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- (c) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (d) All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the motors.

- (e) 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, weatherproof, outdoor junction box. The submerged cable shall be supported to minimize any movement of the cable which results from turbulence caused by the operation of the equipment or the flow of the water.
- (f) Thermistor protection shall be provided for submersible motors.

DA 05.17 **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, derated in accordance with DA 05.16(d) above.

DA 05.18 **TECHNICAL DATA SHEETS**

Details of all individual electric machines and equipment requiring electrical energy shall be indicated on the 380 V motor and equipment schedule included in the technical data sheets.

DA 06 **TESTING AND COMMISSIONING**

DA 06.01 **TESTS TO BE PERFORMED**

- (a) All pumping equipment shall be subject to the commissioning tests as described in Additional Specification SC: General Decommissioning, 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 detail specification.
- (c) The operating point of each pump shall be determined.
- (d) Efficiency tests will only be performed when specified in the detail specification.
- (e) NPSH tests will only be performed when specified in the detail specification.

DA 06.02 **PUMP OPERATING POINT**

During the day 1 commissioning tests the pump operating point shall be determined by observing the following:

- (a) Pump delivery and suction pressures, and
- (b) Electric motor power consumption.

If no efficiency tests are required in the detail specification then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

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.

DA 06.03 FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS

- (a) Testing will be done in accordance with BS 5316 Part 1, class C tests.
- (b) Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.

DA 06.04 TEST CONDITIONS

- (a) All tests will be performed in situ.
- (b) The pumped medium or liquid specified as the process liquid in the detail 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 supplier's curves which are based on water.

DA 06.05 ADDITIONAL TESTS

Additional tests may be specified in the detail specification.

DA 07 MAINTENANCE

All borehole pumping equipment and systems shall be serviced and repaired, following practical completion of the installation of which it forms part, to maintain it in perfect functional condition.

Maintenance to be carried out shall include routine preventative maintenance in accordance with the manufacturer's specification to be set out in the operating and maintenance manual, as well as unforeseen repair work or replacement.

The remuneration for monthly maintenance of borehole pumping equipment and systems shall be deemed included in the tendered rate for ten points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance.

The routine maintenance of the installations, systems and equipment shall include, but not be limited to the items listed in table DA 07/1 below:

DA 07.01 TABLE DA 07/01 ROUTINE MAINTENANCE OF INSTALLATIONS, SYSTEMS AND EQUIPMENT

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Remove, inspect and service submersible pumps	Four-monthly
2	Clean filters/strainers	Monthly
2	Inspect and clean air release valves	Monthly
3	Check V-belts	Monthly
4	Measure rest water-level	Weekly
5	Check MCC panel	Monthly
6	Check electric motors	Monthly
7	Log and record water meter reading and water usage	Daily
8	Log and record amps, volts and hour meter readings	Daily

DA 08 MEASUREMENT AND PAYMENT

DA.08.01 PUMP TESTING OF BOREHOLES Unit: number

The unit of measurement shall be the number of boreholes tested on the written instructions of the Engineer.

The tendered rate shall include full compensation for all labour, equipment and material required for the complete testing of the boreholes in accordance with the specification.

DA.08.01.01 Extra over DA.08.01 for:

(a) The removal of existing equipmentUnit: number

The unit of measurement shall be the number of boreholes from which all the equipment is removed. The tendered rate shall include full compensation for the removal of existing operational pumps and motors and all associated pipework.

(b) Recovery of lost equipmentUnit: number

The unit of measurement shall be the number of boreholes from which all the lost equipment is retrieved. The tendered rate shall cover the recovery of lost pumps and pipework for boreholes.

(c) Installation of temporary pumpsUnit: number

The unit of measurement shall be the number of temporary pumps installed and later retrieved. The tendered rate shall be fully inclusive of the pump and pipes required to effectively test the boreholes in accordance with the specifications.

(d) Ground-water samplingUnit: number

The unit of measurement shall be the number of boreholes of which the water is sampled. The tendered rate shall be fully inclusive of the requirements of the specification irrespective of the number of samples taken from a borehole.

- (e) Compilation of borehole reportUnit: number

The unit of measurement shall be the number of boreholes regarding which approved reports is compiled. The tendered rate shall be fully inclusive of the work required to compile and produce six copies of each borehole recommendation report.

- (f) Standing time Unit: day

The unit of measurement shall be the number of days no work could be carried out. This will cover periods when the test pumping rig and crew or, if more than one rig and crew are fielded, when all rigs and crews are idle, waiting for decisions by the Engineer where those decisions or whose presence is required before the commencement or continuation of the work instructed. Under no circumstances will standing time be payable for any delays other than those incurred by the Engineer's decisions. Except only for abnormal weather conditions as provided for in PS14 of Portion 1 of the Project Specifications, no standing time will be payable due to inclement weather or prevention of access to a site by the Contractor due to inclement weather.

- (g) Interhole movesUnit: number

The unit of measurement shall be the number of interhole moves made. The tendered rate shall include all labour and equipment costs incurred in moving plant, equipment and labour from one hole to another hole.

- (h) Removal of existing pumping equipment Unit: number

The unit of measurement shall be the number of boreholes from which equipment is removed prior to testing the borehole. The tendered rate shall cover the removal of existing pumping equipment from a borehole to be tested. Payment for removal up to an installed depth of 50 m shall be made at the unit rate tendered for in the Schedule of Quantities. Installed depths in excess of 50 m shall be remunerated for the first 50 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

- (i) Reinstallation of existing pumping equipment Unit: number

The unit of measurement shall be the number of boreholes in which removed equipment is re-installed. The tendered rate shall cover the reinstallation of existing pumping equipment in a borehole following test pumping of the borehole. Payment for installation up to a depth of 50 m shall be made at the unit rate tendered for in the Schedule of Quantities. Reinstallation depths in excess of 50 m shall be remunerated for the first 50 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

The existing pumping equipment shall be reinstalled and left in working condition as it was found before removal unless the Contractor is instructed otherwise by the Engineer.

DA.08.02 **REPAIR OF EXISTING STRUCTURES**

DA.08.02.01 Brickwork Unit: square metre (m²)

The unit of measurement shall be the area of brickwork repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair of brickwork.

DA.02.02 **Concrete base slabs** Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete used in the repair of base slab.

The tendered rate shall include full compensation for all labour, materials, and equipment required to carry out the work as well as for all work carried out.

DA.02.03 **Clean around borehole** Unit: number

The unit of measurement shall be the number of boreholes around which the area is cleaned and levelled.

The tendered rate shall cover full compensation for the cleaning of an area 20 m x 20 m around each borehole.

DA.02.04 **Removal of concrete base slab** Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre volume of concrete broken out of the existing base slab.

The tendered rate shall include full compensation for the removal of the concrete inclusive of all tools, labour, removal of surplus material to a dump site and all other work required to satisfactorily complete the task.

DA.02.05 **Painting of exposed pipework** Unit: metre (m)

The unit of measurement shall be the metre of pipework painted inside the pump house. The approximate diameter of the pipework is 110 mm.

The tendered rate shall include full compensation for the tools, labour, material, supply and delivery. The paintwork shall be conducted in accordance with Technical Specification AC.

DA.03 **REPAIR/REPLACEMENT OF ELECTRICAL EQUIPMENT**

DA.03.01 **Detailed inspection and testing of components** Unit: number

The unit of measurement shall be the number of boreholes for which a detailed inspection has been performed and all electrical and mechanical components tested.

The tendered rate shall include full compensation for testing all electrical and mechanical components for carrying out inspections and for all labour and equipment needed to carry out the work.

DA.03.02 **Commissioning** Unit: number

The unit of measurement shall be the number of borehole installations commissioned.

The tendered rate shall include full compensation for all labour and equipment supplied and for the commissioning of each borehole installation. The commissioning must include records such as testing of the pumps, yield performance and records of electrical properties.

DA.03.03 Reconditioning of pumping equipmentUnit: number

The unit of measurement shall be the number of pumps and motors reconditioned.

The tendered rates shall include full compensation for replacement of components and materials and for, tools, transport, site handling and labour necessary for the complete reconditioning of pumping equipment to conform to all the specifications in Sub-clause DA 04.06.14: Pump technical details and installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

DA.03.04 Repair of pumping equipmentUnit: number

The unit of measurement shall be the number of submersible pumps and motors repaired.

The tendered rate shall include full compensation for supply of an identification label, resetting the spacer between impeller and back plate and ensuring that impeller rotates freely, as well as cleaning and corrosion protection and installing a new hoisting chain.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

DA.03.05 De-commissioning and removal of submersible pumping equipment Unit: number

The unit of measurement shall be the number of submersible pumps and motors de-commissioned and removed.

The tendered rates shall include full compensation for tools, plant (TLB), transport, site handling and labour necessary for the complete de-commissioning and removal of pumping equipment.

DA.03.06 Servicing of submersible borehole pumpsUnit: number

The unit of measurement shall be the number of pumps serviced. The tendered rate shall include full compensation for servicing (including all consumables), cleaning, corrosion protection (including pump and motor base), adjusting, aligning, including disassembling and re-assembling. The tendered rate shall include all labour, tools, equipment and spare parts that form part of servicing as set out in the operating and maintenance manuals or as specified by the supplier.

DA.04 SUBMERSIBLE CENTRIFUGAL PUMPS

DA.04.01 Supply and delivery of submersible borehole pumps:

(a) (Pump description) Unit: number

(b) Etc for other pumps

The unit of measurement shall be the number of units supplied and delivered where each unit shall include one pump, one motor, one base plate, drop cable set, earth wire, flow inducer if required and all other accessories as specified.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery to site, storage, patent rights, etc, of all the equipment complete as specified in the Specifications.

DA.04.02 Installation of submersible borehole pumps:

(a) (Pump description)Unit: number

(b) Etc for other pumps

The unit of measurement shall be the number of units installed. Each unit shall include one pump with motor or engine, base plate and all other accessories as specified.

The tendered rates shall include full compensation for the installation of the units (including concrete chamber), the making good of all damaged corrosion protection areas, maintenance and for all other costs and actions that are necessary to provide a complete and efficiently working system.

Payment under this item may only be claimed after the relevant operating manuals have been handed over to the Engineer.

DA.04.03 Supply, deliver and install rising pipe (diameter and pressure class indicated 110mm HDPE type PE 100 Class PN 12.5)

Unit: number

The unit of measurement shall be the metre of rising pipe installed.

The tendered rate shall include full compensation for all labour, plant, transport and materials required to manufacture, supply and install the rising pipe, corrosion protection, fixing to the pump and base plate, including couplings, gaskets, nuts and bolts.

DA.04.04 Remove existing equipment from borehole and store on site as directed by the Engineer:

(a) (Equipment description) Unit: number

(b) Etc for other descriptions

The unit of measurement shall be the number of installations from which the equipment is removed.

The tendered rate shall include full compensation for the removal of the existing borehole equipment, providing a suitable storage facility, transporting the equipment to the storage facility and store the equipment for the period required.

DA.05 SUBMERSIBLE PROGRESSING CAVITY PUMPS

DA.05.01 Supply and delivery of submersible progressing cavity pumping equipment:

(a) Pump unit Unit: number

(b) Pulley head and base frame Unit: number

(c) Rising pipe Unit: metre (m)

(d) Rising pump shaft Unit: metre (m)

The unit of measurement for subitem DA.05.01(a) shall be the number of submersible progressing cavity pump units supplied and delivered.

The unit of measurement for subitem DA.05.01(b) shall be the number of pulley heads including two complete sets of drive belts and their protective safety cages (sized to enclose

the drive pulley heads of the motor or engine, suited to the particular installation) and a base frame for each pulley head supplied and delivered.

The unit of measurement for subitem DA 05.01(c) shall be the linear metre length of rising pipe supplied and delivered.

The unit of measurement for subitem DA.05.01(d) shall be the linear metre length of shaft supplied and delivered.

The tendered rates shall include full compensation for the manufacture, corrosion protection, predelivery testing, transport to site, off-loading and all handling of equipment which shall include the following:

- the pump unit
- pulley head and base frame
- rising pipework and centralisers
- rising shaft and locating bearings
- all accessories including valves, fittings, V-belts, fasteners and auxiliary materials to render a complete pump unit.

DA.05.02 Installation of submersible progressing cavity pumping equipment:

- (a) Pump unit Unit : number
- (b) Pulley head and base frame Unit : number
- (c) Rising pipe Unit : metre (m)
- (d) Rising pump shaft Unit : metre (m)

The unit of measurement for subitem DA.05.02(a) shall be the number of submersible progressing cavity pump units installed.

The unit of measurement for subitem DA.05.02(b) shall be the number of pulley heads including two complete sets of drive belts and a base frame for each pulley head installed.

The unit of measurement for subitem DA.05.02(c) shall be the linear metre length of rising pipe installed.

The unit of measurement for subitem DA.05.02(d) shall be the linear metre length of shaft installed.

The tendered rate shall include full compensation for the site handling and positioning and installation of the equipment including all labour and consumables required for a fully installed submersible progressing cavity pump.

Payment under this item may only be claimed after the relevant operating manuals have been handed over to the Engineer.

DA.06 BOREHOLE STRUCTURES

DA.06.01 Clear area around borehole Unit: square metre (m²)

The unit of measurement shall be the square meter of area cleaned and levelled around the borehole.

DA.06.02 Removal of concrete base slab Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre volume of concrete broken out of the existing base slab.

The tendered rate shall include full compensation for the removal of the concrete inclusive of all equipment, labour, removal of surplus material to a dump site and all other work required to satisfactorily complete the task.

DA.06.03 Laying of Concrete base slabs Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete used for a new base slab or for the repair of a base slab.

The tendered rate shall include full compensation for all labour, materials, and equipment required to carry out the work, as well as cleaning of the construction area.

DA.06.04 Brickwork Unit: square metre (m²)

The unit of measurement shall be the area of brickwork repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair of brickwork. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

DA.06.05 Repair of existing steel cover Unit: number

The unit of measurement shall be the number of steel covers repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair required and repainting of the existing borehole steel cover. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

DA.06.06 Supply, Deliver and Install new borehole enclosure Unit: number

The unit of measurement shall be the number of borehole enclosures installed.

The tendered rate shall include full compensation for all labour, materials and equipment required for the supply, delivery and installation of the new borehole enclosure complete as per the tender drawings. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

DA.06.07 Painting of exposed pipe work Unit: metre (m)

The unit of measurement shall be the metre of pipe work painted. The approximate diameter of the pipe work is 100 mm.