Specification

For

Rigid Polyurethane Coating

And

Solvent Free Liquid Epoxy lining

On API 5L Steel Pipe

January 2017

Ref: JWEL1701.101

Scope

This Specification defines the minimum technical requirements for Liquid Applied Coating and lining for factory coated pipe and specials. The external coating system shall comprise a layer of rigid polyurethane applied in a single coating operation to a thickness of 1.7mm. The internal lining system shall comprise plural component hot applied solvent free epoxy to a thickness of 600µm.

The contractor's scope shall include, but not necessarily be limited to the following:

- Pre cleaning
- Surface preparation
- Application
- Testing of applied coating

The pipeline will be buried and will be protected against external corrosion by external coating and cathodic protection systems.

The external coating shall be suitable for the operating conditions applying to this pipeline and shall have proven good resistance to cathodic disbondment and cathodic over potential. This document supplements the requirements of other project Specifications and Standards for the performance of the work.

Note: The connotation of the following words will be:

- **Shall** – denotes that the requirement is mandatory.
- **Should** – denotes that the requirement is highly recommended but not mandatory.
- **Approved or Approval** – denotes approval in writing by the Corrosion Engineer of Johannesburg Water (CE) or his nominated representative/s.

Contractor's Responsibilities

The Contractor shall obtain the Corrosion Engineer's Approval for any deviation from this Specification or referenced code, standard or project document, in writing at time of tendering. Changes requested later are likely to be rejected.

In the event of any conflict between this Specification, any referenced documents and the Project Data Sheet; the Contractor shall request written clarification of the requirements from the Corrosion Engineer.

Only subcontractors approved by the Corrosion Engineer shall be employed.

STANDARDS AND CODES

Coatings shall be applied in accordance with the requirements of this Specification and the Manufacturers' Specifications.

The order of precedence between this Specification and industry documents is:

- Project Specifications
- Project Datasheet
- Manufacturer's Specifications
- Standards and Drawings
- Industry Codes and Standards

Quality System

The coating operation shall be governed by a documented Quality System, which ensures that the requirements of this Specification are met in every respect.

The Quality System shall be based upon recognized quality standards, of which ISO 9001 is a suitable example. Quality Assurance systems to other equivalent standards may be used if approved by the Corrosion Engineer.

The Contractor Quality Assurance Group shall have been established, which shall be responsible for reviewing the Quality System and ensuring that it is implemented.

Application and test procedures, which comprise the Quality System and the Inspection & Test Plan, shall be submitted to the Corrosion Engineer for Approval.

The Quality System shall include control of material and equipment suppliers and subcontractors and shall ensure that the requirements of this Specification are satisfied by the suppliers and subcontractors operating quality systems in their own organizations.

A Quality Plan and Inspection & Test Plan for the activities necessary to satisfy the requirements of the Specification shall be prepared and issued to the Corrosion Engineer for Approval before commencement of work.

The Quality Plan and Inspection & Test Plan shall include any sub-contracted work and the sub-contractor's Quality Plans shall be submitted to the Corrosion Engineer for Approval.

The Quality Plan shall be sufficiently detailed to indicate sequentially, and for each discipline, the requisite quality control, inspection, testing, and certification activities with reference to the relevant procedures and the acceptance standards.

The Quality System and associated procedures may, with due notice, be subject to formal audits by the Corrosion Engineer.

The application of quality control will be monitored by the Corrosion Engineer's inspectors, who will witness and accept on behalf of the Corrosion Engineer the inspection, testing, and associated work required by the Specification. The provision of inspection services reporting directly to the Corrosion Engineer shall in no way relieve the Contractor of the responsibility to ensure that the full scope of work is carried out entirely in accordance with the Specification, the agreed Quality Plan and Inspection & Test Plan.

Functional Requirements

The coating shall be applied to provide corrosion protection to the pipeline and specials over the design lifetime.

Contractor shall demonstrate that the coating system will fulfil the requirements before production starts.

This shall be demonstrated by complying with the coating qualification procedures herein.

Contractor shall demonstrate that the coating, as applied during normal production, fulfils the requirements by effective quality control procedures in accordance with this specification.

Preference will be given to materials that do not require post application heating to facilitate cure.

The coating shall be suitable for use with cathodic protection and at ambient temperatures.

Technical Requirements

Application shall be by an approved, qualified, and experienced specialist coating contractor.

The specialist contractor, if new to Johannesburg Water, shall submit a full and comprehensive documentation package demonstrating a long term track record of successful completion of identical scopes of work on projects of the same scale.

Materials

The required external coating shall be a two component liquid applied rigid polyurethane.

The required internal coating shall be a two component liquid applied solvent free epoxy. A valid potable water certificate must accompany the data sheet of the material to be used.

The minimum documentation to be provided is detailed at Table 2.

Coating Material Requirements

The two coating components shall have different colours allowing the verification of the correct mixing and checking of the uniformity of the colour of the mixed product.

The external coating is considered cured when it has attained the hardness recommended by the product manufacturer and has passed an adhesion test in accordance with Table 3

The coating materials shall be handled, stored, applied, and cured in accordance with the recommendation of the material manufacturers.

Contractor shall submit, with the quotation, certified test reports and data as listed in BS EN 10290, Table 1 and SANS 1217 Tables 1 and 3 as applicable. Requirements additional to those of BS EN 10290, Table 1 are detailed in Table 2 of this specification

Surface Preparation

All inspection and testing associated with surface preparation shall be based on BS EN 10290, Section 8 and, where necessary, modified as shown in Table 4 of this specification.

Prior to blast cleaning, all surfaces shall be inspected and any oil or grease shall be removed by means of solvent cleaning in accordance with SSPC SP1 using water dispersible cleaners. The solvent shall leave no residue.

Surfaces that have been exposed to a marine or polluted atmosphere shall be fresh water or chemically cleaned to remove any chlorides or other salts to comply with requirements of ISO 8502-6 of less than 20 mg/m² equivalent NaCl.

At the start of each shift, after the compressor has reached operating temperature, the compressed air shall be checked for oil and water contamination in accordance with ASTM D4285

Using dry blasting techniques, the surfaces to be coated shall be abrasive blast cleaned to remove all mill scale and other impurities from the steel surface.

Blast cleaning abrasive shall be of the expendable type approved by Corrosion Engineer. Compressed blasting air shall be clean, dry and free from oil.

The air temperature, humidity, and pipe temperature shall be measured and recorded.

The surface of the pipe shall be blast cleaned as per ISO 8501-1 to Grade **Sa 3** surface preparation quality at the time of coating.

The abrasive material shall be selected to achieve a surface profile of a minimum of 50 µm and a maximum of 100 µm, and as qualified during PQT. Hardness of the abrasive material must be Rockwell C 54 or greater.

The abrasive material shall be dry, clean, and free from contamination.

Salt contamination tests shall be regularly performed on abrasive to verify that total salt level in the soluble contaminants is less than 25ppm.

The method of measurement shall be by an electronic stylus rugosity-type device during qualification to assess profile height and profile density and correlate this with Testex replica tape.

The agreed standard of surface cleanliness and profile height and density achieved during qualification shall be set as the standard for all coating work.

Spot checks using the electronic stylus rugosity device shall be carried out during production as directed by the Corrosion Engineer.

Measurements shall be made with Testex replica tape in accordance with NACE RP0287.

Any loose dust or contamination from the blasting process shall be removed by use of dry clean compressed air, brush, or vacuum cleaner.

The surface of the joint area shall be checked for dust contamination in accordance with ISO 8502-3. The joint surface shall have a dust rating of ≤2

Visual Inspection of Cleaned Surfaces

The Corrosion Engineer shall have final approval on the disposition of pipes, bends, specials and fittings whether or not to release those items for coating, to return for re-cleaning, or to reject the item(s) for excessive surface defects.

Surface Defects

After blast cleaning, the items shall be thoroughly inspected for surface defects such as raised slivers, laminations, or hackles of steel visible on the surface.

The defects shall be removed in accordance with the project requirements.

Items formed from pipe with surface defects, which are considered to require extensive grinding, shall be removed from the production process for further investigation.

Extensive grinding shall not be performed without a certified Engineer approval. Anchor pattern shall be restored on all ground surfaces.

Wall Thickness

After extensive grinding, which must be approved, the remaining wall thickness shall be measured by ultrasonic inspection and shall not be less than the specified minimum wall thickness.

Items formed from pipe with thickness less than the specified minimum wall thickness shall be rejected. Ground areas shall merge smoothly with the surrounding pipe surface.

Elapsed Time until Coating

The total allowable elapsed time between completion of the blast cleaning operation and commencement of the coating operation shall be kept to a minimum such that the surface cleanliness is **Sa 3** at the time of coating.

Delay shall not exceed the times provided in Table 1 below.

Table 1

Time-Humidity Table for Blasting – Coating delay

% RELATIVE HUMIDITY	ELAPSED TIME (HOURS)
85	0.5
80	1.0
70	1.5
60	1.75
50	2.0

Relative humidity and dew point temperature shall be determined using a sling psychrometer or digital hygrometer in the immediate vicinity of the abrasive blast cleaning equipment.

No surface preparation by abrasive blast cleaning or coating application is to be performed unless the RH < 85% and surface temperature is more than 3°C above the Dew Point.

Coating Application

All coating activities shall be performed in accordance with the approved procedures.

The surface shall be heated using an induction heating coil, radiant heaters or hot air to a temperature as recommended by the coating material manufacturer and in accordance with this specification

The use of propane torches or gas burners for pre-heating and post-heating is expressly prohibited. Infrared heaters may be used for post-heating.

The temperature of the bare steel shall be monitored using temperature-indicating crayons.

The amount of crayon used shall be the minimum amount required for accurate measurement.

Crayon markings shall be removed with a wire brush.

Care shall be taken to ensure a uniform heating pattern.

Liquid Coating Application

A layer of liquid coating shall be applied to the blast cleaned surfaces using the method and equipment recommended by the product manufacturer. 100% Solid material should have a dry film thickness (DFT) of 600µm and shall be a minimum of 500µm. A maximum of 800µm will be allowed for the total system.

Note the manufacturer's specifications must always be cross referenced to ensure the total system is achievable whilst remaining within the listed tolerances for the system.

The required minimum dry film thickness in terms of SSPC PA2 is 1.7mm for the external coating.

100% Solid materials must be applied in one single application. The specified thickness shall be achieved in one application for solvent free epoxies. In the event of the thickness being less than the minimum specified, the lining shall be removed and the pipe length shall be re-blasted and relined to comply with the specification. For factory-coated pipe, bends and specials the cut back shall be 150 ±20mm. The edge of the cut-back shall be feathered at 30 – 45°.

The coating shall be uniform, free of defects and shall not show a tendency to laminate, to sag or to curtain.

If post-heating of the coating after application is required, this shall also be carried out in accordance with the product manufacturer's procedure, and as qualified during Quality Control Planning phase.

The wet film thickness shall be measured in accordance with ISO 2808.

Particular attention shall be paid to the recommended dry film thickness which shall be measured in accordance with SSPC PA 2.

No spot measurement may be less than 1.5mm for the polyurethane and 500µm for the epoxy.

No thinner shall be used unless recommended by the product manufacturer.

Tools and equipment shall be cleaned using only such solvents as are recommended by the product manufacturer.

Particular care shall be taken in the handling of the coated items before the coating has reached the minimum value of hardness recommended by the manufacturer and qualified during the rock impact test.

All pipes and other components shall be high spark holiday tested in accordance with NACE RP0274 at the test voltage recommended by the coating manufacturer.

Repairs

Repairs shall be carried out with repair grade materials of the same grade as the spray-applied, and tested in accordance with approved procedures.

Data and Quality Requirements

Table 2:

Data Requirements for System Pre-Qualification Additional to BS EN 10290, Section3, Table 1

PROPERTY	TEST METHOD	ACCEPTANCE CRITERIA
Hardness Shore "D"	ASTM D2240	≥75
Composition	FTIR Fingerprint	
Contractor shall submit data regarding specific curing times to touch dry, dry to handle and full cure for steel temperatures of 10, 20, 30, 40 & 50°C		

(Note: The coating is equivalent to type 1 thickness class B of BS EN 10290 clause 1)

Table 3:

Requirements for Procedure Qualification Additional to BS EN 10290, Section 7, Table 4

PROPERTY	TEST METHOD	ACCEPTANCE CRITERIA
Cathodic disbondment, 66 ± 3°C, 24 hrs, 3.5V	NACE RP 0394	<6mm
Adhesion to steel after hot water soak, 70 ±3°C, 30 days and 60 days	ISO 4624	≥7MPa
Impact resistance	ASTM G14, 23°C	3J/mm
Interface porosity	NACE RP 0394	1-2
Cross section porosity	NACE RP 0394	1-2

Table 4:

Requirements for Quality Control Testing From BS EN 10290, Section 8, Table 5 and or this Specification

Properties
Surface condition before blast cleaning
Dimension, shape and properties of blast cleaning products and checking of the blast cleaning process
Abrasive salt levels
Roughness of the blast cleaned surface
Visual condition of the blast cleaned surface
Temperature of pre-heating, before coating, if necessary
Temperature of post-heating, after coating, if necessary
Temperature and humidity
Wet thickness of the coating system
Dry thickness of the coating system
Appearance and continuity
Holiday detection
Hardness Shore “D”
Infrared scan, check against manufacturer’s data
Adhesion test - Pull off method (1)
Cut back (factory-coated items)

Note 1:

Field pull-off adhesion testing shall be carried out on an offline spool or adjacent to the cut-back on production pipe, every shift.

Publications

The following publications form part of this specification. Unless otherwise specified herein, the latest edition as at the date of this specification shall apply.

ASTM–American Society for Testing and Materials

ASTM D2240	Standard Test Method for Rubber Property (Durometer Hardness)
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM G14	Standard test method for impact resistance of pipeline coatings (Falling Weight Test)
ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air

BS EN–British Standard European Norm

BS EN 10290	Steel tubes and fittings for onshore and offshore pipelines – External liquid applied polyurethane and polyurethane-modified coatings

ISO–International Organization for Standardization

ISO 1514	Paints and varnishes -- Standard panels for testing
ISO 2808	Paints and varnishes – Determination of film thickness
ISO 4624	Paints and varnishes – Pull off test for adhesion
ISO 8501-1	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness - Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates After Overall Removal of Previous Coatings
ISO 8502	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness
ISO 8503	Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Roughness Characteristics of Blast-Cleaned Steel Substrates Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces. Part 2: Method of grading of surface profile of abrasive blast-cleaned steel-comparator procedure. Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile - Stylus instrument procedure. Part 5: Replica tape method for the determination of surface profile.
ISO 8504-2	Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Preparation Methods - Part 2: Abrasive Blast Cleaning

ISO 11124-1	Preparation of Steel Substrates Before Application of Paints and Related Products - Specifications for Metallic Blast Cleaning Abrasives- Part 1: General introduction and classification Part 2: Chilled iron grit Part 3: High-carbon cast-steel shot and grit Part 4: Low-carbon cast-steel shot

NACE - National Association of Corrosion Engineers

NACE RP0274	High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
NACE RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
NACE SP0394	Application, Performance, and Quality Control of. Plant-Applied, Fusion-Bonded Epoxy External Pipe

SSPC–Steel Structures Painting Council

SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC PA 2	Measurement of Dry Coating Thickness with Magnetic Gauges (Steel Structures Painting Manual, Ch 5 - Paint Application Specs.)
SSPC SP1	Solvent Cleaning

South African Bureau of Standards

SANS 1217	Internal and External Organic Coating Protection for Buried Steel Pipelines
SANS 241	Drinking water

JW CP Specification 2015

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GENERAL PREAMBLE

Scope

This Specification defines the minimum and mandatory requirements governing the design, application, installation and commissioning of both Sacrificial Anode Cathodic Protection (SACP) and Impressed Current Cathodic Protection (ICCP) and AC mitigation (ACM) systems for the following:

- Pipelines, fire water and utility piping, as well as pipes located inside chambers;
- Pipeline casings (cased crossings);
- The internal surface of water storage tanks
- Any buried or submerged steel structure

Unless otherwise agreed by the purchaser's Engineer in writing, the materials and specifications used shall strictly follow the clauses of this specification.

The requirements of this specification may not necessarily be repeated in the bill of quantities or typical drawings issued. Thus this specification must be strictly adhered to.

The “Client” shall refer to the asset owner’s Corrosion Engineer or his designated representative.

The “Engineer” shall refer to the CP design engineer or his designated representative.

The “Contractor” shall refer to the supply and/or installation contractor.

The “Corrosion Engineer” be appointed by the Water Authority and shall have discretion and authority in the following:

- Agreeing corrosion protection system and specification
- Approval of Protection System and procedures
- Specific Materials for both corrosion protection and materials of construction
- Quality Control systems
- Approval of qualifications

In the event of any detail that is not fully addressed in this specification and that is warranted to be carried out by The Contractor, the work shall be performed in accordance with the relevant applicable codes and best recognised engineering practices in the cathodic protection (CP/Corrosion) industry. The Consultant shall develop detailed specifications, procedures and method statements required to perform the CP design and/or corrosion engineering during The Engineering phase of work and this shall be submitted to the

Electrical Support Department of The Client for review and approval prior to construction, supply and/or installation work by an appointed Contractor.

AC interference mitigation may be achieved through the use of pipeline-earth grounding systems, in conjunction with solid state DC decoupling devices. It must not adversely affect or interfere with the CP system, or others.

The details and extent of the plant or structure equipment required to be cathodically protected, the site / locality and the meteorological data shall be both specified and supplied by The Client.

Legal Requirements

All works shall be conducted in compliance with the relevant sections of the OHS Act. The Consultant / Contractor is responsible for ensuring that all personnel are equipped with appropriate PPE.

All materials, plant and equipment shall be the best of their respective kinds and spare parts, replacements and servicing facilities shall be readily available from local sources.

The following sections represent general specifications that shall be adhered to. Specific sizes and descriptions are detailed in the Schedule of Rates and Quantities.

All work shall be carried out by qualified personnel and correctly supervised.

The Contractor shall be required to backfill and compact all excavations and ensure that all waste products and materials are removed from site and safely disposed of. All civil works are to be accepted/rejected by an approved competent civil professional.

Should any requirement of the project specification conflict with any requirements of the standardised or particular specifications listed in the list of specifications, the requirement of the project specification shall prevail.

Alternative Materials, Equipment & Work

If alternatives pertaining to materials, equipment and work method are submitted, the Supplier / Contractor shall supply with their quotation/proposal all detailed specifications, designs, calculations, drawings and a fully priced Schedule of Quantities as per the original quotation and/or any alterations and any further information that may be required by The Client for the proper evaluation of the offer.

The attention of the Supplier / Contractor is particularly drawn to the high standard of materials, workmanship, testing and performance applicable to the Contract as a whole.

The Client reserves the right to carry out a factory inspection at their discretion.

Should any requirement or provision of the Project Specification conflict with any requirement of any standardized (SANS 1200) specifications or any drawings, the order of precedence, unless otherwise specified, are:

- Project Specification
- Drawings
- SANS 1200
- Schedule of Quantities

Any discrepancies will be brought to the attention of the Corrosion Engineer or designated representative.

When all tests have been successfully completed to the satisfaction of The Client, an Operational Acceptance Period shall commence and shall consist of a continuous period of operation of 12 months free from trouble.

During the operational acceptance period The Contractor shall carry out all necessary servicing and any adjustments required at their expense.

Guarantee Period

The Contractor is required to supply a written guarantee on the items supplied by them for a period of 2 years from date of site acceptance testing under continuous working conditions after the successful completion of the abovementioned Operational Acceptance Period. The only exceptions shall be for damages arising from vandalism, mechanical damage, and external fire and/or flooding.

Any faults as may be certified by The Client due to poor materials, workmanship or The Contractor's design (where applicable), shall be remedied and faulty goods replaced entirely at the Installation Contractor's cost.

The Contractor is responsible for the guarantee of all items under the terms of the tender and for the safe delivery and installation of the equipment and materials, as called for in the Schedule of Rates and Quantities, unless otherwise instructed in writing by The Client.

Safety and Work Procedures

The Contractor shall ensure that a competent person is assigned to the works at all times in terms of OHS Act. The Contractor shall ensure that he complies with all statutory regulations, municipal by-laws, etc. concerning pollution and the health and safety of his personnel and members of the public who may be affected by his work. The Contractor shall provide for all necessary safety precautions and risk assessments and the loss control or safety officer shall prepare a safety plan for the area to be worked in. The Contractor shall advise The Engineer of all hazardous materials to be brought on site.

All electrical commissioning works and tie in to Eskom or the relevant power supplier shall be carried out by a qualified Electrician registered with the Electrical Contracting Board of South Africa.

All excavation and construction work shall be carried out strictly in accordance with the relevant Health and Safety regulations of local authorities or relevant departments within the Relevant Metropolitan Area.

Oily or solvent rags shall be kept segregated in closed containers and in minimum quantity. Any spillage of volatile material shall be wiped up immediately. Solvents and volatile materials shall be stored in designated areas.

The Contractor shall provide and erect such scaffolds and rigging as may be required. All scaffolds and rigging shall comply with the requirements of the OHSA. Temporary welded support elements are not permitted except where written approval has been granted by The Engineer.

The Contractor shall ensure that the relevant electrical, civil, roads, rail or other departments are timeously informed of proposed project works. The necessary wayleave approval for each aspect of the work shall be kept on file for inspection during the project. On completion of the works, The Contractor shall include the wayleave forms with the documentation to be handed over to The Client. Furthermore, The Contractor shall ensure that the relevant departments are approached to determine:

- Specific requirements according to the SAECC
- Specific department safety regulations.
- Specific construction restrictions and timing.
- Notification of work requirements.
- Procedures for work approval.
- Location of services that may be affected during construction.
- Public notification requirements to inform residents or business owners of potential disruptions.

The Contractor shall inform The Client of the requirements and ensure that the relevant minutes of meetings with departments are kept of record for the duration of the works. The relevant project information and minutes of meetings with third parties shall be copied to The Client at the end of the project. The Contractor shall prepare typical Hazard Identification and Risk Assessment forms for each of the major aspects of a construction project namely:

- Excavation, backfilling and compaction.
- Lifting and moving of heavy equipment on site.
- Operation of machinery on site.
- Road traffic management.
- Working in trenches deeper than 1.5m.
- Managing pedestrian traffic nears construction works.
- Electrical testing, connections and commissioning.
- Locking out and securing of sensitive areas during normal work hours and after hours.
- Entry into pipes of 800mm diameter or less.

Handling and Storage

The following precautions shall be taken for the site storage and handling of supplied items:

- All coated components shall be handled using soft slings and/or acceptable methods that will not cause damage.
- All components to be transported shall be loaded with support blocks, packaging and packing between pieces and tight lashing to avoid chafing.
- Off-loading at site shall be conducted using the same care and precautions for on-loading. Components shall not be tipped off the transportation.
- Coated corrosion protection items shall be stored under cover where possible.
- Items not stored under cover shall be stored in such a manner as to avoid retention of water and allow good air circulation.
- Items shall be stored on baulks of timber to raise the lowest level above the rain splash zone.
- Items shall be stacked using timber packing or other approved means to avoid item-to-item contact. Sufficient bearing area of packing shall be used to avoid damage to items.

CP Design Requirements

The CP system requirements i.e. design life, type, materials, supply and installation method shall be as specified by The Engineer. The buried / immersed steel components should be designed to be accessible for the purposes of supplying, installing, applying, inspecting and maintaining the CP system.

The guidelines to ensure accessibility and suitability for maintenance and upkeep of the complete CP system shall be drawn from SANS 15589 “Cathodic Protection of Pipeline Transportation systems; Part 1 On-Land pipelines”.

Qualified Staff

The Contractor/Consultant shall ensure that there are at all times sufficient suitably qualified, experienced and skilled staff to carry out and supervise all activities.

CP Design Engineer

The CP Design Engineer must:

- Hold an engineering degree or a technical diploma.
- Have a minimum of 20 years corrosion related work experience or a NACE Specialist with a minimum 6 years corrosion related work experience or a NACE Specialist with a Professional Engineer’s License and 4 years corrosion related work experience.

- Have a minimum of 5 years post qualification Cathodic Protection (CP) experience.

CP Engineer

The CP Engineer must:

- Hold an engineering degree or technical diploma.
- Have a minimum of 15 years corrosion related experience or hold a NACE CP Level 3 Certification with a minimum 6 years corrosion related experience.
- Have a minimum of 5 years post qualification Cathodic Protection (CP) experience.

AC Mitigation Engineer

The AC Engineer must:

- Hold an engineering degree or technical diploma.
- Have a minimum of 10 years corrosion related experience or hold a NACE CP Level 3 Certification with a minimum of 3 years corrosion related experience.
- Have a minimum of 5 years post qualification Cathodic Protection experience.
- Have a minimum of 5 years AC Mitigation experience and have suitably been trained on AC mitigation modelling software (Certificates to be provided).

Senior CP Technician

The Technician must:

- Hold a minimum of a 3 year diploma.
- Have a minimum of 8 years Cathodic Protection experience or hold a NACE CP Level 2 Certification with 8 years corrosion related experience.
- Have the ability to sign off and verify all maintenance records that the system is safe for operation.

CP Field Technician

The CP Field Technician must:

- Hold a minimum of a 3 year diploma.
- Have a minimum of 3 years Cathodic Protection experience or hold a NACE CP Level 2 Certification with 3 years corrosion related experience.

Pipe Coatings Inspector

The Inspector must:

- Hold a N3 Technical with English or Grade 12 certificate.

- Hold a NACE Certification with two year post qualification experience or a SAQCC (Corrosion) Inspector certification with a two year post qualification experience or have a minimum of 7 years' experience in Inspecting Coating Systems.
- The inspector's CV should reflect all experience relevant to the job.
- Have the ability to sign off and verify all maintenance records that the system is safe for operation.

Semi-skilled CP Hands (Labourer)

The Labourer must:

- Have relevant experience in the discipline of Cathodic Protection of Pipelines.
- Be a permanent employee of the company.
- Be properly trained for the work that needs to be executed.

Quality Assurance

Contractor Qualification

All material, certification and records of the Contractor will be subject to examination by the Engineer. This shall include the checking and testing of the equipment. If any deviation to the approved QCP or product quality is found, the Contractor may be instructed to perform additional testing and quality surveillance, at no additional cost to the Client. The Engineer may, at his discretion, require a Quality Audit of The Contractor's facility to ensure that he has the management, facilities and skilled staff to carry out the work in accordance with the specification.

The Contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by The Engineer.

Quality Control

The Contractor shall have the necessary equipment and qualified staff to carry out the quality control required to ensure compliance with the specification.

Quality control shall be carried out by a qualified inspector who is independent of the application activities. Quality control cannot be carried out by the site supervisor or any member of staff involved in production and programming.

The Contractor shall keep at least the following records

- Material batch records
- Site Data Sheets
- Records
- Records of specific tests as required by The Engineer

These records shall be kept in a format that meets the approval of The Engineer.

The cost of quality control shall be included in The Contractor's tender price.

Before the commencement of the contract, The Contractor shall prepare a Quality Plan detailing each activity to be carried out during the execution of the works. Each activity shall be supported by a detailed Works Procedure for that activity. The Quality Plan will also detail the inspection requirements of each specific activity, listing whether it be a review, witness or hold point, and define the responsibilities of the various parties at each stage of the works.

The Contractor shall provide the necessary documentation to be used during these inspections. Such documentation shall be reviewed and approved by The Engineer beforehand.

Quality Surveillance

A third party specialist corrosion consultant may be appointed by The Client to perform independent quality assurance inspections.

For the purpose of carrying out quality surveillance, the Specialist shall be granted access to any part of The Contractor's premises relevant to the work being carried out, at any reasonable time. The Contractor shall provide, at his own cost, any equipment or labour necessary to gain access to the works that are in progress.

The Specialist may remove any reasonable samples of materials to be used in the application. Rejection of the samples will place a hold on the use of material of the same batch number and may lead to rejection of all that batch of material and the reworking of any components that have already been worked on with rejected material.

The Specialist may carry out reasonable destructive tests to ascertain compliance with the specification. Areas thus damaged shall be repaired by The Contractor to the satisfaction of The Engineer at no additional cost.

A report shall be compiled by the Specialist for each visit. A copy of the report will be given to The Contractor on completion of each surveillance visit.

RELEVANT SPECIFICATIONS

Below is a list of typical relevant specifications that may be used in the execution of a project. Where applicable, items specified in this document shall comply with the latest revision of the stated specifications and other specifications quoted or referred to within these documents:

NOTE: Where there is a contradiction, the project specification takes preference. The exact specifications to be used will be specified by The Corrosion Engineer at the Pre-Job Conference ("kick-off" meeting).

American Society for the Testing Of Materials (ASTM)

ASTM B265	Standard specification for titanium and titanium alloy strip, sheet and plate
ASTM B338	Titanium Alloy for Heat Exchangers
ASTM A518	Specification for corrosion resistant high silicon iron castings
ASTM G57	Method for field measurement of soil resistivity using the Wenner Four Electrode method
ASTM G95-87	Standard Test Method for Cathodic Disbondment Test of the Pipeline Coatings
ASTM 3418	Method of measuring transition temperatures by Differential Scanning Calorimetry (DSC)
ASTM D293	Standard Test Method for the Sieve Analysis of Coke
ASTM B418	Standard Specification for Cast and Wrought Galvanic Zinc Anodes

British Standards Institution (BS) Specifications

BS 171	Specification for power transformers

BS 1016	Method for analysing and testing of coal and coke
BS 1872	Specification of electroplated coatings on tin
BS 6001	Sampling Procedures for Inspection by Attributes

International Electrotechnical Commission (IEC) Publications

IEC 60038	Standard voltages
IEC 60028	Copper wire.
IEC 60051	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories.
IEC 60071	Co-ordination of insulation.
IEC 60076	Parts 1-5 Power Transformers.
IEC 60144	Degree of protection of enclosures for low voltage switchgear and control gear
IEC 60146	Semiconductor Converters.
IEC 60189	PVC Insulation and PVC Sheath.
IEC 60269	Low voltage fuses – Fuses mainly for Industrial applications.
IEC 60445	Identification of equipment terminals and of Terminations of certain designated Conductors, including general rules for Alphanumeric system.
IEC 60616	Terminal and tapping markings for power transformers.

National Association of Corrosion Engineers (NACE)

NACE SP0169	Control of External Corrosion on Underground or Submerged, Metallic Piping Systems
NACE SP0177	Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
NACE SP 0207	Performing close-interval DC pipe-to-electrolyte potential surveys on buried or submerged metallic pipelines
NACE SP0286	Electrical Isolation of Cathodically Protected Pipelines
NACE SP0502	Pipeline External Corrosion Direct Assessment Methodology
NACE SP0572	Design, Installation, Operation and Maintenance of Impressed Current Deep Groundbeds
NACE RP 0104	The Use of Coupons for Cathodic Protection Monitoring Applications
NACE TM 0102	Measurement of protective coating electrical conductance for underground pipeline
NACE TM 0109	Techniques for aboveground evaluation of the coating condition of underground metallic pipelines
NACE TM 0497	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
NACE Pub	Measurement Techniques Related to Criteria for 10A190 Cathodic Protection of Underground or Submerged Steel Piping Systems
NACE Pub	Impressed Current Anodes for Underground 10A196 Cathodic Protection Systems

South African National Standards (SANS)

SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
SANS 1091	National colour standards for paint
SANS 10129	Plastic tape wrapping of steel pipelines.
SANS 10140	Parts 1 to 3: Identification - Colour Marking.
SANS 10064	Preparation of steel surfaces for coating.
SANS 121	Hot dip galvanised coatings on fabricated iron and steel articles.
SANS 1700 SET/ ISO 1461	Fasteners
SANS 122-1975	Pressure-sensitive adhesive tapes for electrical purposes (Metric Units)
SANS 10199	The design and installation of an earth electrode specifications
SANS 10313	Protection against lightning – Physical damage to structures and life hazard
SANS 1063	Earth rods, couplers and connection
SANS 1411-1	Materials of insulated electric cables and flexible cords Part 1: Conductors
SANS 1411-2	Materials of insulated electric cables and flexible cords Part 2: Poly-Vinyl- Chloride (PVC)
SANS 1411-3	Materials of insulated electric cables and flexible cords Part 3: Elastomers
SANS 1411-4	Materials of insulated electric cables and flexible cords Part 4: Cross-linked Polyethylene (XLPE)

SANS 1411-5	Materials of insulated electric cables and flexible cords Part 5: Halogen free, flame-retardant materials
SANS 1411-6	Materials of insulated electric cables and flexible cords Part 6: Armour
SANS 1507-1	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 1: General
SANS 1507-2	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 2: Wiring cables
SANS 1507-3	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 3: PVC distribution cables
SANS 1507-4	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 4: XLPE distribution cables
SANS 1507-6	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 6: Service cables
SANS 15589 Part 1	Petroleum and natural gas Industries – Cathodic Protection of pipeline transportation systems. Part 1: On-land pipelines.
SANS 50162	Protection against corrosion by stray current from direct current systems.
SANS 53509	Cathodic Protection measurement techniques
SABS 10142	Wiring of Premises - LV Installations
SANS/IEC 79&10108	The classification of hazardous locations and the selection of apparatus for use in such locations
SANS 1222`	Enclosures for electrical equipment classified by IP code
SANS 121/ISO1461	Hot dip galvanized coatings on fabricated iron and steel articles: specifications and test methods.
SANS 1091 H40	national colour standard

SANS 15589	Petroleum And Natural Gas Industries - Cathodic Protection of Pipeline Transportation System.
SANS 089	The installation of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations
SANS 086	Code of practice for the installation and maintenance of electrical equipment used in explosive atmospheres

The relevant SANS Standardised Specifications for Civil Construction shall apply.

It shall be the responsibility of The Contractor to obtain at his own expense, copies of the relevant editions of the documents referred to above. Subsequent amendments or revisions to these documents that have direct bearing on the project specification shall be clarified in writing with The Engineer before construction commences.

In addition to this all elements of the Contract Documents shall be available for inspection on Site at all times.

SANS 1200	A General
SANS 1200	AB Clients Office
SANS 1200	C Site Clearance
SANS 1200	D Earthworks
SANS 1200	DB Earthworks small works
SANS 1200	GA Concrete – small works
SANS 1200	H Corrosion Protection of structural steelwork
SANS 1200	M Roads – General
SANS 1200	MF Base
SANS 1200	MH Asphalt base and surfacing
SANS 1200	MK Kerbing & Channelling

GLOSSARY of TERMS / DEFINITIONS

AC:	Alternating Current
ACM:	Alternating Current Mitigation
Anode:	The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.
Anode Backfill:	Carbonaceous material placed in a hole to fill the space around the anodes, vent pipe and buried components of an anode groundbed.
Anode Groundbed:	One or more anodes installed below the Earth's surface for the purpose of providing a long-lasting, corrosion-resistant, positive connection to earth in a cathodic protection system, that enables the required current to pass into and through the electrolyte to the steel surface to be protected. A sacrificial anode groundbed sacrifices itself in favour of the steel structure being protected.
Anode Groundbed Survey:	This survey involves the measurement of soil resistance values at regular spacing intervals of 2m up to a spacing of 50m or more. Results are analysed to determine the suitability of a location to install a low resistance anode groundbed.
Bill of Quantities (BOQ):	The pricing instructions that are in the tender document that contains the quantities to be supplied or installed.
Bonding:	A method of connecting metal surfaces to each other by cable using exothermic or pin brazing techniques; often used to establish electrical continuity along pipelines coupled with mechanical joints.

Bonding Cabinet:	A cabinet used to house cable that establishes a connection between metal structures.
Bonding Stations:	A station used to facilitate connection of metal structures to each other.
Cathode:	An electrode of an electrochemical cell at which reduction (gain of electrons) is the principal reaction. Electrons flow toward the cathode in the external circuit.
Cathodic Protection:	The process to reduce or prevent corrosion of metal structures in contact with an electrolyte by the flow of direct current from the electrolyte into the structure surface.
Cathodic Protection Station:	A combination of equipment installed to provide cathodic protection to the pipeline.
Chamber Bonding:	Continuity bonding of all pipe work within a chamber.
Client:	The "Client" shall refer to the asset owner's Corrosion Engineer or his designated representative.
Continuity Bonding:	A suitable electrical connection, usually metal, that provides electrical continuity between structures that can conduct electricity.
Copper Sulphate Reference Electrode:	See reference electrode
C&I:	Control and Instrumentation
Contractor:	The supply and/or installation contractor.
Corrosion Engineer:	The individual appointed by the Water Authority
Current Drainage Survey:	Survey aimed at determining the amount of DC current required to render a particular structure cathodic to accepted criteria.

Data Logger:	A digital instrument used to measure the potential of a structure over a period of time. This data is then downloaded on to a computer, processed and graphed.
DC:	Direct Current
Digital Multi Meter:	Digital instrument used to measure current, voltage and resistance. For example: a "Fluke™" meter.
Drain Point:	The point on the pipeline where the connection of the negative terminal of the cathodic protection voltage source is made to conduct (drain) the returning current from the pipeline to the foreign voltage source.
Electrolyte:	A conductive liquid or material such as soil or water in which an electric current can flow.
Earth Spike:	16 mm diameter, threaded type, 1.5 m long electroplated SANS 1063.
Earth Cable:	70 mm^2 bare stranded copper
Engineer:	The CP design engineer or his designated representative.
Exothermic Welding:	An exothermic welding process that makes use of copper oxide and aluminium powder to weld copper cables to a pipe or other steel structure.
Flange:	A mechanical joint comprising two flush steel faces, usually at pipe ends, used to join pipe lengths.
Forced Drainage Unit (FDU):	A unit comprising of a TRU and a bypass diode connected between pipe and rail.
Foreign Structures/Pipelines:	Metal structures or pipelines other than that under consideration in contact with the same electrolyte as the structure/pipeline and which are or may become under the influence of the structure/pipeline's

	cathodic protection system. Foreign structures /pipelines may be owned by The Client and/or other companies and may or may not be equipped with cathodic protection.
Impressed Current:	A DC electric current supplied by a device employing a power source that is external to the electrode system. Current that flows as a result of an impressed voltage between anode and cathode components of a cathodic protection system.
Isolation Flange:	An isolation flange typically comprises a gasket of phenol resin with insulating sleeves over high tensile bolts fitted with insulating washers .The purpose of the isolating flange is to stop current flow between a pipe and structural steel or earthing systems.
"IR Free" potential:	The pipe-to-soil potential measured immediately after the cathodic protection system is switched off and the applied electrical current stops flowing to the pipeline surface, but before polarisation of the pipeline has decreased.
Marker Stations:	Typical stations of concrete construction to mark out cable and pipe routes.
Megger:	A meter used to measure resistance values.
Midpoint:	The point on a pipeline between two cathodic protection stations where the influence of the two cathodic protection stations is expected to be equal and the protection levels are usually expected to be at their lowest depending on the design overlap that has been included.
Monitoring Cabinet:	A metal cabinet designed to house recording equipment for monitoring purposes.

Natural Drainage Unit (NDU):	An electrical device comprising a diode and surge protection units linked between pipe and rail to allow the flow of current back to the rail under certain conditions.
Natural Potential:	The pipe-to-soil potential measured shortly after installation of the pipe when the soil has been backfilled and compacted. No cathodic protection is applied, polarisation caused by cathodic protection is absent and no significant stray current is present.
OEM:	Original Equipment Manufacturer
"OFF" Potential:	The pipe-to-soil potential measured immediately after the cathodic protection system is switched off and the applied cathodic protection electrical current stops flowing to the pipeline surface, but may still include stray current or foreign service interference in the measured value.
"ON" potential:	The pipe-to-soil potential measured while the cathodic protection system is continuously operating.
O&M:	Operations and Maintenance Manual (also OMM)
Pipe-to-Soil Potential:	The difference in electrochemical potential between a pipeline or foreign structure/pipeline and a specified reference electrode in contact with the electrolyte. Similar terms such as structure-to-soil potential, pipe to electrolyte potential are sometimes used as applicable in the particular context.
Polarisation:	The change of the pipe-to-soil potential caused by the flow of DC current between an electrolyte and a steel surface.
PRE:	See SRE
Reference Electrode:	An electrode with an open circuit potential that is constant under similar conditions of measurement,

	which is used for measuring the relative potential of other electrodes or metals under varying electrolyte environments.
Sacrificial Anode System:	Anodes manufactured from materials that are sacrificed preferentially when placed in a galvanic couple with another metal i.e. Magnesium coupled to steel in soil.
SCADA:	Supervisory Control and Data Aquisition
Sealer:	Mastic putty, rubber tape and PVC insulation tape.
Soil Resistivity:	An indication of the soil resistance at a certain depth measured using a Megger and the Wenner four-pin technique.
SRE:	Stationary Reference electrode
Stray Current:	Current that flows through paths other than an intended circuit i.e. current flow though the soil that originated from a DC traction railway line. The current may cause interaction with the cathodic protection system and often acts upon foreign structures and/or pipelines.
Test Station:	A point, often of concrete or steel construction, where regular measurements of structure-to-soil potentials may be taken. Test cables are connected directly to the structure being monitored. This term can be used interchangeable with Test Post, Test Point, Test Chamber, Test Cubicle etc. There are several types of Test Station namely: ▪ Type A – monitoring station ▪ Type B – SRE monitoring station ▪ Type C – Cross bonding test station ▪ Type D – Temporary protection station ▪ Type E – 4 wire current span test station ▪ Type F – Test station with ACM

Transformer Rectifier Unit (TRU):	An electrical device designed with the purpose of stepping down either single or three phase power to a suitable voltage and then rectifying the power supply to provide a suitable DC output.
Viking-Johnson Type Coupling:	A coupling that uses a rubber seal on both sides of the coupling barrel, allowing flexibility of the joint, but also electrically insulating one length of pipe from another.

CABLING for CATHODIC PROTECTION

General Properties of Insulating Compounds

Cable insulation properties are based on environmental, physical and performance requirements. All three requirements are key factors to consider for CP design purposes, however the cables insulation performance with respect to the environmental conditions is more critical.

Cable insulation properties should be based on the environmental requirement and the best insulating material for this requirement should be selected. These insulation materials can generally be split into thermoplastic and thermoset materials.

Thermoplastic materials soften and flow when heated and usually possess a definitive melting point. The material will become firm again upon cooling. These materials can be moulded and shaped with a heating and cooling process and the process can be repeated.

Thermoset materials are soft and pliable during one stage of the processing, can be moulded and extruded at this state after which they are set or cured, usually at a higher temperature. After the setting or curing process (cross linking) is complete, they cannot be softened by reheating.

Some of the insulation compounds available include, but are also not limited to:

- Polyvinyl Chloride (PVC)
- Polyolefins
- Polyethylene (low (LMPE), medium (MMPE) and high density (HMWPE)) (PE)
- Polypropylene
- Cellular Polyolefins
- Non-Halogen compounds
- Fluorocarbons (PTFE, PVDF (Kynar™), ECTFE (Halar™), ETFE (Tefzel™))

The primary insulation material (i.e. outer cable insulation) is the most important of the cable material for overall performance reasons. The key requirements that should also be considered include, but are not limited to:

- Voltage dielectric properties for higher voltage charge at the conductor surface.
- Low loss material for high frequency signal cables,
- Heat resistance in high temperature environments,
- Low temperature flexibility,

- Toughness for cut-through, abrasion and burial (crush) resistance.
- Fire resistance
- Ultra violet (UV) resistance (weatherability)
- Chemical resistance (i.e. acids and alkalis, pH resistance)

Cable & Cable Insulation Compliance

Cathodic Protection cables shall be insulated and rated for voltages up to 600V/1000V and shall have stranded copper conductors in accordance with SABS 1507 or ASTM Specification B-8. The cable conductor and cable voltage drop shall be calculated in accordance with SANS 10142.

All cable suppliers are to ensure that they are familiar and possess the latest SABS specifications herein referred to (refer to section 1.3).

Alternative cabling solutions are to adhere to the requirements as stipulated Preamble "Alternative CP Materials".

Cathodic Protection Cable Requirements

The following table shall be used when selecting DC cables for Cathodic Protection. The insulation layers are specified as inner/outer layer. All cables are to be embossed or otherwise identified on the outer insulation. The specific labelling requirements are outlined in Section 4.4. The material certification will be available upon inspection and/or delivery**.**

Cathodic Protection Single Core Cable Insulation Requirements

Cable Detail	Installation Environment	Insulation Layers* & Type	Insulation Colour
Positive DC	Direct Sun	HMWPE/PVC	Red
	Partial Sunlight	PVC/PVC	Red
	Soil (Non Polluted)	PVC/PVC	Red
	Soil (Polluted)	PVDF/ HMWPE/PVC	Red
Negative DC	Direct Sun	HMWPE/ PVC	Black
	Partial Sunlight	PVC/PVC	Black
	Soil (Non Polluted)	PVC/PVC	Black
	Soil (Polluted)	PVD/ HMWPE/PVC	Black
Continuity / Cross Bonding DC	Direct Sun	HMWPE/PVC	Black
	Partial Sunlight	PVC/PVC	Black

Cable Detail	Installation Environment	Insulation Layers* & Type	Insulation Colour
	Soil (Non Polluted)	PVC/PVC	Black
	Soil (Polluted)	PVDF/HMWPE/PVC	Black
Earthing	Direct Sun	PVC	Green-Yellow
	Partial Sunlight	PVC	Green-Yellow
	Soil (Non Polluted)	PVC	Green-Yellow
	Soil (Polluted)	PVC	Green-Yellow
Sacrificial Anodes	Soil (Non Polluted)	PVC/PVC	Red / Blue
	Soil (Polluted)	PVDF/HMWPE/PVC	Red / Blue
Pipe Monitor	Soil (Non Polluted)	PVC/PVC	Black
	Soil (Polluted)	PVDF/HMWPE/PVC	Black
Reference Electrode	Soil (Non Polluted)	PVC/PVC	Red
	Soil (Polluted)	PVDF/HMWPE/PVC	Red
Corrosion Coupons	Soil (Non Polluted)	PVC/PVC	Black
	Soil (Polluted)	PVDF/HMWPE/PVC	Black
AC Mitigation Grounding	Soil (Non Polluted)	PVC	Green-Yellow
	Soil (Polluted)	PVC	Green-Yellow

*Insulation layers are defined inside layer to outer layer.

In exceptionally corrosive environments, fluorocarbon insulation shall be provided, as detailed by The Client.

The cable and associated cable warning tape burial depth will be specified in the Bill of Quantities. No chevron or bunting tape will be allowed. Warning tape is to stipulate live electrical cables and/or CP cables. Furthermore, negative cables to pipe and positive cables to the anode groundbed may require additional protection against vandalism i.e. concrete encasement.

In certain instances, multi-core power cabling might be required, such as: 4 Core PVCI/PVCS/SWA/PVCS, as per the Bill of Quantities.

Cable Identification

Cables are to be labelled by means of permanently marked plastic ferrules with black lettering on a white background. Ferrules shall be the slip-on type and matched to the size of the cable.The ferrules are to be fastened to the cable with cable ties. Ferrules shall be situated so as to read the right way up on horizontal cables and from lug to insulation on

vertical cables. All labels of this type shall be supplied in “made-up” condition ready for fixing.

Cable Weld Attachments

General

The cable weld attachment method to be used shall ensure that metallurgical contact is achieved between the cable and the pipe substrate surface.

The Contractor shall submit detailed QCP’s of the preferred system for approval listing the equipment and staff. In addition a detailed QCP for the coating repair and re-instatement thereof is to be submitted for approval.

Unless otherwise specified, all cable connections to the pipe are to be by means of thermit (exothermic) welding. This applies equally to the cable for the following CP installations:

- Main negative cable,
- Continuity cables,
- Cross Bonding Cables,
- Test station Monitoring cables,
- DC Decoupling device cables, etc.

Where cables are attached to the overt of the pipe, these attachments should be made at field joints to minimise the number of repairs required. The minimum amount of pipe coating shall be removed in preparation for the weld.

Where ever possible, cable connections should be made onto a flange inside a secure chamber.

Thermit welding may not be used on the barrel of epoxy lined pipes unless weld pads have been provided. Solder pads many be use subject to satisfactory prequalification trial. Charge size, cleanliness and fluxing are critical aspects of solder pad use.

All welding on epoxy lined pipes must be preceded by a trial on spare pipe or reference pipe piece and the epoxy subjected to visual and holiday detection testing after welding.

Exothermic welding is not permitted on a pipeline where the wall thickness is less than 3.0mm or severe corrosion i.e. metal loss has occurred and the pipe wall thickness is unknown.

In these instances, cables shall be connected by means of pin brazing / Stud welding / Capacitive Discharge Welding. The proposed method of attachment shall be detailed with adequate substantiation to address the relevant concerns set out previously, thereby allowing The Engineer to make an informed decision.

Surface Preparation

The area where the welding is to take place shall be thoroughly cleaned to provide an area slightly larger than that of a typical graphite mould (approximately 75 x 75mm). The welding surface area must be brushed with a steel wire brush and all traces of petroleum mastic, concrete, bitumen coating, primer material or any other matter shall be removed.

Prior to making the weld the area shall be roughened using a coarse file or an angle grinder fitted with a flapper disc.

Always ensure that the steel surface is dry prior to welding.

Exothermic Welding (Thermit Welding)

A detailed QCP procedure is to be submitted by the contractor for approval. A guideline procedure for thermit welding is as follows:

- Bare the end of the insulated cable for a distance of 25mm.
- Select the correct size and type of mould for the weld application.
- Place the supplied retaining cap in the bottom of the mould and pour the correctly sized weld metal powder into the mould.
- Pour the starting/igniter powder over the weld metal, close the lid and sprinkle some on the lip of the mould.
- Place the cable on the pipe and the mould squarely over the cable, pressing down firmly. Ensure that the mouth of the mould is turned away from the welding operator.
- Ignite the starting powder with a flint gun and allow the weld to solidify, the mould is to be kept still during the entire procedure.
- Remove the mould and clean out the residue in preparation for the next weld.

The cables and charges as well as types of joins will be suitably matched as follows (the list below is not considered exhaustive and the manufacturer's guidelines should be adhered to):

Cable (mm^2)	No. of Welds	Entry	Charge Size (g)
10	One	Single	15
16	One	Single	15
35	Two	Single	15
70	Four	Single	15

For multicore cables, each core will require its own thermit weld as per the table above.

A ferrule is required on any 10mm^2 cable.

Stud Welding/Pin Brazing

A detailed QCP procedure is to be submitted by the contractor for approval. Equipment and rating thereof to be identified, ensuring that the welding unit is suitable for the studs and pipe to be welded. After successful trials and reference samples have been signed, all works will be performed in strict accordance with this QCP and adhered to for all further work.

A guideline procedure to be followed when stud welding is as follows:

- Bare the end of the double insulated cable and crimp into the appropriate sized lug using an approved OEM crimping tool. Insert the stud in the welding mechanism (gun) i.e. Mandrel and place against the cleaned steel surface. Ensure all pins have pipe contact.
- Select the appropriate power setting and press the trigger of the stud welding gun, pressing down firmly. Ensure that the correct setting, stud welding consumables, studs, and lugs have been selected prior to welding.
- Remove the stud welding from the cable connection and clean any residue from the brazed connection.

Stud welded connections shall be tested as above, but the stud will be protected using a nut in order to prevent damage to the thread. Should any movement occur the cable shall be re-welded and re-tested.

Testing

After the above procedure(s) have been carried out, a number of welds shall be tested by an approved inspector as appointed by The Client. The test will be performed by striking the weld with a 2kg hammer. Should any movement occur the cable shall be re-welded and re-tested.

Safety Precautions

In addition to all OSH Act requirements and relevant safety procedures, the following precautions should be exercised when welding (stud or exothermic):

a. Ensure that the weld-metal and starting powders, mould and surface to be welded is perfectly dry.
b. Do not attempt to weld in areas where the water level is close to the area to be welded on.
c. Ensure that the correct mould and consumables are used. Do not use moulds past their design life or force a cable into an incorrect mould.
d. Use correct PPE and safety shoes which may be readily removed or shoe spats are to be used.
e. Wear appropriate eye protection, welding gloves and protective clothing. Always ensure that the mouth of the mould face away from the body of the operator. Centre the mould over the pipe, holding it steady during welding. Use special exothermic putty on small bore pipes, in order to prevent the hot liquid weld-metal from escaping between the base and the pipe damaging the coating system and/or possibly cause harm to the operator.
f. Use only a pistol type flint igniter, matches and/or cigarette lighters are not permitted.
g. Follow all permit conditions required by the pipeline owner prior to and during the exothermic and/or stud welding operation.

Coating Make-Good

All coating repairs associated with CP connections shall be made in accordance with the repair procedures relevant to the coating system applied to the pipe. The Contractor is to submit detailed QCP for the coating repair and re-instatement thereof is to be submitted for approval.

After connecting the cable the entire exposed area shall be encapsulated. Remaining coating to at least 50mm beyond the final repair limits shall be removed and the outer edges suitably feathered.

All cable to pipe connection and coating repairs shall be witnessed by The Engineer or The Client's nominated representative.

Any buried attachments to the exterior of the pipe will require repair using circumferential wrapping. Patch repairs may not be used in buried applications.

Cable connections to epoxy coated specials in valve chambers will require a different coating make good application. A surface tolerant high-build epoxy shall be applied adequately covering the weld and cable area and overlap onto the existing pipe coating by at least 25mm. Epoxy is to be given time to fully cure.

CONTINUITY and CROSS BONDING

Continuity and cross bonding shall include excavation, cable connections, make-good of the coating system, QA/QC test and back filling.

Make good of the coating system where necessary is to be carried out in accordance with the relevant specifications.

Cross bonding

Cross bonding facilities are to accommodate cable facilities that will enable the following:

- Bonding if a common cathode approach is required
- Current bond is required
- Interference bond is required
- Facilitate breaking of the bond to allow for fault finding and pipe utility tracing

Each cross bond cable shall be clearly identified and labelled, indicating to which pipe it is connected.

Cables shall be identified in accordance with Section 4.4 above.

Cross bonding facilities will be required where buried pipeline systems run parallel to each other or to other foreign services.

Where sections of buried piping of varying diameter run parallel for some distance, frequent cross bonding facilities are required.

Bonding is required from one pipeline to another, i.e. upstream feed and downstream supply of a pump station, or a current carrying bond is required from one system to another that cross or run parallel to each other.

All cross bonding will be done through approved cross bonding facilities i.e. concrete bunkers adjacent to valve chambers using bonding links mounted in the bunker.

One 4-core 16mm² SWA cable shall be installed between foreign pipeline and the bunker.

Continuity Bonding of Buried Joints

Examples of buried pipe joints are as follows:

- Flanged joint
- Bolted flanges
- Viking Johnson type Type Couplings
- Victauilc pipe joints
- Spiggot and socket
- Piping within valve chambers
- Flexible couplings

Buried pipe joints shall be continuity bonded by means of two double insulated single core copper cable connected to either side of the joint on the pipe using either of the approved CP connection methods as described in Section 4.5. Cable insulation and compliance is to be in accordance with the requirements as stipulated in Section 4.2.

Guidelines on the cable size to pipe diameter for continuity bonding is given as follows:

Buried pipes Ø < 700mm → 2 x 16mm²

Buried pipes Ø ≥ 700mm → 2 x 35mm²

In the case of Viking Johnson type couplings, at least one cable shall be bonded to the body of the coupling.

Continuity Bonding of Buried/Below Grade Bolted Flanges (Alternative System)

Continuity bonding will be required on all buried/below grade bolted flanges, preferably at the pipe overt.

Continuity bonding by means 25mm x 6mm steel flat bar is to be welded across the flanges (flange centre to flange centre).

Flat bar to have a minimum thickness of 6mm.

Guidelines on the number of flat bars size to pipe diameter for continuity bonding is given as follows:

Buried pipes with Ø < 700mm → 2 x flat bar

Buried pipes with Ø ≥ 700mm → 3 x flat bar

The weld shall be a full depth fillet weld across the end of the flat bar.

Weld approval will be in accordance with the weld test as given in Section 4.5.
Coating make good of the flat bar is to be in accordance with one of the options referred to section 4.6.

Continuity Bonding Inside Valve Chambers

Valve chambers shall be continuity bonded by means of insulated copper cable connected to either side of the valve chamber. Cable shall be run through a 20mm diameter PVC conduit mounted with saddles 200mm above the top of pipeline along inside wall of the chamber.

Where there are aboveground sections of piping on a buried pipeline network that section of aboveground piping is also to be electrically continuous. Continuity bonding will be required on all above ground dismantling flanges or couplings (i.e. Viking Johnson type Couplings).

Continuity bonding is by way of double insulated single core copper cable. The cable size to pipe diameter relationship for continuity bonding is given as follows:

Pipes with Ø < 700mm → 1 x 16mm²

Pipes with Ø ≥ 700mm → 1 x 35mm²

Continuity Bonding Outside Valve Chambers

Continuity bonding will be required around all valve chambers where bolted flanges, dismantling flanges or couplings are found. Bonding cables will be attached to the pipe(s), each side of the valve chamber wall. Weld should be placed approximately 300mm from the valve chamber wall to accommodate ease of coating make-good. The cables are to be laid around the outside of the valve chamber walls at a depth of 1000mm below final grade level.

Continuity bonding by means of 2 off black single core, double insulated copper cables which are to be welded on the pipe overt on either side of the valve chamber.

The bonding cable is to be independent from any monitoring cables.

The cable size to pipe diameter relationship for continuity bonding is given as follows:

Pipes with Ø < 700mm -> = 1 x 16mm²

Pipes with Ø > 700mm -> = 1 x 35mm²

The bonding cables are to be independent from any monitoring cables.

ELECTRICAL ISOLATION OF CATHODICALLY PROTECTED PIPELINES

Cathodic Protection (CP) is most effectively, efficiently and uniformly applied when the primary structure requiring CP is electrically isolated from those structures not requiring CP. Electrical isolation implies that all metallic/electrical contacts with foreign metallic structures are completely eliminated.

Electrical isolation provides three major benefits:

- Restriction of the required protective current to the surface of the primary structure to produce a uniform polarised level of protection.
- Minimising stray current influence (AC and/or DC).
- Prevention of unwanted galvanic current flowing between metallic structures.

Best practice guidelines are to be followed here, and Insulating joints are to be installed as above ground and housed in a well-drained and ventilated chamber with inspection access.

IF are typically required at:

- Pump stations
- Reservoirs
- Pressure break tanks
- Electromagnetic flow meters
- Valve actuators
- At points of dissimilar metal contact
- Any earthed instrumentation
- Any other place indicated by the Corrosion Engineer

Insulating Flanges

Pipeline electrical Insulating Flange (IF) materials shall be selected with consideration given to quality and standard material availability. The chosen material shall be suitable for the following pipe conditions:

- Gasket material must be drinking water approved
- Flange type
- Flange face
- Dielectric properties
- Line temperature maximum and minimum
- Surrounding Temperature maximum and minimum
- Pressure
- Medium
- Cyclic loading

- Predicted line movement
- Installation of IF's is to be conducted by accredited and competent joint integrity bolting practitioners.

IF materials shall be cross referenced to the manufacturer's specifications to ensure compatibility between materials, service and the environment. The materials required per IF, shall be supplied as one complete set. The IF kit shall consist of an insulating non-metallic central gasket, non-metallic bolt sleeves and non-metallic washers and steel thrust washers, as well as the associated studs, nut and bolts.

A detailed QCP procedure is to be submitted by the contractor for approval. Equipment and rating thereof to be identified, ensuring that the IF kit and surge protection device used is acceptable. Type of gasket, thickness and whether the gasket is raised face or full face must be specified, together with material certification and approvals.

Insulating Gasket

The contractor shall provide full details of the manufacturer's specifications and recommended application procedures for approval and sign off by the engineer.

The insulating gasket between flanges is to be in accordance with following table based on pipe diameter and pressure rating. The internal diameter of the pipe and gasket shall be equal in all instances.

Field Test Pressure MPa	Nominal Pipe Dia. (mm)	Insulating Gasket Material
Lower or equal to 2.5	All diameters	3.2mm Thick High Density Polyethylene to PEH Hostalen GM5010 Specification, full face gasket in one piece.
Lower or equal to 4.6	Smaller or equal to 1200	3.2mm Thick Fabric Reinforced Phenolic (BS EN 60893-3-4) full faced gasket in one piece with neoprene or nitrile rubber faces 0.8mm thick.
Greater than 4.6	Smaller or equal to 1200	3.2mm Thick Fabric Reinforced Phenolic (BS EN 60893-3-4) full faced gasket in one piece with neoprene or nitrile rubber faces 0.8mm thick with a composite gasket.

Insulating gasket shall be 3.2mm thick fabric reinforced phenolic full face gasket (Tested to BS5102 Appendices A-M: type III) with not more than 3 only factory made lap joints and with Neoprene or Nitrile faces 0.8mm thick. The gasket's internal diameter (ID) is to be 6mm smaller than the pipe ID.

The non-metallic central gasket and non-metallic washers shall conform to the following materials specification:

Material Property	ASTM Test Method	SI Value	Imperial Value
Dielectric Strength (Min.)	D149	21 kV/mm	540V/mil
Compressive Strength (Min.)	D625	340 MPA	49,000 psi
Water Absorption (Max)	D229	0.1%	0.1%
Operating Temp (Min)	----	-17°C	0°F
Operating Temp (Max)	----	+93°C	200°F
Hardness, Rockwell M (Min)	D785	115	115
Shear Strength (Min)	D732	150 MPA	22,000 psi

Insulating Bolt/Stud Sleeves

Insulating sleeve shall be shall be between 1 and 1.5 mm thick, glass fibre reinforced, polyester sleeve for each bolt/stud. Total length of the bolt/stud sleeves is to be 2-3 mm less than the length between inside faces of the steel washers. The insulating sleeves shall fit inside the insulating washers and extend partially inside the steel washers.

The contractor shall provide full details of the manufacturer's specifications and recommended application procedures for approval and sign off by the engineer.

Insulating Washers

Insulating washers shall be 3.2mm thick fabric reinforced phenolic resin with an outer diameter (OD) the same as that of machined steel washer. The internal diameter to be a sliding fit over the outer diameter insulating sleeve. Two off for each stud bolt. The inner diameter of the insulating washer shall be a sliding fit over the OD of insulating sleeves.

The contractor shall provide full details of the manufacturer's specifications and recommended application procedures for approval and sign off by the engineer. The manufacturer shall provide recommended torque values to ensure that the washers are not damaged during the tightening process.

Steel Washers

Steel washers shall be machined with diameter and thickness to SANS6149:1989. Stud bolts shall be to SANS 1700 and nuts to SANS 1700.

Studs, Nuts And Bolts

All studs, nuts and bolts supplied are to be of the same material grade as the pipe flange to mitigate any galvanic effect, unless otherwise stated.

Stud bolts and studs shall be grade 8.8 and nuts grade 8 to SANS 1700.

Stud bolt diameters shall be selected to the next smaller size for installation in standard drilled flanges. Stud bodies shall be machined down to the next smaller standard size and suitable smaller nut to be used.

Stepped stud bolts shall be sized on the one end to fit the tapped blind bolt holes in the valve flanges, the other end shall be of the same diameter as the normal stud bolt.

Surge Protection

The Contractor is to ensure that compliance with electrical surge requirements is maintained and that approval and sign off by a professional electrical engineer is obtained. The following are best practice guidelines that the contractor can follow providing the mechanical compliance of the joint is maintained:

Suitable surge protection with manufacturer supplied mounting brackets as approved by the engineer shall be installed across the flange faces complete with mounting brackets to suit the flange bolt. The width of the holding bracket surge protection device shall be the same as that of the steel and insulation washer. The bottom end of each bracket is to be rounded off to fit into faced area of the flange.

If required for AC mitigation, a steady-state DC decoupler (SS-DCD) device or technically compliant equivalent shall be installed across the flange faces complete with surge rated non-corroding metal mounting brackets to suit the flange bolt. The DCD shall be located in a suitably rated enclosure as stipulated in SANS/IEC 79 and SANS 0108.

In the absence of a DCD, a spark gap device or technically compliant equivalent shall be installed across the flange faces complete with hot-dip galvanising mild steel mounting brackets to suit the flange bolt.

Installation of the brackets is to be in strict requirements with the OEM requirements ensuring that there is adequate mechanical, metal, electrical contact to the metal surface with minimal coating damage to the surface.

Identification & Protection of Insulating Flange

Visual, physical and insulation testing is required at IF installations. Positive visual identification in the form of an approved paint system, aluminium punched tag (minimum 12mm punch die) (and ID) is required for traceability and routine testing requirements. The identification of IF installations using paints, tags or labels shall be submitted to the engineer for approval.

Protection of IF Installations

- All IF testing is to be completed and signed off together with the installed surge protection device before protection of the IF can be supplied and installed.

  No painting over the studs, nuts, bolts and washers

- Protection of the IF installation is to be installed to cover the gap between the flange faces only. If possible an opaque covering should be used to allow for visual inspection of the sleeves and/or gap.

- Flange protection devices and/or tape wrap systems approved by the engineer shall be installed

- Nuts are to be protected against corrosion and rust, nut protection covers are to be installed.

Wrapping of the IF Installation

The engineer shall specify whether or not the IF installation shall be wrapped and will be determined by the following environmental considerations:

- Likelihood of flooding.
- Likelihood of conductive material build up on the exposed surface of the flanges.

The entire insulating flange shall be wrapped circumferentially with a 1.5 to 2.0mm thick white plastic backed polymer modified bituminous tape, or similar approved. The latter shall have a minimum overlap of 25mm. In the case of surface irregularities, i.e. stepped flanges, etc. A CLIENT approved Petrolatum mastic material shall be used to provide a smooth contour for subsequent tape application.

The insulating flange shall be wrapped circumferentially with a 1.5 to 2.0mm thick white plastic backed polymer bituminous tape, or similar approved. The latter shall have a minimum overlap of 25%. In the case of surface irregularities, an approved Petrolatum mastic material shall be used to provide a smooth contour for subsequent tape application.

The entire insulating flange should be wrapped circumferentially with a white plastic backed polymer modified bituminous tape, or similar approved, 1.5 to 2.0mm thick with a minimum 25mm overlap.

In case of surface irregularities, i.e. stepped flanges, etc., an approved mastic material shall be used to provide a smooth contour for subsequent tape application.

The entire insulating flange should be wrapped circumferentially with a white plastic backed polymer modified bituminous tape, or similar approved, 1.5 to 2.0mm thick with a minimum 25mm overlap.

In case of surface irregularities, i.e. stepped flanges, etc., an approved mastic material shall be used to provide a smooth contour for subsequent tape application.

Visual Identification of IF Installations

For coding, a red colour band of 30mm width shall be applied in the centre on the horizontal surface. The tape shall be a plastic backed electrical tape to SANS 1222. A 2mm thick aluminium plate shall be fixed to the insulating flange with stainless steel strapping. The following shall be stamped thereon in 20mm high characters filled with black indelible ink:

- “OPERATING INSULATING FLANGE”
- “NO ATTACHMENT TO PIPEWORK PERMITTED”
- “VALVE CHAMBER TO BE KEPT DRY”
- “DO NOT PAINT”

Electrical Insulation Testing Of Insulating Flanges

Electrical insulation testing of the joint (IF and surge protection) must be conducted after installation confirming that the insulating joints are in compliance with the specifications and drawings.

The Contractor is to submit a detailed QCP of their IF insulation testing procedure together with test report formats for approval by the engineer. Once joint integrity has been confirmed a data book for each IF must be prepared for sign off once:

- All material certifications for the IF kit and surge protection device are on hand and signed off
- Joint integrity has been tested and confirmed including torque tightness and pressure tests
- Visual inspection has confirmed that all insulating sleeves, washers, steel washers etc. are in place
- Surge protection device has been installed.

The IF inspection shall be witnessed by The Client, the CP Design Engineer and the IF installation contractor.

The procedures for the electrical insulation tests on the IFs to be performed as a minimum are detailed below:

OPTION 1

- Switch off Transformer Rectifier.
- A free-floating compass shall be placed on top of the insulating flange. The needle normally aligns itself along the pipeline axis. If strong stray currents are present the needle may align at an angle to the pipeline
- A 12 Volt heavy-duty car battery or DC welding generator should then be used to bridge this insulating flange. If the insulating flange is functioning correctly, no significant deflection of the needle will be observed. If the insulating flange is not functioning, the compass needle will deflect to a position orthogonal to the pipeline.
- The current drawn from the battery is an additional indicator of flange integrity. A short circuited IF will typically draw in excess of 200A
- Before changing a faulty insulating flange assembly, a bolt by bolt continuity check should be carried out to determine if the problem is not a faulty bolt, isolating sleeve or isolating washer.
- Re-testing must be carried out upon replacing faulty components.

OPTION 2

Short wave radio frequency testing device such as the Tinker & Rasor IF™ tester or equivalent shall be used.

Testing across the flange face and across the stud to flange interface of each stud is to be tested, recorded and verified.

CATHODIC PROTECTION TEST STATIONS

Potential Criteria for Cathodic Protection

There are several techniques used to verify the levels of efficacy of the Cathodic Protection (CP) system to ensure that the minimum specification guidelines are adhered to. For buried steel coated pipelines, the pipe-to-soil potential measured with respect to a calibrated copper to copper sulphate reference electrode (CSE) will be used as the criterion for corrosion protection.

In general, the natural potential of steel (i.e. iron) in soil with respect to CSE is in the region of -0.4 to -0.5 Volts (DC).

The buried water pipeline shall be regarded as being under effective CP when a negative (Cathodic) potential of at least -0.95V (with reference to a CSE) with the Cathodic Protection applied is measured. Voltage drops across the structure-to-electrolyte boundary must be considered for valid interpretation of the voltage measurement. This additional negative potential i.e. more negative than -0.85V is required for mitigation against microbe induced corrosion and effects.

A 100mV (0.1V) minimum polarisation obtained between the carbon steel surface of the pipeline and a stable reference electrode contacting the electrolyte can be used as an alternative measure. The formation or decay of polarisation may be measured to satisfy this criterion.

Locations

The test station location and positioning shall be selected based on a number of considerations, such as:

- On the pipeline servitude and pipeline right of way (ROW),
- Risk of vandalism, theft and/or general damage;
- Access relating to operation, maintenance and monitoring;
- Possible damage by agricultural vehicles, plant vehicles, etc.

Test stations are to be constructed over the pipeline within the servitude. Locations where test Stations are to be installed are listed as follows:

- Pipeline crossings (Client and foreign) which are cathodically protected and major pipeline (> 200mm OD) crossings which are not cathodically protected.

- Other utility crossings which are cathodically protected and major pipeline (>200mm OD) crossings which are not cathodically protected.
- Sacrificial anode locations, unless otherwise specified by the Pipeline owner.
- Either side of electrified and non-electrified railway lines.
- AC power line utility corridors as a minimum at the crossing point, parallel sections at the start middle and end of these parallelisms.
- Either side of all national, provincial and major roads.
- At all cased, directional drilled and/or pipe jacked crossings.
- On one side of all frequently used (greater than 50 vehicles per day) roads and/or heavy haul sand / dirt roads.
- AC mitigation stations.
- Major water crossings (on both sides) where water flows for at least 6 months of the year on a continuous basis and the river crossing exceeds 3m in length.
- Reservoirs.
- In stray current environments, TP are to include IR-Free reference electrodes as and where The Client specifies.
- Every 1 km (maximum separation between any two TPs).
- Other locations The Client considers important.

Test Station Installation Options

Test stations will fulfil various roles as follows and can be located as follows:

- Free standing test stations (concrete and/or galvanised construction)
- Valve chambers
- Buried test stations are test station facilities design with burial or below ground construction in mind.

Monitoring test posts are to be constructed of reinforced concrete. The test posts are to be monolithic construction, containing no part that operate or close, nor any that have a cover with lock. The test post should be nominally 1.4m in length with approximately the bottom 0.5m concreted into the ground. The cross section should be minimum 130mmx130mm square. The test post will be constructed with a mild steel flat bar 6mm thick by 30mm wide and 40mm long protruding from it halfway down. The flat bar is to have a 15mm diameter hole to which a recording instrument may be chained.

A concrete bunker shall comprise of 20MPa concrete in a ratio of 1:4:4 (Portland cement: 13mm stone: river sand) placed on at least a 350mm thick complete steel reinforced 20 MPa 1250mm x 1250mm x 75mm thick surround. The concrete shall be agitated while wet and cured for 48 hours prior to moving. All surfaces are to be smooth and free of spalling, cracking and honeycombing. The minimum concrete wall thickness shall be 150mm. All reinforcing steel (mesh and rods) shall be 10mm in diameter and shall be hot dip galvanised to SANS 121/ISO 1461.

The door shall be manufactured from 5mm thick hot dip galvanised steel plate. The door locking mechanism shall be deadbolt locks (keyed alike to JW requirements) and the door shall be hung on internal concealed hinges.

400 Grade Stainless Steel 40mm rod, with an M12 internal threaded hole shall be installed at least 100mm into the concrete. The stainless steel rod shall welded onto a stainless steel base plate (50mm x 50mm x 3mm) in order to ensure that the bunker may be suitably moved on site.

The concrete stations and/or points will be sealed and painted with an undercoat. Test stations, bonding test stations and/or bunker test stations will then be painted with PVA paint. With exception of the test stations which will be painted white, all concrete structures will be painted Grey Green according to SABS 1091 H40.

A 50mmm diameter orange circle will be painted around the potential test station banana jack test point.

Labelling characters are to be 20mm high and filled with black indelible ink.

The aluminium plate is to be secured with stainless steel “nail in anchors”. Alternatively, a 20mm stencil may be used with black paint to label concrete stations. If the labelling procedure is not specified in the Schedule of Rates and Quantities Contractor shall ascertain from The Client at the time of tender which labelling technique shall be used for the specific project.

Care must be taken not to damage the cable or the Test station during the attachment of the plate.

Bunkers should be installed with suitable glands and conduit to ensure the cables are not damaged. Each bunker shall have a portable reference electrode drop tube which shall comprise of 110mm PVC drain pipe and shall extend from 150mm above the pipe into the bunker.

TYPES OF TEST STATIONS

Type	Description	With AC
A	Monitoring Test Station	FA
B	IR Free Station (SRE installed)	FB
C	Cross Bonding Station	FC
D	Temporary CP installation	FD
E	4 Wire Current Span Station	FE
F	AC mitigation installed	F

Pipe-to-soil Potential Monitoring Test Station (Type A)

These are to be located nominally every 1000m over a given pipeline route or as specified by The Client.

Preferably MTS are to be placed in a concrete bunker adjacent to valve chambers and/or at other significant locations as detailed in the MTS listing and installation schedule.

This standard monitoring test station comprises two single core 16 mm² black double insulated cables exothermically welded to the pipe.

MTSs will have a DC coupon installed. Refer to Section 7.5 for details.

IR-Free Test Station (Type B)

These test stations will be used to measure “IR-free” potential readings. They will be located as specified or at minimum every 5 km. These test stations will contain two 16 mm² black double insulated cables exothermically welded to the pipe.

In addition, a separate buried stationary reference electrode (SRE) and a separate steel coupon are to be installed. The SRE will be connected to the test station with 6 mm² yellow cable and the coupon will have one 2-core 2.5mm² blue PVC/PVC cable.

Each coupon shall be connected via a reed switch or a fuse link (10A slow-blow).

Cross Bonding Test Station (Type C)

Cross bonding test stations allow current to pass from one buried structure to another. Caution should be exercised when testing or maintaining the system at these stations due to the current flowing. The pipe shall be cross bonded as follows:

- To other “foreign” pipelines,
- To other foreign utility structures
- To parallel pipelines where a common cathode is required,
- Current bond required for Cathodic Protection requirements

Bonding cables from the foreign pipe to the bunker shall be one 2-core 16mm² SWA cable.

Bonding test stations are to be constructed of reinforced concrete or galvanized steel.

The Test stations are to be installed over the pipeline.

The contractor shall supply and install 0-2 Ohm 100W resistor.

Temporary CP Test Stations (Type D)

Temporary CP can be offered during upfront pipeline construction or at times when there are prolonged outages on impressed current CP (ICCP) systems. This will be provided using sacrificial anodes.

For upfront pipeline construction, this will be used for short lengths of pipeline. However, once the pipeline sections reach a longer length and start becoming subjected to stray currents, the temporary protection will be provided with impressed current systems.

The temporary CP station will comprise a standard MTS with facilities to connect and dis-connect the associated sacrificial anodes as and when required. The MTS will be connected to a pair of bagged magnesium anodes (as the need arises). Once the sacrificial protection is no longer required, the magnesium anodes will be disconnected from the test station and the test station will therefore function as a MTS.

Sacrificial anodes and type are to comply with the requirements as stipulated in Chapter 9.

4-Wire Current Span Test Station (Type E)

These test stations will be used to measure the magnitude and direction of current flow at selected locations along the route to monitor stray current activity.

One 2-core 16 mm² SWA PVC/PVC cable (upstream) and two single core 16 mm² SWA PVC/PVC cables (downstream) will be used for each test station. The first cable will be connected to the pipeline 1m downstream of the test station (yellow), the second cable will be located 1m away from the first cable (blue), in the upstream direction, the third cable will be located between 90 -125 m away from the second cable (black), in the upstream direction and the last cable (red) will be 1m away from the third, in the upstream direction.

One test station will be located within 1km from each cathodic protection rectifier.

Test Station with AC Mitigation Hardware (Type F(X))

Any test station that has AC mitigation hardware and/or gradient control installed.

Coupons

The design life of the coupon should be such that it will be able to operate continuously for 20 years under conditions of full cathodic protection. The coupons shall be used in conjunction with either Copper Sulphate or Silver Chloride reference electrodes to achieve essentially IR-free and instant “off” potentials in terms of NACE RP0169, NACE RP0104 and BS EN 13509. The coupon shall be designed to operate in a temperature range between 0°C and 50°C. Each coupon shall have a unique identification number and sizing certificate to suit.

Coupon suppliers/manufacturers shall provide the following information with their QCP for approval by The Client:

- Record of manufacturing coupons with a 10 year, or longer, intended design life.
- QA/QC documentation of coupons previously supplied to industry with verifiable track record i.e. contact persons and names.
- Coupons previously supplied should have a service life of more than 10 years with traceable records.
- Substantial evidence of product performance comprising a mixture of local and/or international customers that may be verified by The Client.

The coupon shall comprise a round steel elements that is flush mounted into a suitable acid, alkali and chemically resistant epoxy. The coupon material shall be similar to the pipe material. Details of the proposed coupon material shall be approved in writing by The Engineer before manufacturing commences. The coupon shall be connected to a standard 2 core 2.5mm^2 cabtyre cable with all the connections encapsulated in epoxy. The cabtyre shall

exit the coupon assembly via a suitably sized cable gland. The cabtyre cable length i.e. tail, shall be specified by The Engineer.

For AC measurements the coupon shall be machined from an 11 mm diameter steel rod. Each AC coupon shall be connected via a 10 ohm 50W resistor.

For DC measurements the coupon shall be machined from a 36 mm diameter steel rod.

Random testing will be carried out on 10% of the coupons manufactured and supplied. The random testing shall be carried out as follows:

- Select coupons.
- Check coupon dimensions.
- Check assembly and physical appearance for compliance in terms of the specification.
- Sign off.

Stationary Reference Electrodes (SRE)

The SRE design life should exceed 15 years' active use and will be used in conjunction with bare steel coupons to allow for "IR-free" potential measurement in terms of NACE RP0169, NACE RP0104 and BS EN 13509. The SRE installation position (3 or 9 o'clock) shall be determined by The Engineer on site and shall be placed in the same soil as the pipeline adjacent to the coupon not more than 200mm from the pipe.

SRE suppliers/manufacturers shall provide the following information with their QCP for approval:

i. Record of manufacturing PRE with a 20 year intended design life.
ii. QA/QC documentation of reference electrodes previously supplied to industry with verifiable track record i.e. contact persons and names.
iii. SPRE previously supplied should have a service life of more than 10 years with traceable records.
iv. Substantial evidence of product performance comprising a mixture of local and/or international customers that may be verified by The Engineer.

The SRE should be commercially available from a reputable supplier with a proven track record. The Contractor must supply full details of the intended manufacturer.

Client approved IR Free stationary burial type electrodes with monitor coupons shall be used, complete with the approved PC Board. The shunt shall be rated at 20W and 0.1Ω as a

minimum and a Reed Switch shall be used to interrupt the coupon during testing. Push button and toggle switches are not permissible.
The permanent burial type shall consist of an encapsulated ceramic tube with yellow protective end caps.

Stability to be <10 milli-volts (mV) with 3 micro-amp load in a temperature range of 0^{o}C to 57.2^{o}C.

SRE Manufacture Specifications

Full data packs of the design detail of the proposed reference cell must be submitted. Failure to do so may disqualify the bid. A standard drawing detailing the reference cell is included in this technical specification.

The SRE shall display high stability under conditions of continuous measurement and when inactive or not attached to an external measuring circuit.

The reference cell stability shall be tested before shipping and shall comply with the following limits:

- 2mV potential shift after application of:
- 0.1µA for 30 seconds,
- 12mV potential shift after application of 1.0 µA for 30 seconds.

The SRE shall be designed to operate in a temperature range between 0°C and 50°C. Full details pertaining to the chemical composition, calibration procedures, manufacture process and drawings of the SRE shall be submitted at the time of tender. Each SRE shall have a unique identification number and calibration certificate to suit.

Random testing will be carried out on up to 10% of the reference cells manufactured and supplied.

ICCP ANODE GROUNDBEDS

General Description

The actual length of each groundbed is presented in the CP design report. However, each groundbed has the following common features:

- Anodes,
- Canisters,
- Spacer canisters
- Coke breeze backfill
- Sand fill,
- Bentonite,
- Positive header or ring main cable
- Splices of the anode tail to the ring main shall be encapsulated in epoxy spicing kits
- Watering system
- Cable warning tape
- The watering system will be installed during the groundbed construction,
- Cable warning tape (yellow on black) will be installed at a depth of 600 mm below surface along the entire length of the groundbed.
- Anode junction box and concrete markers

The Contractor shall await The Client's instruction to proceed with groundbed construction. The Contractor is to supply detailed QCP for approval. All materials are to be pre-inspected and signed off with the material certification data book.

Groundbed Components

Watering System

Watering systems shall be provided to enable groundbed hydration during dry seasonal periods.

The watering system shall consist of a ribbed and slotted, double walled PVC drainex pipe, 110mm in diameter, typically 6m in length. The pipes should be coupled together suitably and the end of the pipe must be closed with an end cap. The pipe along its full length is to be covered by one layer of flow net and then by one layer of Bidim cloth A2. The pipe shall be fed using a 50mm HDPE pipe from the closest valve chamber. The pipe shall be laid in the same trench as the groundbed header cable.

Anode Cabling

No cable joints are permitted in these systems. The outer insulation of the anode cables shall be fluorocarbon based e.g. PTFE, PVDF (Kynar™), ECTFE (Halar™), ETFE (Tefzel™). The anodes will be supplied with certification to this effect.

The cable size to be used for the anode positive cable connection shall be stipulated by The Client. All positive anode cable insulation shall be PVC / HMWPE / PVDF or PVC / PVC / Halar insulation. The minimum thickness of each layer of the insulation shall be 2mm. No cable joints will be permitted under any circumstances in the buried or submerged portions of the positive anode cable. The minimum cable to anode breaking strength shall be greater than the cable breaking strength.

Where the anode tails are connected directly to the ring main cable, the PVC insulation of cables must first be thoroughly cleaned, all grease and dirt removed and roughened with coarse sandpaper.

The cables are to be joined using a type 3M Scotchcast™ 91-T2 or equivalent cable jointing kit. Allow a minimum of six hours for the resin to set before backfilling.

Anodes may be connected in pairs.

Connections shall be made to alternate sides of the ring main cable

Cable warning tape will be inserted above the groundbed, at a depth of 600 mm below grade.

The positive cable from the groundbed to the TRU shall be encased in concrete as shall the power supply cable.

The anode tails shall be terminated into a suitably rated DC distribution cabinet / enclosure, cognisance shall be taken of the area classification, environment, type and rating of enclosure required.

Should anodes not terminate into a distribution cabinet, the anode tails shall then be crimped to the ring main cable via a suitably sized ferrule. The resultant connection shall be wrapped with self-vulcanising tape and the entire connection be placed into a correctly sized cable splicing kit.

Sufficient time should be allowed for the splicing resin to cure prior to backfilling. Splicing should not be carried out in wet or moist weather. The ring main cable shall be joined in a similar fashion to the positive DC header cable.

All cable connections shall be inspected and approved prior to backfilling. Cable warning tape (yellow skull and bones with associated wording) shall be placed along the entire length of the horizontal anode bed at typically 500mm below grade.

Anode Junction Box

A concrete bunker shall be installed on top of the anode groundbed in the case of a deep well and at a position indicated by The Engineer in the case of shallow vertical groundbeds. The anode tails as well as positive cables from the TRU shall enter the anode junction box via an HDPE conduit.

The anode tails and the TRU positive cables shall be terminated on a tinned copper or aluminium bus bar. This bus bar shall be rated to 50A and shall be mounted inside the enclosure by means of insulated stand-offs.

Anode Canisters

Anodes shall be pre-packed in spirally welded galvanised steel canisters that are thick enough such that each canister is self-supporting, as per BoQ. Both ends are to be sealed off with galvanised steel end caps and have a side gland conduit for the exit of the anode cable. The anodes will be centrally located within the canister and the annular space between the anode and the canister will be filled with coke breeze.

Care shall be taken in the storage of these anode canisters to ensure they are stored in controlled areas.

Anode canisters filled with coke breeze shall be used as spacer anodes, in order to ensure that the correct anode separation is achieved, in horizontal anode beds. This is not required in vertical distributive systems.

Each anode shall be centralised inside its canister and encapsulated in coke breeze. Cable glands are to be used for exit of the tail cable as to avoid damage that can be caused by the sheet metal.

Cable Warning Tape

Cable warning tape shall be placed along the entire length of the horizontal anode bed at the required depth below grade at 600mm. The relevant inspection shall be carried out during the cable installation as stipulated in Section 4.

Anodes

Mixed Metal Oxide Anodes (MMO)

The MMO and PMO (precious metal oxide) anode operating voltage shall not exceed 50V for soil and 9V for sea water and halogen polluted applications. The latter assumes that no Halide pollutants are present such as Fluorine (F) or Bromine (Br). Where deleterious pollutants are to be expected, the precise soil and ground water chemistry shall be determined, prior to the use of any MMO/PMO anodes. The anode manufacturers maximum current output for the various anode configurations and dimensions shall not be exceeded under any circumstances. The anode current output and other parameters shall be submitted during the quotation or proposal stage.

In addition to the certification provided by the manufacturer, two anodes from each batch will be subjected to the following range of destructive tests at an independent laboratory:

Test	Minimum requirements/Test Method
Test solution	10% by volume sulphuric acid
Test temperature	Less than 50 ºC for duration of test
Test Current Density	20 kA/m^2 min
Test Duration	Minimum 35 days at the specified current density
Coating adhesion test	ASTM B 571
X-Ray/NDT	The tubular anode shall be X-Ray'ed in order to ensure that bubbles are not contained within the epoxy sealant
Metallurgical and SEM analysis	Anodes will be sectioned and the MMO/PMO coating verified

The anode tails will be 10 mm^2 PVDF/ HMWPE/ PVC.

All anodes, regardless of type shall be rated for at least 2A, 60Ayr and 25y life.

Anode dimensions and loading parameters shall be specified in the CP design document and the BoQ.

Chemical and Performance Testing of Anodes

A specified number of anodes will be randomly selected from the batch to be supplied and tested as detailed below. The anodes for testing will be selected as per BS 6001/ISO 2859- “Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection”.

The anodes will be tested by an accredited third party laboratory, such as MINTEK, in order to confirm compliance with the specification. Details of the third party laboratory must be approved by The Client prior to testing.

In all instances a suitable hole will be drilled into the end of the thread or rod and the cable shall be brazed / soldered into the hole.

The insulation of the cable shall be removed for a length such that at least 25mm of the copper is inserted into the drilled galvanised steel rod hole.

The cable shall then be brazed / soldered into the hole. At least 25mm of insulation shall extend into the anode recess.

Mechanical connections between the anode cable and the pre-galvanised steel rod or thread shall not be permitted under any circumstances.

The anode recess shall be completely flooded with hydrochloric acid (10% solution) resistant epoxy. All proposed epoxies shall be submitted to The Client for review, prior to their use. The epoxy shall completely fill the recess without spilling over onto the external surface of the anode.

No bare copper cable shall extend outside the epoxy; the insulation shall extend at least 25 mm into the epoxy as stipulated above.

The maximum cable to anode resistance shall be 10 mΩ. The cable shall be pulled or tugged initially as a test after making the cable to anode connection.

The solution potential of the anode when fully submerged in the test chamber, shall be more negative than -1,65 V with respect to a saturated copper / copper sulphate reference electrode.

The anode shall maintain this potential at a 100 mA output and shall possess a capacity of 1200 A.hrs/kg.

A complete set of both chemical and metallurgical tests shall be conducted on a number of randomly selected anodes, as determined in accordance with BS 6001, Part 1, prior to installation of the anodes. All of these costs shall be borne by the supplier/installation contractor Anodes may only be installed subsequent to testing and review from The Client.

Complete chemical and metallurgical compliance shall be ensured prior to their installation and a detailed report shall be submitted to The Client for review. Testing shall be carried out at the contractor's expense.

The natural anode potential and current drawn shall be measured prior to permanently connecting the anode to the pipe / structure. This data shall be submitted with the commissioning report.

Carbonaceous Backfill

Carbonaceous backfills include various coke products produced from coal, tar (pitch cokes) and bitumen (petroleum cokes) and graphite granules. The coke is in essence the solid residue left from coal after its volatile constituents have been driven off by heating in the absence of air and as such, coke is amorphous. This also implies that any metallurgical coke, contains significant amounts of sulphur, ash and volatiles. The ash also generally entraps the heavy metals, such as lead, cadmium, mercury, copper, zinc, etc, which would not be environmentally acceptable.

The effective resistivity of the soil surrounding an electrode (anode) is confined to the immediate region of the anode, it is therefore common practice to reduce the local resistance by using these so-called backfill materials. The backfill being a conductor, "carries" a measure of the current, reducing to some extent, the consumption rate of the anode. Therefore, the essential purpose of the carbonaceous backfill, is to lower the anode/soil interface resistance, increase the current capacity by increasing the effective anode area and thus prolonging the anode's life. The backfill must also allow for the egress of anodic gases during its normal operation and be as environmentally safe and friendly, as possible.

Preference shall be given to pitch coke, however, calcined petroleum cokes may be permitted, providing that it is fully compliant with the technical specification. The supplier must be an ISO 9002 or equivalent accredited organisation. Alternatives will only be permitted to be used upon written approval from The Client.

Coke breeze with the following chemical composition shall be used:

Element/Compound	Specification	Test Method
Fixed Carbon	99.5% min	By calculation – 100% minus (%ash + VCM)
Sulphur	0.25% max	ASTM D 4239
Ash & volatiles	0.50% max	Ash – ASTM D 4422 Volatiles – BS 1016: Part 4
Moisture	0.15% max	ASTM D 3173
Bulk density	1000 kg/m3 max	ASTM D 527
Resistivity	55 Ωm max	Alusuisse C-109

The particle size distribution (PSD) of the impressed current anode backfill material is a very important variable and shall vary according to the anode material and burial depth. The PSD shall be determined in accordance with the following specifications ASTM D293-69, BS.

Anode Type	Environment	Burial Depth	Max. PSD	Min. PSD
MMO/PMO	Soil / Brackish	< 15m	100% < 1.0mm	5% < 0.5mm
MMO/PMO	Soil / Brackish	> 15m	100% < 1.5mm	5% < 0.5mm
MMO/PMO	Soil / Brackish	> 50m	100% < 2.0mm	5% < 0.5mm
Silicon Iron Anode	All	All	100% < 3mm	5% < 0.5mm

Technical motivations for the use of other PSD will be considered by The Client, should the above values not suffice.

The particle size distribution shall be a maximum of 100% < 1.0 mm and a min of 5% < 0.5 mm.

The coke breeze will be used to surround the anode in the canister and in addition, the canister anodes will be located within a coke breeze surround as per design document.

The bottom portion or active zone of the Groundbed is to be filled with calcined petroleum coke of particle size 100% <1.5mm and 5% <0.5mm. The exact numbers of holes as well as quantities of coke are given in the drawings. The remainder of the Groundbed or inactive zone is to be backfilled with graded washed silica sand of particle size 5-7mm with quantities

indicated in the drawing accompanying the tender document .Refer to page 66 in this document..

The backfill material shall be supplied in 25kg polypropylene bags that are to be packed on palettes to a safe height and weight.

The Contractor shall make provision in the quotation for adequate testing by an approved third part laboratory. At the time of quotation the Contractor shall nominate a suitable laboratory capable of carrying out the tests required to assess compliance with the standards of this section of the quotation document.

2 weeks prior to delivery 10 randomly selected 500g samples drawn by the Engineer from the materials at the Contractor's premises will be sent to the nominated laboratory for testing to confirm compliance with the standards set in this section of the quotation document. Should any of the randomly selected samples fail to comply with the said standards the Contractor shall then conduct further tests at his own expense to verify the compliance of the remaining materials. Should compliance not be achieved the materials shall be rejected by the Engineer. The rejected materials shall be replaced at the Contractor's expense.

Groundbed Installation Types

Shallow Horizontal Anode Ground Beds

The contractors shall supply Anodes as specified in the bill of quantities. Shallow horizontal groundbeds will contain either mixed metal oxide (MMO) or silicon iron (SiFe) anodes, encased in galvanised steel canisters, with each canister spliced alternatively to the positive ring main cable. The anode canisters will be 2 m in length, 200 mm diameter, while the spacer canisters will be 1 m long, 200 mm diameter.

The groundbed shall consist of a number of anodes installed horizontally at a specified distance away from the pipeline and shall have a spacing of 1 x anode or anode canister length between them .

The depth of the anode trench shall be at depths as specified but care should be taken when exceeding 2 meters below natural grade level.

The bottom part or third of the groundbed shall be filled with calcined petroleum coke covering the anodes with at least 300mm of coke.

The second third with selected backfill and the last third with backfill to grade level.

All depths are to be verified and signed off the contractor and CP design engineer.

Watering systems will be provided to enable the groundbed hydration during dry seasonal periods and to prevent groundbeds from drying out.

Vertical Anode Ground Beds

Anode centralisers shall be employed in order to locate the anodes in the centre of the coke column / groundbed. Centralisers shall be designed as such that they do not cause bridging of the coke backfill. Coke is then to be poured/pumped into the borehole in order to ensure that the anode is surrounded by pitch coke. The coke must be pumped as a wet mixture when MMO / PMO anodes are used. Graded and washed river sand with a particle size distribution of 0.5mm to 3.5mm shall be poured into the hole to a depth of 1.5m below the grade level. The last remaining 1.5m shall be filled with Bentonite.

The Groundbed shall consist of a number of shallow vertical holes drilled or augured to a maximum depth and diameter as specified with a minimum spacing of 3m at positions as indicated by the Engineer and a 150mm nominal bore steel casing shall be installed where the stability of the hole above is doubtful. The exact numbers of holes as well as quantities of coke are given in the bill of quantities.

Anode strings shall be installed centrally inside the coke bed with individual tails being brought to the level of the positive cable trench from where they shall be run to the position of the anode junction box.

The vertical position of the anodes in each hole shall be given in the bill of quantities.

The Engineer shall witness the entire anode Groundbed installation.

Vertical AGB Anode Installation

The bore holes shall be drilled by an approved professional drilling contractor registered with the Borehole Water Association. Contractors are to submit details of the company they intend to use for this activity.

Relevant deep soil resistivity tests shall be carried out as directed by the Design Engineer.

The main borehole shall be drilled as follows:

- The Engineer shall specify the dimensions of the AGB and may vary from those provided in this specification.
- A 36cm diameter hole shall be drilled to the depth of the inactive zone.
- A hole of 25cm diameter shall be drilled to accommodate the active zone.
- A 25cm diameter steel casing (schedule 20) with a closed bottom (welded closed) shall be inserted for the full borehole length.
- A 30cm diameter PVC casing shall then be installed on the outside of the steel casing for the length of the inactive zone.
- Drilling depths as well as quantities of coke and silica sand are given in the drawing.
- The Engineer shall witness the entire anode Groundbed installation.

Graded washed river sand with a particle size distribution of 0.5 mm to 3.5 mm shall be poured into the anode bed to a depth of 1.5 m below grade level. The remaining 1.5 m to grade level shall be sealed with Bentonite.

The anode tails shall be terminated into a suitably rated DC distribution cabinet / enclosure. Inside process plant areas, cognisance shall be taken of the area classification, environment, type and rating of enclosure required.

SACRIFICIAL ANODES

Magnesium Anodes

The performance characteristics of the 1.75V high potential magnesium alloy, is detailed below. The high potential alloy is specially formulated from pure virgin magnesium and other elements to produce a higher voltage. The advantages of the high potential anode versus its 1.55 V counterpart, is as follows:

The higher driving potential permits fewer anodes in this specific application;

The capacity of a high potential anode is some 4 % greater than that of the other anodes, improving the overall life of the anode;

The anodes shall be manufactured in accordance with ISO 9002. The contractor shall submit written confirmation from the relevant standards authority, confirming complete registration in this regard.

The anode shall be free of blow holes, cold laps, porosity seams and any other imperfection which may impair its performance. Extruded anodes shall be used and cast anodes may be used if approved by The Client.

A 5mm diameter pre-galvanised steel threaded stud or rod shall be centrally located within the anode. The latter shall extend for at least 95% of the anode length and shall be extruded or cast into it. The pre-galvanised threaded steel stud or rod shall be suitable for the electrical connection of the anode to anode cable, which shall terminate in a recess at the one end. The connection shall be suitable for 20 years under submerged conditions.

Magnesium anode locations will be designated by the CP design engineer. The hi-potential anodes, manufactured from virgin material, shall have the following composition:

Element	Composition (%)
Al	0.01 max
Mn	0.5 – 1.3
Cu	0.02 max
Ni	0.001 max
Fe	0.03 max
Zn	-
Other	0.05 max each or 0.3 total
Mg	Balance
Potential (V)	-1.7
Capacity (Ahrs/kg)	1100

The anodes will be pre-packaged in a cotton bag with a backfill containing 70% gypsum, 25% bentonite and 5% sodium sulphate. The volume of the backfill shall be such that there is a minimum of 35mm surrounding each anode.

The anodes will contain a steel core, onto which the anode cable connection will be soldered and the connection will be covered in an appropriate epoxy. No mechanical connections between the cable and the steel core are allowed.

Typical Installation Details

All anodes shall be installed at a minimum depth of 2.5m or pipe invert depth, whichever is the deeper. The anodes shall be located a minimum of 3.5m from the pipe or as determined by the CP Design. The anode / pipe separation distance shall be stipulated in the bill of quantities of the RFQ document.

The distribution of the anodes shall also be stipulated in the in the bill of quantities of the RFQ document.

The cable connection, installation and backfilling / reinstatement shall be witnessed by The Client.

TEST		**MINIMUM REQUIREMENT /TEST METHOD**
Test Solution	:	10% by Volume Sulphuric Acid (H_2SO_4)
Test Temperature	:	Less than 50°C for duration of the test
Test Current Density	:	20,000 A/m^2 Minimum
Test Duration	:	Minimum of 36 days at the Specified current density.
Coating Adhesion Test	:	The coating adhesion shall comply to full to ASTM B571
X-ray	:	The tubular anode may be x-Rayed at The Client's discretion in order to ensure that bubbles are not contained within the epoxy sealant.
Metallurgical/SEM Analysis	:	Anodes will be sectioned and the MMO/PMO coating verified.

TRANSFORMER RECTIFIER UNITS (TRUs)

Introduction

All powered units (TRU or NDU) will be standard / modular construction in order to minimise the carrying of spares.

The TRU's are to be installed in concrete structures in a rural / urban area with significant industrial atmospheric pollution. All components must be treated so as to provide satisfactory service under the corrosive conditions of the sites.

The general details of the sites are as follows:

Ambient Temperature:	10° to 40° C
Relative Humidity:	30% to 90%
Lightning risk:	severe

The TRU's may be used in environments where metallic dust, soot and grit may be present.

All structure bolts, washers and nuts shall be stainless steel. Bolts with spring washers are preferred and "Nylock" nuts are permissible where devices being secured remain at ambient temperature.

The TRU's will be installed within concrete enclosures, so no TRU cabinet is required and the TRU components shall be mounted on a free-standing frame capable of being located inside the concrete enclosure.

All components shall be mounted on one frame, and access to all components, especially in regard to replacement of diodes shall be possible without excessive dismantling.

Suitable lifting lugs (capable of carrying the total mass of the frame and all its components) shall be incorporated onto the frame/cabinet to allow safe handling and installation on site.

Housing

The TRU will be housed inside a suitably sized concrete enclosure as per the BoQ. The NDU will be housed in a concrete bunker. These structures result in no cabinets being required, and the various components are therefore built on a chassis and housed within the structure.

Remote Monitoring

The unit performance and operation will be monitored remotely, by the installation of remote monitoring systems

Power Supply

Input

400V, 3 phase, 50Hz or

230V, 1 phase, 50Hz

Typical Outputs (refer to BoQ)

0 - 50V DC

0 - 50A

Control

Selection of constant pipeline potential, constant current and manual voltage control for over line surveys. Each selection must be controllable from zero to full output.

Facilities are required on rectifiers for switching in order to undertake over line surveying and site commissioning testing.

Test Switch Facility

The rectifier must have a facility to plug in a switch on the output circuit for over line testing on the protected pipelines. This requirement is irrespective of any built in timer which may be provided.

Manual output voltage adjustment facility

Over line surveying testing requires a "manual mode" to adjust to a constant voltage range from zero to full output voltage. This is to enable over line testing at a preset output current.

- Ideally the thyristor firing circuit of the rectifier can be switched with a switch through a timer socket
- Firing cards must provide 100% balanced firing over all phases.
- The adjustment of the firing card must be such that the rectifier attains full set output current within 100ms of switching.

Irrespective of control mode, the TRU control equipment must be capable of output voltage, output current and potential pre-set limits.

When the control equipment is changed from one control mode to another control mode, all user programmable parameters must be automatically restored to minimum values to prevent an instantaneous application of output voltage or output current to the load.

Rectification

The rectifier shall provide single phase bridge or 3 phase full wave six pulse (minimum) rectification.

Control shall be provided by one of the following techniques, as set out in the schedule of quantities:

- matched thyristors in the primary circuit of the main transformer
- control of the saturation current in a magnetic amplifier incorporated in the primary circuit of the main transformer
- fully controlled secondary thyristor bridge
- switch mode

All semiconductors shall be rated at twice full load current and 1600V PIV

Forced cooling of thyristors and semiconductor devices is not permitted.

The efficiency of the transformer rectifier unit must be not less than 85% at maximum rating.

Control stability must be within 3% of set point over the whole range, irrespective of control mode selected.

Transformers & Chokes

Transformers must be continuously rated, double wound air cooled.

The transformer must have suitable windings on the secondary of the transformer to facilitate coarse selection of the voltage. The windings must be so wound to provide coarse adjustment of 33%, 66% and 100% of the step down voltage.

All transformers and chokes shall be earth screened.

Aluminium wound chokes are not permitted.

Instrumentation

Note: Output indication may be by means of a multifunction digital display.

- DC Output current (Analogue millivoltmeter with shunt located on load side of smoothing devices)
- Pipeline reference potential (Cu/CuSO4) (high impedance digital meter) Note: the input impedance of the monitoring/feedback control circuit shall be a minimum of 10 megohms in order to prevent polarisation of the stationary reference electrode.
- Mains on indication
- DC fuse fail indication
- AC fuse fail indication
- kWh meter

Alarm Indication

Mains fail indication by means of undervoltage and phase failure (if applicable) relay (voltage free contact)

AC/DC fuse fail (voltage free contact)

Testing Probes

Standard insulated banana socket points @ 20mm centres for external measurement / calibration.

- Pipe-to-soil potential (Cu/$CuSO_4$ reference electrode)
- Rectifier output voltage.
- Rectifier output current (from shunt – shunt rating to be indicated on label)

Protection

All metal components shall be connected to the common earth and to the AC supply earth.

All electrical circuits shall be floating with respect to earth.

All earth connections within the enclosure must be as short as possible and rated at possible fault current.

Earth buss bar mounting studs must be adequately sized to accommodate collective fault current.

A separate earthing system will be provided for the TRU consisting of suitable earth rods and bare earthing cable which will have a resistance below 10 Ω in compliance with SANS 10142.

Surge Protection

Necessary surge protection must be installed to protect the rectifier and control circuits, both input and output, against power surges and lightning. This shall incorporate a “pi” filter in the negative leg of the TRU.

Electrical Protection

Necessary fuse and overload protection must be provided to protect the equipment. The grading must be in a way to limit unnecessary trips. Phase rotation protection must be installed.

DC Output fuses must be capable of carrying the full load current of the unit.

The input circuit breaker must be of the magnetic type to carry inrush currents after a power failure in order to prevent nuisance tripping.

All protection devices, semiconductors, power devices and wiring must be matched to prevent overheating and component failure due to overload.

Radio Frequency Protection

The rectifier must be radio frequency protected.

Smoothing

Necessary smoothing of the output must be provided to prevent interference with telephone, radio and other services.

Smoothing shall be such that the peak – trough amplitude of the output waveform shall be less than 10% of the mean DC output voltage across the entire range of the rectifier unit. The output ripple shall be measured using an oscilloscope with the rectifier connected to a pure resistive load.

Cabinets

The rectifier and control must be mounted on a stainless steel skeleton frame suitable for installation in a concrete enclosure

Powder coating for chassis plates

Coating shall comply with Type 5 of SANS 1274:2013 including the use of a wet primer.

Degrease, pickle and phosphate in accordance with powder manufacturer's requirements.

Apply powder by means of electrostatic spray to ensure a final DFT of 120 micron.

Finish colour: white

Electronic PCB

All electronic printed circuit boards shall be coated with a proprietary military specification conformal coating designed to prevent corrosion to the exposed component leads. All PCB's shall have a primary solder mask and legend.

Wiring

All current carrying conductors shall be insulated to withstand a minimum voltage of 1000V. All wiring shall comply with the provisions of the Wiring Code of Practice; SANS 10142 (latest edition).

All current-carrying conductors shall be multi-stranded, flexible and sized to adequately carry the design current without a rise in temperature.

Thyristor gate leads (if fitted) shall be screened or twisted pair.

All conductors shall be terminated at each end with suitably-sized, pre-insulated lugs or pre-insulated ferrules. No trimming of conductor strands will be permitted. All ferrules and lugs shall be crimped with appropriately sized crimping equipment.

All primary and secondary power cables and control wiring must be marked to ease installation and maintenance of rectifiers. Both ends of each cable shall be uniquely numbered in accordance with the wiring diagram.

Cable markers must be colour coded as well as have their number embossed indelibly on the marker. i.e.

0- Black
1- Brown
2- Red
3- Orange
4- Yellow
5- Green
6- Blue
7- Violet
8- Grey
9- White

Cable markers must be appropriately sized to suit the insulation size of the cable.

Cable markers shall read from cable to lug on all conductors.

All AC supply conductors shall be colour coded according to the incoming phase and retain the colour nominated throughout the cabinet.

Positive and negative power cables shall have colour coded shrouds/shrink sleeve over the lugs.

All conductors excluding busbars shall be routed in trunking or harnessed using polyethylene spiral wrapping.

AC carrying conductors must be routed separately from DC carrying conductors.

Grounding cables connected to surge diversion devices must be kept as short as possible and may not be routed with either AC or DC carrying conductors.

No more than two cables may be terminated at any one point.

All bolt on terminals shall be independently mounted with locknuts such that cables may be removed without having to hold the terminal.

The positive and negative output terminals must be marked Pipe, Anode, Reference etc. to prevent incorrect connections.

All terminals shall be completely accessible after completion of wiring.

All terminations made to buss bars shall be provided with spring washers.

All supply power terminations shall be enclosed and be highlighted with a warning label.

Transformer and inductor or smoothing capacitor terminations shall be covered with a transparent cover prohibiting accidental contact.

Output terminals shall be fully insulated from any metal of the housing or chassis.

All terminals shall be clearly marked and sized according to the current the terminal will carry.

Power Point

A 230V AC power point with separate earth leakage must be provided for use of small electrical hand tools and instruments inside the rectifier panel.

Drawings

Relevant drawings and manuals must be supplied with the rectifier.
A laminated schematic drawing of the rectifier must be installed in the rectifier.

Spares

A recommended spares list must be supplied.
Necessary breakdown spares must be installed in each rectifier comprising:

- 3 sets of fuses
- 1 set of semiconductors
- 1 set indicator lamps (if used)
- 1 set transient protection devices (other than chokes & capacitors)

Labelling

Terminals within a TRU/FDU/NDU shall be labelled as follows:

+ GROUNDBED or RAIL (depending on application)
- PIPE
PIPE MON
REF CELL
COUPON
EARTH
TELEMETRY
AC 400V or 240V (whichever is applicable)
SHUNT ??mV:??A (rating to be inserted for each unit type)

Labels shall be fixed by means stainless steel pop rivets such that they shall not become dislodged during the life of the unit. Component and other labelling/marking shall be engraved or fixed on fixed chassis and not on loose chassis or trunkings.
Labels shall be engraved trafolyte or other hard stamped equivalent. Labels shall be fixed to the panels with screws. Adhesive labels are not permitted.

Inspection

All rectifiers will be inspected and tests witnessed by The Client's representative prior to despatch.
All material, test and compliance certificates must be incorporated into the O & M Manual.

The following tests must be carried out at the manufacturer's works, after successful completion of the tests a certificate will be issued by the manufacturer and signed by the Engineer or his nominated representative. All testing and damaged components resulting from the testing will be at the manufacturer's expense and carried out at the manufacturers premises. Adequate adjustable load resistances, adjustable power supplies and testing equipment will be made available to the engineer by the manufacturer to verify specified operational characteristics of the TRU under test.

Pre power-up testing

The various earth points, cabinet body, chassis plates and all exposed metal surfaces shall be measured for continuity to the main earth terminal.

The cabinet and AC inputs, the DC outputs shall withstand a 1 kV insulation test. The insulation testing shall be conducted with all circuit breaker and fuses in their normal operating position without power or load connected.

Power on Testing

The TRU shall operate for a period of 6 hours continuously at maximum current and at full rated voltage with all doors closed or until the temperature of the Rectifier heat sink is stable for a period of one hour. Where the temperature continues to rise after a period of 7 hours the equipment will be rejected. The ambient, cabinet compartment internal temperature, heat sink temperature and transformer winding temperatures must be recorded during the heat run and plotted upon conclusion of the heat run. K type thermocouples shall be used for the continuous recording of the all the various temperatures.

Immediately after the heat run, the aforementioned insulation check will be carried out without the power or load applied. A maximum heat sink temperature of 80 °C is permissible at the highest vertical point of the heat sink.

Control mode testing shall be carried out after the conclusion of the heat run.

Constant current tests

The manufacturer will demonstrate the TRU's ability to control the output current to within 5 % of the pre-determined set point. The load resistance is to be manually adjusted to ensure that the output current remains constant irrespective of the load resistance. Four specific current set points are to be set 25%, 50% 75% and 100% of maximum rated output current. Voltage at the given pre-determined set points will be recorded and noted in the O & M Manual.

Constant voltage tests

The manufacturer will demonstrate the TRU's ability to control the output voltage within 5% of the pre-determined set point. The load resistance is to be adjusted to ensure that the output voltage remains constant irrespective of the Load resistance. Four specific voltage set points are to be set 25%, 50% 75% and 100% of maximum rated output voltage. Current at the given pre-determined set points will be recorded and noted in the O & M Manual.

Constant potential tests

The manufacturer will demonstrate the TRU's ability to control the electrolyte to structure potential within 50 mV of the pre-determined set point. Current limit and voltage limit features are to be tested and verified whilst carrying out potential mode testing. Dynamic feedback is required to demonstrate the control mode. That is, a simulated Cathodic Protection system must be used to demonstrate the control mode. In the potential mode verification a variable power supply may not be used to simulate the Reference Electrode.

Telemetry

The rectifier shall be provided with outputs suitable for connection to a SCADA system. The outputs shall be potential free contacts for alarm and status signals, and 4 – 20mA, 0 – 5V, or actual value for analogue signals. A comprehensive Ethernet Modbus signal may be provided as an alternative.

- Power consumption and quality monitoring
- Mains failure
- Fuse failure
- Output current
- Output voltage
- Pipe/soil potential

Detailed requirements for remote monitoring will be determined by the C & I system for the project.

NATURAL DRAINAGE UNITS (NDUs)

General

Typically an NDU is a device connected between a pipeline and the return rail of a DC traction system. The NDU allows current to pass through in a unidirectional manner i.e. when the Pipeline becomes more positive than the rail, then current will pass through the NDU from the pipe to the rail. When the rail is positive with respect to the pipeline no current will flow through the NDU.

It is critical that the diode within the NDU be adequately sized and protected by a series fuse which is selected to meet both the forward current and I^2t rating of the Diode as well as the cables. All field cable terminations will be made directly to sections of copper buss bar designed for cable termination.

All current carrying conductors shall be suitably rated buss bars fabricated from copper. The buss bars shall be capable of carrying a continuous current of 600 A. The temperature of the buss bar shall not increase by more than 6°C above ambient at 600 A.

Joints and connections in the buss bars must be kept to a minimum. Suitably sized brass bolts, flat washers and spring washers shall be used to secure the joint. The brass securing bolt or bolts must have the same cross sectional area as the buss bar. The jointing faces must be liberally coated prior to jointing to ensure oxygen exclusion at the joint face with a suitable proprietary compound. Excess compound shall be cleaned from the joint after the joint has been finally tightened at correct torque setting.

Copper buss bars must be tinned or white zinc plated irrespective of whether the buss bar is sleeved with a heat shrink or plastic sleeve.

Diodes shall be of the silicon type. The Diode shall be a suitably rated hockey puck type and shall be mounted between two aluminium heat sinks and clamped to manufacturers torque settings. No parallel diodes will be permitted. Care must be taken when mounting the diodes between the heat sinks to ensure that the faces to which the diode contact are absolutely parallel.

The diode selected is to be rated at a minimum of 4 000 V peak inverse voltage and be capable of a peak forward current of 2800 A. Stud mount diodes will not be permitted.

The resistor and capacitor used in the snubber network must be suitably rated to cope with transients from both pipe and rail caused by lightning or switching surges.

The snubber devices are to be mounted separately, be easily accessible and must be as close as possible to the diode, without being mounted to the heat sink. Connections to the snubber devices must be kept completely separate from any other wiring in the NDU.

A 50mV shunt must be installed in series with the cathode leg of the diode immediately after the diode. The sensing terminals of the shunt must be brought out to captive insulated test stations (Banana Sockets) to accommodate banana plugs. A 72 x 72mm panel mount moving coil milli-volt meter must be installed. Full Scale Deflection of the meter must be 600 A and graduated in minor divisions of 20 A with major graduations of 100 A. The banana sockets must be mounted below the moving coil meter. The accuracy of the panel meter must be better than 1.5%.

A substitute shunt rated at 60A with the same physical stud spacing as the 600A shunt must be provided with the unit.

Fuses shall be of the DIN 3 indicating fuse type. Fuse holders shall be knife action type with adequate spring tension. A fuse puller must be left attached to the fuse within the NDU. A DIN 3 fuse base must be installed into the cathode leg as well as the anode leg of the NDU as close to the cable connections as possible. Only one fuse will be fitted into the cathode leg and the fuse base mounted in the Anode leg of the NDU must be fitted with a suitably rated removable link equipped with similar removal fixtures as the fuse. Fuses shall be rated to protect both the current and I^2t rating of the diode.

A 100A fuse of the same dimensions as the 600A fuse must be provided with the unit.

Surge Protection

Surge protection shall be incorporated so as to protect the NDU from surges from both the pipe (lightning) and the rail (switching). Note that the rail being a live load places severe demands on the quenching capabilities of any spark gaps used in the NDU. The surge diversion devices are to be connected to the field side of the fuse holders. The surge protection shall be in the form of “pi” filters in both positive and negative legs with air-cored inductors.

The brass terminating studs utilized for rail connections must differ in diameter to those utilized for terminating the pipe connections. The rail termination studs must be M16 and the pipe termination studs M10. Only one termination is permissible per stud. Termination lugs used for field cable termination must be of the distribution lug type, adequately rated and hexagonally crimped. Dimple crimping of the cable lug to cable core is not permissible. Colour coded heat shrink or plastic sleeves must be installed to identify the rail and pipe conductors. Rail conductor is to be marked with a red sleeve 40mm in length and the pipe conductor with a black sleeve 40mm in length as close to the lug body as possible. The

sleeves must be tight fitting and not able to slide easily along the length of the conductor after fitment.

FORCED DRAINAGE UNITS (FDUs)

The FDU comprises a TRU and NDU mounted on a common chassis.

The FDU will typically operate in constant pipeline potential mode.

Provision must be made to decouple the TRU from the NDU with a series resistor in the event that it is necessary to limit the output of the unit under natural drainage conditions.

The FDU shall be designed and constructed in accordance with the specifications for TRU and NDU.

The rating of the TRU component of the FDU will typically be 100V 100A DC.

The unit shall be so designed that the transition from forced to natural drainage and vice versa will be seamless. Under natural drainage conditions, no current should flow through the TRU power circuit.

TESTING AND MONITORING

Pipe-to-soil logging

Pipe-to-soil potential measurements will be complimented by measuring the stray current fluctuations over periods of twenty four hours, using data loggers.

Testing of Isolating Devices

The status of isolation devices such as insulating flanges and monolithic joints will be tested using a radio frequency tester, such as the Tinker and Rasor™ RF IT Tester and not by measuring the potential difference on either side of the joint with a conventional digital voltmeter.

Digital volt meters and CP Analyser

All digital voltmeters used for potential measurements and logging will need to be calibrated.

The use of cathodic protection analysers, based on waveform analysis is encouraged.

Coating Performance Testing

The pipeline itself must be electrically continuous and all other civil structures and extraneous earths shall be electrically isolated from the pipeline at pump stations, off-takes, chambers, scour valves, air valves, non-return valves, etc. by means of insulating flange kits, etc. The pipeline shall not be bonded to Foreign Service pipelines unless designed accordingly and subsequent to interference testing.

Current draining testing shall be conducted in accordance with NACE TM0102. Not more than 5,000 m of pipeline may be tested at any given time during construction.

The Contractor shall submit a written Method Statement regarding the current draining testing for approval, prior to commencing with the Works.

The Electrical Coating Conductance shall be normalised to the 10 Ω.m soil.

The Electrical Coating Conductance shall be <100 µS/m² for the pipeline.

All coating defects shall then be located using the Direct Current Voltage Gradient (DCVG) technique, as approved by the Engineer. The Contractor shall then carry out excavations and coating defect repairs, until the coating complies with the <100 µS/m² criteria.

TEMPORARY CP

Temporary cathodic protection during construction of the pipeline is a vitally important activity. Significant external corrosion can occur on pipelines during construction if this is not done correctly.

Temporary cathodic protection under stray current conditions is time consuming as the stray current patterns change on a daily basis, as the pipeline segments increase in length. The temporary protection is provided by a number of different systems, both sacrificial and impressed current and these also change depending on the level of stray current activity on the pipeline. In addition, there are many temporary bonds, using copper cable to tie-in segments of pipeline in order to make them electrically continuous. These need to be checked and monitored on a daily basis.

It is therefore necessary to take frequent potential measurements on the pipeline segments during construction and make daily adjustments to the temporary CP systems. The procedures and methodologies for doing this are described in this section.

Temporary CP Criteria

The criteria for temporary protection during monitoring of temporary CP shall be in accordance with SANS 15589 as follows:

During temporary protection where temporary ICCP is in use, a minimum ON potential of -2500mV (excluding spiking) vs. $Cu/CuSO_4$ reference electrode shall be utilised.

The percentage time within the specified protection criteria shall be determined and ensure that a minimum of 95% of the potential recording is within the specified protection criteria.

Where temporary SACP is in use, and there is no stray current activity, a minimum ON potential of –1000mV vs. $Cu/CuSO_4$ reference electrode shall be utilised.

Installation of Temporary Cathodic Protection

Installation of hi-potential magnesium anodes for temporary CP

For temporary protection using bagged Hi Potential Magnesium Anodes the following procedure will apply:

The anodes shall be installed vertically such that the top of the anode is 1.5m below the natural ground level.

The anodes shall be installed where required in conjunction with a Type D test station.

The distance between the anode/s and the pipe to be protected shall be 3-5m depending on available space and shall be installed on the spoil side of the pipe.

The anode tail of each anode shall be terminated on the pipeline by means of a thermit weld or stud weld on the access tee flange. Welding the anode tail onto the barrel of the pipeline is not permitted.

The anode excavations shall be backfilled with native soils.

The GPS co-ordinates of the exact location of the Hi-potential Magnesium anode/s shall be recorded to ensure that the magnesium anode/s is disconnected once the permanent CP system is installed and energized.

Installation of temporary ICCP systems

Under stray current conditions experienced during the construction phase, it may be necessary to implement temporary ICCP system. The following procedure is recommended for the implementation of temporary ICCP systems in order to provide protection.

The temporary ICCP systems shall comprise constant current portable TRU's when DC railway lines are being used as temporary groundbeds, or potential-controlled battery systems with temporary anodes.

The location of the ICCP stations shall depend on the following:

- Construction progress.
- Stray current levels measured on the pipeline.
- Progress in the installation of the permanent ICCP Stations.

Appropriate soil resistivity in the area where temporary protection is required.

The extent and frequency of ICCP systems shall be at the discretion of the cathodic protection site engineer and as a rule shall be applied to provide protection wherever the integrity of the pipeline may be compromised by stray current activity.

Temporary Cathodic Protection Monitoring Procedure

The temporary protection monitoring procedure shall be classified for SACP and ICCP segments as follows:

SACP segments

- Spot ON potentials shall be taken once per week for 15 minute intervals during which the minimum, maximum and mean potentials shall be determined.
- The ON potential measurements shall be carried out at the following locations:
- Start of segment
- One third of length of segment
- Two thirds of length of segment
- End of segment
- Each segment shall not exceed 5km in length. Once a section exceeds 5km then the ON potential measurements shall be carried out at every 1 to 1.5km along the pipeline section.
- The mean potential value shall comply with the minimum ON potential of -1000mV vs. Cu/CuSO4 reference electrode.
- Where spot potentials do not comply at any location, the situation shall be rectified by the installation of additional discreet bagged magnesium anodes. The exact location of these anodes shall be the subject of interpretation by the cathodic protection engineer. The location and GPS coordinates shall be recorded for future reference.
- Results of monitoring and non-compliance interventions shall be reported on a monthly basis.
- Should the difference between minimum and maximum potential recorded exceed 800mV the relevant pipeline section shall be classified as a stray current affected pipeline section (ICCP segment).

ICCP segments

- 24 hour stray current ON potential recordings shall be carried out once per week on all pipeline segments classified as stray current affected pipeline sections.
- The recordings shall be carried out at the following locations:
- Start of segment
- One third of length of segment
- Two thirds of length of segment
- End of segment

- Each segment shall not exceed 5km in length. Once a section exceeds 5km then the 24 hour stray current ON potential recordings shall be carried out at every 1 to 1.5km along the pipeline section.
- The ON potential recordings shall be graphically presented and the maximum, minimum and mean values determined.
- The minimum potential shall comply with the specified temporary protection criteria, i.e. a minimum ON potential of –2500mV (excluding spiking) vs. Cu/CuSO4 reference electrode.
- The percentage time within the specified protection criteria shall be determined and ensure that a minimum of 95% of the potential recording is within the specified protection criteria.
- Where stray current ON potential recordings do not comply due to stray current activity the situation shall be addressed by the installation of temporary portable transformer rectifier units and groundbeds (SiFe). The exact location of these units shall be the subject of interpretation by the cathodic protection engineer.
- Results of monitoring and non-compliance interventions shall be reported on a monthly basis.
- Only once a particular pipeline segment has an energized permanent ICCP system at either end shall monitoring be reduced to 24hr ON potential recordings fortnightly, until the commissioning of that particular pipeline segment is completed. Subsequent to this and upon approval from the owner, the 24hr ON potential recordings may be reduced to once every 2-3 months.

OPERATION AND MAINTENANCE MANUALS

The contractor will refer to The Client's specification regarding number of copies, format, binding etc. of submitted documents.

The CP System Operation & Maintenance Manual (O&M/OMM) will provide the owner and technical staff with knowledge on the operation of the CP system and the subsequent maintenance thereof.

The OMM shall include the following

In general an OMM shall include the following:

- Manual Update / Revision Register: Page where any alterations, after the final manual distributed, can be noted.
- General Description: This is aimed at Artisans and Operating personnel and should be presented in simple terms with little technical detail.
- Operating Instruction: These should be clear, concise, easy to follow and must include all necessary checks.
- Routine Maintenance: This shall include charts covering the complete installation, i.e. if a manufacturer's manual is included to cover a "brought-in" item, then the relevant maintenance instructions must be extracted and included on a master chart so that the Operator has only one check-list of periodic servicing to cover the whole installation.
- Fault Diagnosis (Flow chart could also be used) and Repair Procedures: Shall include details of all servicing replacement and repairs which Artisans or Operating personnel would be expected to carry out on site. In this section the reader may be referred to supplier's brochures elsewhere in the manual for specific detail.
- Full details of calibration and adjustment for the meters, monitors and electronic circuitry including all control and power supply cards shall be provided.
- Components
    - Component Names.
    - Component Values and/or Rating.
    - Spares Lists: where possible, drawings shall be positioned opposite to the appropriate text.
    - Component values, description and Supplier's name and contact details shall be included in the Maintenance Manual.
- Certificates: The following certificates must be included:
    - Competence test certificate.
    - Heat run test certificate (Generation Graph).

    - Handover certificate.
    - Delivery checklist complete Guarantee.
    - Coating certificate.
    - Output load test certificate – Maximum Output.
    - Overload test certificate
    - Insulation Test Certificate (1kV)
- Electrical schematic, component layout drawings and cabinet construction and layout drawing must be included with the maintenance manual.
- Telemetry: Details of Remote Monitoring operation, service, testing and repairs. Specification: Brief summary of the equipment specifications must be given
- Special and Safety instructions: Any special instructions regarding the equipment which is important to know.
- Subcontractors / Supplier's brochures and instructional literature.

Installation data packs:

All drawings are to be to scale and presented in suitable AutoCAD format as agreed to with The Client. Prior to finalising drawings it shall be submitted to The Client for his/her perusal and approval.

Records of the installation, problems, and site meetings shall be kept and handed to The Client upon handover.

Minutes shall be kept at every meeting held with The Client or third parties affected by the contract. Copies of these minutes approved / accepted by all parties concerned shall be distributed and kept on record as the project proceeds. Approved minutes of meetings will be used as the basis of assessing additional work, claims and extensions of time. Should The Contractor fail to keep such minutes The Client reserves the right to assess claims, additional work and extensions of time based on fair assessment of the site conditions and requirements to complete the project successfully.

The Contractor shall keep thorough records for the duration of the contract with a duplicate file for presentation to The Client on successful completion of the project. Documentation should typically include, but not be limited to:

- Quality Control Plans.
- Hazard Identification and Risk Assessment Plans.
- Test certificates.
- Certificate of Compliance for electrical works.
- Site inspection certificates.

- Minutes.
- Variation orders.
- Correspondence with The Client.
- Correspondence with third parties.
- Rainfall on site.
- Site notes reflecting working conditions, difficulties and progress on a daily basis.

AC MITIGATION

The use of Solid State DC Decoupling (SS-DCD) devices is the most superior form of ensuring electrical isolation. This equipment must not only ensure that it meets the safety standards enforced relating to effective earthing / grounding of a structure, but it must also ensure adequate electrical isolation for the Cathodic Protection (CP) system. The SS-DCD shall protect personnel and equipment during all types of electrical disturbances by providing an effective grounding / earthing path which will instantaneously conduct:

- AC fault currents
- Lightning
- Induced AC
- Power switching surge currents

Applications include but are not limited to:

- AC fault current protection across IFs and other devices
- Mitigation of induced AC on pipelines and other structures.
- Lightning protection for equipment including Transformer Rectifier Units (TRU), pipelines, cathodically protected tanks and other structures.
- Decoupling between primary structures and general earthing systems.

A CP engineer will conduct AC interference investigations and there-after compile a report containing findings and mitigation recommendations to be discussed with The Client's Engineer. Investigations and reports shall be conducted as per NACE SP0177 and ESKOM guidelines. Mitigation measures will be designed to maintain the following conditions on the pipelines and appurtenances.

- Steady state touch potentials at above-ground appurtenances will be below 15 VAC
- Maximum steady state touch potentials at buried and normally inaccessible portions of the pipelines will be below 50 VAC
- Maximum coating stress voltages will be below 5 000 V
- Short term transients will be in accordance with IEC voltage/time constraints.

Where mitigation is required to maintain the above criteria, gradient control wires, zinc grounding electrodes and gradient control mats will be designed.

All pipelines crossing or running parallel to overhead power lines with the rating greater or equal to 66kV will be investigated. The Client will provide the shape files of the Eskom power lines to the successful contractor.

Gradient Control Wires

Zinc ribbon shall be installed (where necessary, depending on the detailed AC mitigation design) within the pipeline trench at strategic locations as gradient control wires to ground any steady state AC and reduce the potential difference between the pipelines and local earth during AC power system fault conditions.

The composition of the zinc will be as per ASTM B418, and suitable independent compositional testing will be carried as directed by The Client, in addition to the quality control information presented by the supplier of the zinc ribbon.

The zinc ribbon geometry will be of the “standard” dimensions as follows:

Cross section (D1 x D2)	12.7 mm x 14.3 mm
Radii (R1 x R2)	2 mm x 5 mm
Zinc weight	0.89 kg/m
Steel core diameter	3.3 mm
Potential	-1.1 V vs CSE
Capacity	780 Amp hrs/kg

Ribbon is to be installed at a depth of 800mm and where necessary, spaced 1000mm apart equidistant either side of the pipe centre-line.

Gradient control wires will not be connected directly to the pipelines, but through low voltage solid-state decoupling devices (SS-DCD), see below. These wires should not be installed in length in excess of 400m for the given rating of the SS-DCD

The length of zinc ribbon required at each location has been detailed in the CP and ACM Design Report.

Valve Chamber Earth Mats

Gradient control mats (equipotential mats) and/or insulating surface layers shall be installed at valve chambers and bunkers for step and touch protection. The mats will comprise 200 x 200 x 8mm galvanised weldmesh. A connection point must be provided for attachment of the 25 mm² cables.

External mats shall be buried at 600mm below grade and extend 1.2m beyond the valve chamber in all directions.

Alternatively, an external “skirt” or surround of asphalt 150mm thick with an underlying impermeable 1mm thick polymeric membrane shall be placed around the chamber extending 1,2m in all directions.

Internal mats shall be placed below the stone layer of the floor of the valve chamber, or cast into a conductive screed in place of the normal cement screed as appropriate.

Continuity bonding of chamber reinforcing may be utilised subject to the approval of the Engineer in place of the gradient control mats provided the reinforcing is welded to create a continuous cage.

The internal grid (rebar or weldmesh) must be connected via two separate insulated copper tails.

The groundmats (internal and external) must be separately connected to the pipeline through the low voltage SS-DCD’s

All the excavation related to the installation of the earth mat should be priced for under the installation of valve chamber earth mat item on the bill of quantities.

Cable connections

All cable connections from either zinc ribbons, gradient control mats or valve chamber reinforcing shall be 25mm^2 stranded copper with green/yellow insulation.

2 cables are required for ground mat and rebar connections. Copper to steel connections shall be crimped and encapsulated to prevent water ingress

Solid State Decoupling Device (SS - DCD)

The SS-DCD shall be non-electrolytic, fail safe and maintenance free.

Fail safe shall imply that the failure of any SS-DCD component, shall result in an open circuit system and not a short circuit system. That is, the pipeline or structure shall never be directly connected to the earthing or grounded system.

SS DCD will be installed inside an enclosure at locations along the AC-affected portions of the pipelines, through which the gradient control wires will be connected to the pipelines.

Two types of decoupling devices are used. The first type will be used to decouple the zinc ribbon from the pipeline and the second to decouple the gradient control mats from the test station connection.

Details are as follows:

Performance specification for AC mitigation decoupling device

Steady state AC current:	45A
AC fault current rating:	3.7kA for 500ms
50Hz AC impedance:	0.04Ω
Lightning current rating (10/350µs))	100kA
DC blocking voltage:	-12/+1V
Diode PIV	1500V
Diode forward surge current	1200A
DC steady state current (15 min):	60A
DC sparkover voltage:	1.0kV
Lightning impulse voltage:	2.2kV

The decoupling device shall comprise a suitably rate diode stack capable of blocking direct current in both directions at the specified voltages.

Once the blocking voltage is exceeded, the diode stack shall be capable of conducting the steady state DC up to 60A (15 minute rating) without overheating.

The device shall exhibit a progressive, smooth transition from blocking to conduction and vice versa without commutating.

A bypass capacitor (network) shall be connected in parallel with the diode stack to conduct 50Hz AC up to the blocking voltage of the diode stack.

The capacitor and diode network shall be protected by a suitably rated spark gap for high voltage and lightning induced transients. This will include the appropriate inductance required to decouple the spark gap from the diode stack in terms of lightning protection zone standard practice.

Note: If DC blocking voltage higher than 12V is required, a thyristor based SS-DCD may be utilised. Details of the design and performance characteristics shall be submitted to the Engineer for approval.

The decoupling device shall preferably be of open frame construction to permit maintenance / replacement of component parts. The frame shall be sized to fit on a standard 800 X 600mm chassis plate. The unit will be mounted inside an IP65 rated enclosure.

Component parts shall be of reputable manufacture with proven performance record and certificated test data.

The decoupling device shall be provided with two M10 terminals at each pole for the connection of 25mm² single core cables.

Performance specification for a DC transient protection device for test station ground mats.

AC fault current rating:	50kA
DC blocking voltage:	100V
Lightning current rating 8/20:	40kA
Lightning impulse clamping voltage:	<500V
Response time:	25ns

The test station ground mats are provided for personnel safety during short term (transient) voltage spikes which may occur due to powerline faults or lightning. They are not required for steady state AC mitigation.

Enclosure Construction

The SS-DCD device shall be enclosed in a suitably rated enclosure as required by SABS 0108, SABS 089 and SABS 086. The enclosure shall also be rated according to the environmental conditions prevailing. This includes but is not limited to vandal resistant concrete reinforced structures where required on transmission and distribution pipelines. Solid State DC Decoupling Devices (SS-DCD)

Inspection and Testing

The testing of the SS-DCD shall be carried out at the Supply Contractor's works or at the third party inspector's laboratory/works. A sample of the SS-DCD to be supplied shall be selected in accordance with BS 6001: Part 1 for testing purposes. All of the SS-DCD device components shall pass the tests and the testing shall be carried out in the presence of The Client. The Supply Contractor will issue a Test Certificate upon completion of the tests and it shall be signed by The Client. All of the testing shall be carried out at the Supply Contractor's expense.

The SS-DCD shall be supplied with the following items :-

- A removable clear-polyester laminated circuit diagram, which shall be located inside the enclosure.
- Operation and Maintenance Manual (OMM).
- Recognised third party testing certificate that sets out the test conditions and test results confirming compliance with the performance specification of the SSDCD.

The equipment shall carry an unconditional two year guarantee. The only exceptions shall be for damages arising from vandalism, mechanical damage, external fire and flooding.

Cathodic Protection Monitoring Points

All cathodic protection monitoring points along the section of the pipeline subject to AC interference are to be of dead front construction unless the appropriate gradient control mats have been installed.

A dead front test point shall be constructed in such a way as to ensure that no metallic parts are exposed to a person on the operating side of the equipment. Contact should only be possible with insulated measuring probes. Appropriate operating instructions and a warning of the hazard shall be printed adjacent to the measurement points. Access to the live side should only be available to trained personnel. The test station is to be installed inside a galvanised steel or reinforced concrete bunker enclosure.

NAMING CONVENTION FOR EQUIPMENT AND MATERIALS

The labelling technique for each item will be specified by The Client. If a technique is not specified the labelling shall comprise the use of stencils with a compatible paint system approved by The Client before application.

The naming convention for all equipment shall following the following convention:

TRUs, NDUs and FDUs

TRU, NDU and FDU shall have engraved name plates labelled with the following:

- Location name.
- Reference number comprising: Client abbreviation, Unit Type first letter, supplier abbreviation, supply date month and year ie. JW/T/CPSA/0105.
- Supplier serial number.
- Date of Supply.
- Client Name.
- Font size to be no less than 6mm high.

The Client shall specify external and internal labelling requirements for TRU, FDU and NDU for ease of identification. Typically these units will have the following external labels:

- Unit name.
- Location.
- Contact number.
- Font size to be no less than 30mm high or as specified.
- Black lettering on white background.

Test Stations, Monitoring Points, Bunkers & Other Monitoring Facilities

Test stations, monitoring points, bunker type stations and other monitoring facilities shall have a sequential number system relative to the pipeline or pipe network.
The monitoring facilities system shall be labelled as follows and/or in accordance with the Client's specifications:

- Monitoring test station : Type A
- IR free test station :Type B
- Recording stations :Type C
- Bunker stations :Type D
- Cross Bond stations :Type E
- Test station where ACM is installed :Type FX*

*X can be any letter from A-E depending on the type of installation within the ACM test station.

- Unique number supplied by The Client to follow above abbreviation.
- Client abbreviation will prefix the stations label. Example: JW/TP10013.
- Font size to be no less than 20mm high.
- Monitoring stations that have lockable doors / facilities shall include internal labelling comprising:
    - Date of manufacture.
    - Station number.
    - Pipeline route.
    - Label and print size will be determined by the space available in the enclosure.
    - Labelling to be on a white Trafolyte board with black lettering.

CONTRACTOR REQUIREMENTS

Construction, Testing and Inspection

The Contractor shall not commit any act of trespass or commit any nuisance and must confine all installation personnel to the servitude widths, access roads, etc., as approved by The Client so as to avoid any damage to adjacent crops, structures, fences, livestock, etc.

The Contractor shall provide and maintain at all stages of the work adequate drainage pipes at all contour drainage channels, existing furrows, subsoil drains, subsoil irrigation pipes, etc., which are cut by the works and the cost of this work shall be to The Contractors account.

The Contractor shall not permit any operation which may constitute a fire hazard.

The Contractor shall bear the cost of damage caused by fire started during the Contract or maintenance periods due to any negligence on the part of The Contractor or his workmen.

FDUs, NDUs and TRUs

The Client or his representative shall at all times have the right to inspect and test all equipment, materials and workmanship as work progresses and to reject material and/or workmanship which is defective, does not comply with best Engineering practice or otherwise not in accordance with the Contract.

The Contractor shall manufacture one of each type of equipment for inspection and notify The Client of its completion.

Any rejected work or material shall be satisfactorily corrected and/or replaced, the cost to be borne by The Contractor.

On written instructions of The Client, The Contractor may be called upon to leave the pipeline exposed for inspection for any particular part of the works that they consider necessary. Such written notice can be given at any time during the installation of the works.

On completion of all works and prior to the commissioning, The Contractor shall avail himself for a final site inspection. This shall comprise of a thorough inspection of all works carried out and a punch / snag list shall be issued for any remedial works.

Work to be Supervised by a Qualified Representative

The carrying out of all works included in the contract shall be supervised throughout the duration of the Contract by an approved representative of The Contractor.

Supplier to Submit Full Details

The Contractor shall submit full data and particulars to enable a decision on the conformity of the equipment, etc., offered to the Specification and to enable a comparison with the other quotations / proposals received.

The data and particulars required which shall be submitted in duplicate, shall include full technical, descriptive and dimensional particulars and drawings of:-

- Transformer Rectifier Units,
- Resistive Bonding Units,
- Wire Anodes and
- Any other equipment as specified in the Bill of Quantities.

No proposal / quotation will be considered which is not accompanied by sufficient data and particulars as described above. Unless specifically stated, it will be assumed that all equipment complies in full with the Specification.

Commissioning, As-Built Drawings and Records

Commissioning

The CP System will be commissioned by the appointed Specialist Consultant to ensure that the installation was performed to standard and that all respective equipment operates satisfactorily.

Drawings

All drawings are to be to scale and presented in AutoCAD 2000 format. Prior to finalising drawings it shall be submitted to The Client for their perusal and approval.

Records

Records of the installation, problems and site meetings shall be kept and handed to The Client upon handover.

Spare Parts

Spares (2 off) shall be supplied as specified and either attached to a panel affixed inside the equipment cabinet or separately in a spares box. Listing of all spares detailing their specifications, locations and sizes shall be attached to the equipment.
The component manufacturer (supplier) list and contact details shall be provided with all spares complete with current price list – fuses, MOVs, diodes, Thyristors, spark gaps and control cards.

Installation

Supply / Installation Obligations

The Contractor shall warrant and guarantee that the materials and workmanship provided shall be in accordance with the Contract Specification.

The Contractor shall furnish to The Client, on completion of all works and before Contractor's handover, detailed sketches of all as built equipment, should they differ from the original proposed equipment and installations, thereby providing The Client with a correct record of all works carried out.

It shall be the responsibility of The Contractor to ensure that all items are available for inspection prior to delivery.

All materials, plant and equipment shall be the best of their respective kinds and spare parts, replacements and servicing facilities shall be readily available from local sources.

All work shall be carried out by qualified personnel and shall be correctly supervised.

Guarantee of Equipment

The Contractor is required to supply a written guarantee on the items supplied by him for a period of 2 years from date of commissioning under continuous working conditions (refer to Section 1).

Any faults as may be certified by The Client due to poor materials, workmanship or The Contractor's design (where applicable), shall be remedied and faulty goods replaced entirely at The Contractor's cost.

The Contractor is responsible for the guarantee of all items under the terms of this tender and for the safe delivery and installation of the equipment and materials, as called for in the Schedule of Rates and Quantities, unless otherwise instructed in writing by The Client

Operation and Maintenance of the CP System

The CP System Operation & Maintenance Manual (OMM) will provide the owner and technical staff with knowledge on the operation of the CP system and the subsequent maintenance thereof.

CP System Acceptance Criteria

Operational Acceptance Period

When all tests have been successfully completed to the satisfaction of The Client, an operational acceptance period shall start and shall consist of a continuous period of operation of two weeks free from trouble. During the operational acceptance period The Contractor shall carry out all necessary servicing and any adjustments required.

Certificate of Completion

A certificate of completion will be issued in line with the conditions of contract applicable to the specific project in question.

CONSULTING AND ENGINEERING SERVICES

Method Statements and Performance Criteria Statement

Before any consulting or engineering task is undertaken the onus rests on the organisation tasked with the work to provide a detailed method statement that will include as a minimum:

- The relevant, recognised standard that will be used a baseline for reference or evaluation purposes.
- The specific method statement for the work at hand that sets out the expected challenges, proposed solutions, actual evaluation and assessment of results.
- Quality Control and Assurance Plan complete with suitable methods for application in the field and during the reporting phase to ensure a high level of repeatability and traceability.
- Hold Points for Client or authorised representative validation and sign off.
- Reporting format and level of raw data to be provided.
- Failure to provide the minimum information set out above may result in The Client exercising the right to issue a re-work instruction for the specified tasks to be repeated at no cost to The Client.

Performance Criteria Statement shall be established before field work and investigations are undertaken and will typically require the following as a minimum:

- Project Schedule with a minimum of Level 3 planning visible for main tasks.
- Milestone dates for the delivery / completion of each task.
- Anticipated delays: rain, access, interference from 3rd parties, equipment failure, permits, health, safety and environmental requirements. The Project Schedule should make adequate provision for anticipated delays that can be validated by The Client in the event of a cost implication.
- Performance Measurement and Payment shall be linked to the project schedule, agreed milestones and specific Quality Control and Assurance criteria that can be measured.
- The organisation undertaking the surveys, investigations, designs, QA/QC and field supervision shall submit a Performance Criteria Statement to The Client for review, acceptance and sign off before work commences on site.

Failure to provide the minimum information set out above may result in The Client exercising the right to issue a re-work instruction for the specified tasks to be repeated at no cost to The Client.

SURVEYS AND INVESTIGATIONS

Soil Resistivity

- Measurement at 100m intervals and 50m if less than 50 Ω.m.
- All measurements to comply with ASTM G57 (Wenner Four Pin Method)
- All measurements to be supplied with GPS co-ordinates (minimum 5m accuracy) WGS 84 Datum.
- Two readings per location by the Wenner 4 pin method with a spacing of 1m and at the average pipe invert depth. Layer resistivity to be calculated for the two layers.
- Results to be tabulated and presented as resistance and calculated layer resistivity values.
- Results to be plotted on a map using GIS software, colour coded according to parameter values.
- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.
- Instruments: Calibrated Null balance Soil resisitivity meter.
  Applicable wire harness .
  Steel Copper plated / Galvanised electrodes ASTM G57.

Spot Pipe-To-Soil Potentials

- Co-ordinates to be supplied for every measurement (minimum 5m accuracy) WGS 84 Datum.
- Measure potentials with respect to a saturated $Cu/CuSO_4$ reference electrode (unless otherwise specified) at all available monitoring facilities, valve chambers and above ground pipe segments.
- Results to be tabulated.
- Results to be plotted on a map using GIS software, colour coded according to parameter values.
- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.
- Instruments: Digital Voltmeter – 10MΩ Minimum Input Impedance.

- Reference Electrode Saturated $Cu/CuSO_4$ reference electrode (unless otherwise specified).
- Relevant SANS and NACE standards shall be weighed up against site conditions, stray current conditions, foreign structures / pipelines and the congestion of the pipeline route to select the most suitable measurement / assessment technique.

Stray Current

- The presence of stray currents and the magnitude shall be assessed prior to the installation of the pipeline and after the installation. Acceptable input impedance data loggers shall be used with the sampling rate of at least one value in every 5 seconds for a minimum duration of 24hrs.
- Relevant SANS and NACE standards shall be weighed up against site conditions, stray current conditions, foreign structures / pipelines and the congestion of the pipeline route to select the most suitable measurement / assessment technique.
- Recordings to be carried out at 1km intervals along the pipeline route on existing pipelines. Where a route is being assessed prior to pipe installation, an assessment is to be made by recording the potentials of existing adjacent metallic infrastructure such as existing pipelines, powerlines etc. Where the pipeline crosses a railway line, the potential of the rail is to be recorded at the crossing point. Where the pipeline route runs parallel to a railway line, the rail potential shall be recorded at the point of approach and departure of the parallelism as well as at 1km intervals in between.
- Provide Raw data files plus graphs
- Results to be plotted on a map using GIS software, colour coded according to average, maximum and minimum parameter values.
- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.
- Scale to be clearly indicated (Volt Scale to be used) and standardised for each recording
- Instruments: Digital Recording Data Loggers
    - Input impedance must be greater than 10MΩ
    - Must be synchronisable – date and time stamped
    - Voltage ranges +20Vdc to -20Vdc and +100mV to -100mV.

Electrical Continuity, Isolation and Coating System

- Electrical continuity of pipelines shall be assessed under current drainage conditions.
- A DC current is to be applied to the pipeline by means of a suitable portable transformer rectifier unit and temporary groundbed and shift in pipe potential is to be determined at all available monitoring points, valve chambers and above ground pipe segments. Where an electrical discontinuity is suspected, a test is to be set up at a point beyond the suspected break and the discontinuity verified. In some cases it may be possible to install a temporary continuity bond as a means of verifying the break and extending the range of the test. Testing should cover the entire pipeline length.
- All locations requiring continuity bonding shall be identified such from the testing as well as from visual inspections of features such as in-line valves, etc.
- All pipeline electrical isolation requirements shall be determined and identified during the survey. This shall be determined from the current drain test results as well as from visual inspections.
-
- Results to be plotted on a map using GIS software, colour coded according to average, maximum and minimum parameter values.

  Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form. Equipment and Instruments: Suitably rated portable transformer Rectifier unit, portable generator and associated cabling and earthing equipment, a suitably rated solid state DC interrupter. Digital Voltmeter – 10MΩ Minimum Input Impedance. Reference Electrode Saturated Cu/$CuSO_4$ reference electrode (unless otherwise specified).

Current Requirement

- Pipeline current requirement is to be determined under current drainage conditions.
- A DC current is to be applied to the pipeline by means of a suitable portable transformer rectifier unit and temporary groundbed and shift in pipe potential is to be determined at all available monitoring points, valve chambers and above ground pipe segments.
- Spot pipe-to-soil potentials at each installed monitoring facility or selected locations prior to and during survey
- Temporary continuity bonding (Minimum 16mm² PVC cable – thermit welded / stud welded) may be installed if required. No clamped connections.
- Greater than 12 hour data recordings at selected locations
- Results to include calculated current density. Current density calculations are to take into account the attenuation profile of the test.
  Instruments: Suitably rated portable transformer Rectifier unit, portable generator and associated cabling and earthing equipment, A suitably rated solid state DC interrupter. Digital Voltmeter – 10MΩ Minimum Input Impedance. Reference Electrode Saturated Cu/$CuSO_4$ reference electrode (unless otherwise specified).Digital Data Loggers

Sulphate Reducing Bacteria (SRB)

- Soil samples to be collected and tested for the presence of SRB at pipeline depth.
- The laboratory facility, test kit or proposed method of assessment must be detailed and presented to The Client for acceptance and sign off before the tests are conducted. Failure to do so may result in a re-work instruction at no cost to The Client.
- Results to be plotted on a map using GIS software, colour coded according to parameter values.
- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.

Chemical Substance Analysis

Soil samples are to be analysed at 5km intervals (or as stipulated by the client) for the following:

- o pH
- o Calcium hardness (as CaCO3) (mg/ℓ) - Phenolphthalein
- o Magnesium ion (as Mg) (mg/ℓ)
- o Total sulphate ion (as SO4) (mg/ℓ)
- o Chloride ion content (as Cl) (mg/ℓ)
- o Total dissolved solids (mg/ℓ)
- o Conductivity (mS/m)
- o Redox Potential (V)

Holiday Detection

- Calibrated High Voltage Spark Tested as per SABS 1178 Section 7.2.2.
- Calibrated Wet Sponge Tester shall be used for internal linings.

Internal Inspection

- Physical inspection - access to be gained via access hole / valves.
- Digital colour photographs to be taken.
- Slime and/or any bacterial activity to be observed, collected and analysed.
- Upon The Clients request a Close Circuit Television (CCTV) camera inspection may be conducted.

AC/DC Stray Current Interference

- A comprehensive AC Mitigation survey shall be carried out as per NACE SP0177, in order to evaluate corrosion and safety risk of pipeline and satisfy the requirements issued by Eskom.
- Where transmission pipelines are located in close proximity of high voltage power lines, where resistive and/or capacitive and/or inductive coupling may occur, computer modelling of the system shall be performed in order to determine the extent of the interference under steady state and fault conditions.
- All of the relevant data pertaining to the supply authority shall be obtained including tower positions (coordinates), conductor details tower

geometries, locations of transpositions, peak load currents and fault current information, The soil resistivity is to be measured to depths of 200m in exponential increments as follows : 0.1m, 0.2m, 0.3m, 0,5m, 0,7m, 1m, 2m, 3m, 5m, 7m, 10m, 20m, 30m, 50m, 70m, 100m, 150m, 200m. Soil resisistivity measurements are to be taken at all crossings between pipelines and powerlines as well as at 1km intervals where the servitudes run parallel.

- A three dimensional model of the system is to be constructed incorporating all pipelines and powerlines known to lie within the system.
- Soil data collected is to be processed into multilayer soil models with an RMS error of less than 15%. This modelled soil data for each respective reagion is to be inserted into the interference model.
- The computer model is to be used to determine the extent of steady state and fault condition interference as well as to design the measures required to mitigate the interference to within acceptable ranges.
- Equipment and Software :

  Deep Soil Resistivity Meter :

  An appropriate deep soil resistivity meter capable of at least 800W of output and with facilities to measure and report standard deviations of each reading.

  Software :

  Software to be used is CDEGS Right of Way Pro or equivalent. The software shall have the following capabilities as a minimum :

  Allow for the construction of a complete three dimensional interference model containing multiple pipelines, multiple power lines within an environment of multiple (regional) multi-layer soils. The facility shall exist to individually specify for each element within the system, three dimensional geometries, coating conductances, conductor material parameters, and energizations. The software shall calculate, at a user selected interval, the steady state interference effects as well as the total (Conductive, Inductive and Capacatative) interference effects under fault conditions.

Pipeline Current Mapping (PCM) Survey

- Current and Current Loss Measurements to be made at 50m intervals for old pipelines (>10years) and 100m interval for new pipelines (<10 years).
- Defect locations to be identified in numerical order.
- GPS sub-metre accurate coordinates and pipeline chainages to be supplied for all measurements.
- Defect sizes (dB) to be identified and correlated with excavations.
- Results to be plotted on a map using GIS software, colour coded according to parameter values.
- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.
- Instruments :
  o Pipeline Current Mapping (PCM) equipment shall be used.
  o “A” Frame shall be used to pin-point defects.
  o Sub metre accurate GPS equipment shall be used.
- Relevant SANS and NACE standards shall be weighed up against site conditions, stray current conditions, foreign structures / pipelines and the congestion of the pipeline route to select the most suitable measurement / assessment technique.

Anode Groundbed

- Identify all possible locations, with and without AC power availability.
- Locate closest possible AC supply points
  - Relevant reference numbers on all masts
  - GPS coordinates (minimum 5m accuracy) WGS 84 Datum
  - Land owner details
  - AC supply owner details
- Sub meter accurate co-ordinates to be supplied with all measurements.
- Resistivity is to be measured at pin spacings as follows : 1m, 2m, 3m, 5m, 7m, 10m, 20m, 30m, 50m, 70m, 100m, 150m, 200m.
- Distance >100m from pipeline for all conventional horizontal type anode beds.
- Soil resistivity values are to be used to derive a multilayer soil model utilising computer software.

- The multilayer soil model is to be used to calculate anode groundbed resistance within a three dimensional DC computer model. The same computer model shall be used to calculated the attenuation profile along the pipeline.
- Results to be plotted on a map using GIS software, colour coded according to parameter values.
- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.
- Instruments: Deep Soil Resistivity Meter :

  An appropriate deep soil resistivity meter capable of at least 800W of output and with facilities to measure and report standard deviations of each reading.

  Software :

  Software to be used is CDEGS Resap and Malz or equivalent.

Direct Current Voltage Gradient (DCVG) Survey

- Relevant SANS and NACE standards shall be weighed up against site conditions, stray current conditions, foreign structures / pipelines and the congestion of the pipeline route to select the most suitable measurement / assessment technique.
- This survey will require a full DCVG survey equipment set including temporary rectifier systems, if there is no permanent CP system.
- Current interrupters will be installed at all DC current sources on either side of the section being tested. The switching cycle will be 900ms/450ms Off/On.
- The current interrupters shall be synchronized by means of GPS.
- The location of defects shall be made while walking directly over the pipeline. Measurements of the size of the defect shall be taken at every defect using remote earth.
- Position measurement of the defect shall be by means of GPS. GPS coordinates shall be to sub-metre accuracy.
- The coating integrity survey shall be undertaken by means of DCVG survey technique in accordance with NACE TM 0109 section 6, with compensation for stray currents. (Refer to NACE SP 0207)
- Results to be plotted on a map using GIS software, colour coded according to parameter values.

- Results to be supplied as hard copy as well as in spreadsheet and shape file soft copy form.

Close Interval Potential Survey (CIPS)

Relevant SANS and NACE standards shall be weighed up against site conditions, stray current conditions, foreign structures / pipelines and the congestion of the pipeline route to select the most suitable measurement / assessment technique.

This survey will require one mobile data logger and two static data loggers.

Current interrupters will be installed at all DC current sources as well as at the pipe/coupon connection of the test stations on either side of the section being tested. The switching cycle will be 800ms/200ms On/Off.

The current interrupters and the data loggers shall be synchronized by means of GPS.

Static data loggers shall be installed at test stations on either side of the section to be surveyed. These tests shall capture the “on” and “off” coupon potential values for a 24 hour period each at a minimum interval of 1s.

The “on” and “off” measurements shall be made while walking directly over the pipeline. Measurements shall be taken at least every 2m with an “off” value being recorded at least every 5m.

Position measurement shall be by means of a surveyor’s wheel as well as by GPS. GPS coordinates shall be recorded on the mobile data logger while surveying.

Design and Reporting

General Considerations

- Reference to be made to all relevant standards and specifications.
- Pipeline and landowner servitudes to be observed and adhered to.
- Design to afford protection for at least 20 years.
- The CP system to be complimentary to the protective coating system.

Choice of CP System

- Possible choices of CP system types to be considered during the investigation surveys. The two choices are ICCP or SACP.
- The choice to depend on practicality, cost effectiveness and other prevalent site conditions, etc

- Each system type to be investigated, discussed and motivated.
- Preliminary designs and budget estimates of each system type to be provided if applicable.

Detailed Design Calculations

- The final design document shall include all design calculations and the conclusion reached.
- The design calculations to be based on approved technical specifications and standards. All references to submitted with the design report.
- Certain components of the design shall be determined utilising modelling software. These include AC interference effects, DC interference effects, and anode groundbed designs

Reporting

- Three copies of each report to be provided along with a suitably marked CD containing the report in PDF format.
- Results provided in tabulated, graphical and statistic formats where applicable.
- Comments and Discussion of results.
- Graphs of data recordings (voltage scale clearly indicated).
- Recommendations.
- Estimated budget figures.
- Raw Client data (as uploaded from the data logger including any PCM survey) and the converted *.txt file format to be included on CD for each recording made.

ENVIRONMENTAL MANAGEMENT PLAN

JOHANNESBURG WATER SOC LTD

ENVIRONMENTAL MANAGEMENT PLAN

REVISION:05

Prepared By:

OHSE & DM

Environmental Management Section

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Marshalltown

2001

DISCLAIMER

1. Should there be any other Environmental related activities issued as non-compliance during construction, the contractor is liable to comply with those requirements
2. Should the contractor deviate from the conditions and requirements of the EMP and/or Environmental Authorisation (if applicable), the contractor is liable for non-compliances, rectification and associated fines thereof
3. This EMP does not exempt the Contractor from complying with other relevant legislations related to the construction activities.

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Annexure B: Contractors Environmental File Evaluation Form
Annexure C: Environmental Work Instruction
Annexure D: Johannesburg Water General Surface Rehabilitation Specification

LIST OF ACRONYMS Acronym	**Description**
BA	Basic Assessment
BAR	Basic Assessment Report
CA	Competent Authority

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DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EO	Environmental Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme Report
GDARD	Gauteng Department of Agriculture and Rural Development
GN	Government Notice
I&AP	Interested and Affected Party
JW	Johannesburg Water
km	Kilometre
m	meter
MSDS	Material Safety Data Sheets
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PHRAG	Provincial Heritage Resources Authority for Gauteng
RE	Resident Engineer
WUL	Water Use License
WULA	Water Use License Application
WWTW	Wastewater Treatment Works

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DEFINITIONS

Environment

The surroundings in which humans exist and which comprise of:

- Land, water and atmosphere of the earth.
- Micro-organisms, plant and animal life.
- Any part or combination of a) and b) and the interrelationships among and between them.
- The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that can influence human health and well-being.

Environmental Aspect

Those components of the company's activities, products and services that is likely to interact with the environment.

Environmental Authorisation

The written statement from the relevant environmental authority in terms of the National Environmental Management Act (Act 107 of 1998), with or without conditions, that records its approval of a planned activity and the implementation thereof and the mitigating measures required to prevent or reduce the effects of environmental impacts during the life of a contract.

Environmental Impact Assessment (EIA)

The decision making process of examining the environmental impacts of a development in terms of the NEMA (107 of 1998) and the EIA Regulations (Government Notice No. R982, R983, R984, R985 and R986) as amended.

Environmental Management Programme (EMPR)

An environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced.

Environmental Management System (EMS)

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A set of process and practices that enable an organization to reduce its environmental impacts and increase its operational efficiency. The EMS provides a framework that helps a company achieve its environmental goals through consistent control of its operations.

Auditing

A systematic and objective assessment of an organization's activities and services conducted and documented on a periodic basis internally and externally.

Environmental Objective

An overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and which is quantified where practicable.

Environmental Target

A detailed performance requirement quantified where practicable, applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.

Floodplain

A flat expanse of land bordering a river channel, formed through sediment deposition and other alluvial processes, and often characterized by frequent flooding as a result of bank overspill from the river channel.

Groundwater

Sub-surface water in the zone in which permeable rocks, and often the overlying soil, are saturated.

Hazardous waste

Waste that are proven to be toxic, corrosive, explosive, flammable, carcinogenic, radioactive, poisonous or classified as such in legal terms.

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Heritage Resource

Any place or object of cultural significance including buildings, structures, landscapes, graves and geological, archaeological artefacts and paleontological sites.

Landscape

Land modified for human use and occupation, embracing both the natural (wilderness) environment and the urban.

Management actions

Practical actions aimed at achieving management objectives and targets.

Management objectives

Desired outcome of management measures for mitigating negative impacts and enhancing the positive impacts related to project activities and aspects (i.e. risk sources).

Monitoring

A systematic and objective observation of an organization's activities and services conducted and reported on regularly.

Natural Vegetation

All existing vegetation species, indigenous or otherwise, of trees, shrubs, groundcover, grasses and all other plants found growing on the site.

Pollution

Any change in the environment caused by substances, radioactive or other waves, or noise, odours, dust or heat, emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such

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3. This EMP does not exempt the Contractor from complying with other relevant legislations related to the construction activities.

an effect in the future. Furthermore, pollution can also be regarded as an undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities.

Protected Plants

Plant species officially listed on the Protected Plants List (each province has one), and which may not be removed or transported without a permit to do so from the relevant provincial authority.

Reinstatement

Reinstatement is defined as the return of a disturbed area to a state, which approximates the state (where possible), which it was before disruption.

Riparian Habitat

The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Runoff

The total water yield from a catchment including surface and subsurface flow.

Sensitive environmental features

Environmental features protected by legislation (e.g. heritage resources), or identified during the EIA as sensitive through specialists' findings and input received from Interested and Affected Parties.

Subsoil

The soil horizons between the topsoil horizon and the underlying parent rock.

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Topsoil

Topsoil can be regarded as the fertile upper part or surface of the soil.

Transplanting

The removal of plant material and replanting the same plants in another designated position.

Veld

Unimproved areas of natural vegetation

Wastewater

Water contaminated by the project activities.

Watercourse

A geomorphological feature characterized by the presence of a stream flow channel, a floodplain and a transitional upland fringe seasonally or permanently conveying surface water.

Waterlogged

Soil or land saturated with water long enough for anaerobic conditions to develop.

Weeds and Alien Invasive Plants

Weeds and Alien Invasive plants are defined as undesirable plant growth that shall include, but not be limited to all declared category 1, 2 and 3 listed Alien Invasive species as set out in the Conservation of Agricultural Resources Act (No 43 of 1983) regulations. Other vegetation deemed to be invasive should be those plant species that show the potential to occupy in number, any area within the defined construction area.

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Wetland

Land where a surplus of water (i.e. waterlogging) is the key factor determining the nature of the soil development as well as the types of plants and animals living at the soil surface.

1. BACKGROUND

The purpose of this document is to provide management measures that will ensure that potential negative impacts associated with the activity are minimized whilst positive impacts are optimised, provided that the EMP is implemented by a suitably qualified Environmental Officer (EO). The development proponent, the main contractor and the sub- contractor are responsible for the implementation of the EMP throughout the stages. Therefore, it is imperative that the EMP is circulated to site managers, contractors and Depots who will perform any work on site which has the potential to cause environmental damage. Any parties responsible for transgression of the underlying management measures outlined in this document will be held liable for non- compliances.

The following is a generic EMP to mitigate against “generally occurring impacts” associated with the construction phase of Johannesburg Water’s activities. "Generally occurring impacts" refers to potential impacts typical of Johannesburg Water’s activities and are not restricted to a single or specific site. The findings of this EMP will be implemented at all sites.

This section is an essential component of the contract specification and shall be included during **planning, design, construction, and operational phases.**

PURPOSE

The purpose of this EMP is to ensure that Johannesburg Water conducts all its activities related to the construction and maintenance in accordance with the provisions of NEMA, and other applicable legislations. This EMP has considered the provisions of the Constitution and the principles of Integrated Environmental Management.

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2. APPLICABLE LEGISLATIONS

Several laws and regulations apply to the protection of the environment. These laws contain environmental principles and standards that need to be applied when applicable permits and licences that need to be obtained. This EMP will be subject to regulatory control under a range of State, Provincial and Local regulations. Such legislation largely embraces pollution prevention, sustainable resource use, conservation, and socio cultural (heritage) protection. This chapter reviews legislation pertaining to this generic EMP.

According to Section 2 (1, 2 & 3) of the National Environmental Management Act No. 107 of 1998 (NEMA), all organs of state must apply certain principles set out in NEMA when taking decisions that may significantly affect the environment. The key principles of this Act include that all "actions" that they approve must be economically, socially, and environmentally sustainable. It further states that "people and their needs" must be at the forefront of "its concern" and their interests must be served equitably. These legislative requirements include, but are not limited to, the provisions of the legislation represented as described below:

The Constitution of the Republic of South Africa Act No. 108 of 1996)

Section 24 of the Constitution of South Africa (Act 108 of 1996) states that "Everyone has the right (a) to an environment that is not harmful to their health or well-being; and

(b) To have the environment protected, for the benefit of present and future generations through reasonable legislative and other"

Measures that:

- Prevent pollution and ecological degradation;
- Promote conservation; and
- Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".
- Section 152 of the Constitution states that the objectives of local government are to:
- Ensure that services are provided to communities in a sustainable manner.

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- Promote social and economic development; and
- Promote a safe and healthy environment.

National Environmental Management Act No. 107 of 1998 (as amended)

The National Environmental Management Act 107 of 1998 (NEMA) requires that an environmental authorization is obtained before activities, which have been listed in terms of NEMA, are commenced with. The failure to obtain such an environmental authorization, before commencing with listed activities, could result in administrative sanctions, including compliance notices or directives ordering the cessation of the operations until authorized; and fines of up to ZAR10 million for each such contravention.

The Environmental Impact Assessment Regulations (EIA Regulations) set out the process to be followed in applying for an environmental authorization, while the listing notices; list the activities that require authorization (the Listing Notices). NEMA 107 of 1998 amended in 07 of April 2017.The following are the listed activities:

- EIA Regulations GNR 326
- Listing Notice 1; Government Notice Number (GNR) 327 (Basic Assessment).
- Listing Notice 2; Government Notice Number (GNR) 325 (Full EIA/ Scoping & Environmental Impact Report).
- Listing Notice 3; GNR 324 (It applies on both Basic Assessment and full EIA).

National Environmental Management: Biodiversity Act No. 10 of 2004

Provides management and conservation of South Africa's biodiversity within the framework of NEMA 107 of 1998; the protection of species and ecosystems that warrant national protection and the sustainable use of indigenous biological resources.

The National Environmental Management Waste Act 59 of 2008

The National Environmental Management Waste Act (NEMWA) reforms the law regulating waste management in order to protect health and the environment providing reasonable measures for the

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prevention of pollution and ecological degradation and for securing ecologically sustainable development; to provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; to provide for compliance and enforcement; and to provide for matters connected therewith.

The Occupational Health and Safety Act No. 85 of 1993

The Occupational Health and Safety Act make provision in regulation

- Section 8 for the general duties of employers to their employees.
- Section 9 of the Regulations makes provision for general duties of employers and self-employed persons to persons other than their employees.

National Heritage Resources Act (NHRA) No. 25 of 1999

The protection and management of South Africa's heritage resources are controlled by the National Heritage Resources Act. The South African National Heritage Resources Agency (SAHRA) is the responsible authority for implementing the National Heritage Resources Act (NHRA) 1999, (Act 25 of 1999).

Section 38(1) of the NHRA lists development activities that would require authorisation by the responsible heritage resources authority. Activities considered applicable to the proposed project include the following:

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length.

(b) the construction of a bridge or similar structure exceeding 50 m in length; and

(c) any development or other activity which will change the character of an area of land, or water -

i exceeding 5 000 m² in extent,

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ii involving three or more existing erven or subdivisions thereof; or

iii involving three or more erven or divisions thereof which have been consolidated within the past five years; or

iv the costs of which will exceed a sum set in terms of regulations by SAHRA or a Provincial Heritage

v Resources Authority.

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a Provincial Heritage Resources Authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development.

Water Services Act No. 108 of 1997

This Act provides for the rights of people to basic water supply amongst others basic sanitation. It acknowledges that that there is a duty on all spheres of government to ensure that sanitation services are provided in a manner which is efficient, equitable and sustainable and that it should be sufficient for subsistence and sustainable economic activity. The provision of sanitation services must be undertaken in a manner consistent with the broader goals of water resource management. This goal is in line with the Act as it aims to provide sufficient sanitation services to the region in a sustainable manner.

Conservation of Agricultural Resources (CARA) Act, Act No. 43 of 1983

The CARA aims to ensure the protection of agricultural resources such as land with agricultural potential and water and makes provision for the eradication of alien and invasive species, and protection of topsoil.

NEMA Air Quality Act (AQA), Act No. 39 of 2004

The aim of this law is to regulate air quality and protect the environment in South Africa through reasonable measures to prevent pollution and ecological degradation, while securing sustainable development. The Act also provides national norms and standards for air quality management, monitoring and control. Under this legislation, Priority Air shed Areas can be proclaimed, where specific

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Air Quality Management Plans are applicable. Regulations are also published under this Act for the format of air quality assessments and what should be included in the assessment. Any Air Quality Management Plan which has been compiled for the area and any proposed WwTW should be in line with this Management Plan. This Act may list activities which may result in atmospheric emissions, and which may have a significant detrimental effect on the environment.

Government Gazette 32434 of 24 July 2009 listed activities, which require an atmospheric emission license before it commences. Air quality limits and thresholds are fundamental to effective air quality management, providing the indicators to safe exposure levels for the majority of the population. The current South African standards have been revised and National Ambient Air Quality Standards were promulgated on the 24th of December 2009 (Government Gazette No. 32816, Notice No. 1210). The newly proposed standards include particulate matter specifically PM10 (particulates with a diameter of less than 10 micrometre), sulphur dioxide (SO2), nitrogen dioxide (NO_2), ozone (O3), lead, carbon monoxide (CO) and benzene. These revised standards have been adopted as the VTAPA air quality objectives. Any emissions from the proposed WWTW should be within these standards.

National Water Act (NWA), 36 of 1998

Water use is controlled by the National Water Act (NWA) Act No. 36 of 1998. The NWA recognises that water is a scarce resource in South Africa and its provisions are aimed at achieving sustainable use of water to the benefit of all users. The provisions of the Act are thus aimed at discouraging pollution and waste of water resources. According to Section 21 of the NWA the following activities require a water use licence (WUL) prior construction:

"21.(a) taking water from a water resource;

21.(b) storing water;

21.(c) impeding or diverting the flow of water in a watercourse;

21.(d) engaging in a stream flow reduction activity contemplated in section 36;

21.(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);

21.(f) discharging waste or water containing waste into a water resource through a pipe, canal,

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sewer, sea outfall or other conduit;

21.(g) disposing of waste in a manner which may detrimentally impact on a water resource;

21.(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

21.(i) altering the bed, banks, course or characteristics of a watercourse;

21.(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

21.(k) using water for recreational purposes."

3. OBJECTIVES OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The purpose of this EMP is to provide an easily interpreted reference document that ensures that the project environmental commitments, safeguards and mitigation measures from the environmental planning documents, project approvals, and scope of work are implemented.

The objectives for the EMP are:

- To develop, implement and maintain effective management systems for the environmental aspects.
- To document details of environmental protection infrastructure and controls so that they are able to provide long term protection for the natural environment.
- To ensure compliance with relevant legislation (National, Provincial and Local), regulatory requirements and environmental documents.
- To maximise the value and outcomes of environmental monitoring activities so that the information can be applied to the planning and implementation of future projects.
- To ensure that all Environmental Management considerations are implemented during the planning, operational and maintenance phases of the project.

All the environmental specifications and the procedures discussed in this document were also developed in accordance with the relevant legislation applicable to the development.

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3.1 Phases of the Project

The EMP deals with the following phases as detailed below:

3.1.1 The Planning and Design Phase

Overall Goal for Planning and Design: Undertake the planning and design phase of the development in a way that:

- Ensures that the design of the proposed development responds to the identified environmental constraints and opportunities.
- Ensures that the best environmental options are selected for all components of the project.
- **Ensures that there is sufficient financial provision for environmental assessment, monitoring, rehabilitation, and maintenance. The JW rehabilitation calculation template must be used (See Annexure D).**
- The qualified landscaping specialist must be appointed to undertake rehabilitation on site. The landscaping specialist must pose the following qualifications and work experience:

  - Landscaping Specialist should at least have BA/BSc Honours Degree or 4-year Degree in Natural Sciences/Ecological

  - The Landscaping Specialist must at least be registered with South African Council for Natural Scientific Professions (SACNASP) as a Professional Natural Scientist (Copy of SACNASP Certificate must be submitted).

  - At least three letters from their client/s must be submitted, detailing the landscaping work he/she has undertaken (letters should have the name of the client, description of the project and/or scope of work done, contact details and must be signed). Letters should be in their client's company letterhead, and it must indicate if the work has been completed satisfactorily or not. - Copy of CV must be submitted, specialist should at least have a minimum of five (5) years working experience as landscaping Specialist (See Table 1).

The EMP offers an ideal opportunity to incorporate pro-active environmental management measures with the goal of attaining sustainable development.

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Pro-active environmental measures minimize the chance of impacts taking place during the construction and operational phase. There is still the chance of accidental impacts taking place; however, through the incorporation of contingency plans (e.g., this EMP) during the planning phase, the necessary corrective action can be taken to further limit potential impacts. In order to meet this goal, action plans for planning and design stages of the project must be identified together with monitoring requirements.

3.1.2 The Construction Phase

The bulk of the impacts during this phase will have immediate effect (e.g., noise-, dust- and water pollution etc.) If the site is monitored on a continual basis during the construction phase, it is possible to identify these impacts as they occur. These impacts will then be mitigated through the contingency plans identified in the planning phase, together with a commitment for sound environmental management from Johannesburg Water and its agents.

3.1.3 Rehabilitation and Reinstatement Phase

This phase will involve restoring the land impacted during the construction phase back to its original state (in the case of slopes, gradients, soil profiles, and hydrology) or better. This process will be mainly on rectifying the negative impacts that have been caused during construction by the removing pollution or contaminants and other dangerous substances from groundwater, sediment, or surface water and improvement of the soil.

3.1.4 The Operational Phase

By taking pro-active measures during the planning and construction phases, potential environmental impacts emanating during the operational phase will be minimised. This, in turn, will minimise the risk and reduce the monitoring effort, but it does not make monitoring obsolete.

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4. ROLES AND RESPONSIBILITY

The implementation of this EMPr requires the involvement of several stakeholders, each fulfilling a different but vital role to ensure sound environmental management during the construction and operational phases. The stakeholders are discussed below:

4.1 Johannesburg Water and its Agents shall:

Ensure that the EMP is kept on JW's Sites and construction sites.

- Remain ultimately responsible for ensuring that the development is implemented according to the requirements of the EMP.
- Ensure that the Environmental section attends all project related tender briefing sessions.
- Although Johannesburg Water appoints specific role players to perform functions on its behalf, this responsibility is delegated.
- Be liable for restoring the environment in the event of negligence leading to damage to the environment.
- Ensure that the EMP is included in the tender documentation so that the contractor who is appointed is bound to the conditions of the EMP, and there's sufficient budget for environmental assessments and/or assessment during the planning, design, construction, replacement of vegetation and restoration of habitats, decommissioning (rehabilitation) phases of the project.
- Ensure that the contractor appointed understands, acknowledges and fully accepts the content of this EMP and their responsibilities for implementation and compliance.
- Monitor compliance with the conditions of the environmental authorisation and the EMP and compliance audits are undertaken.
- Ensure that the Environmental section signs all close out reports to confirm rehabilitation.

4.2 Appointments and competencies

- The contractor and its appointed sub-contractor must meet the relevant legislative and non-statutory appointments, which must be maintained valid for the entire contract duration.

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- All appointees shall be suitably trained and certified competent for the responsibilities they are assigned for.
- Copies of all relevant appointments and the relevant competence certificates must be kept in the relevant Environmental file.

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Table 1: Environmental Officer's Appointment Index

Appointment	Project Type	Legislative Ref	Competency requirements (Min)
Contractor SHE Officer	Unauthorised Project	JW EMP/ JW Waste Management Procedure	National Diploma in Safety & ISO14001:2015 (Introduction/Awareness, implementation, and auditing ISO14001:2015) + 2 years' Experience **OR** National Diploma in Environmental Management + 2 years' Experience OR NEBOSH / SAMTRAC & Basic ISO14001:2015/ Basic Environmental Awareness (Introduction and Implementations to ISO14001:2015) + 4 years' Experience. Register with SACPCMP.
Contractor Environmental Liaison Officer/Environmental Officer	Authorised project	JW EMP and Project Specific approved EMP /Directives/Environmental Authorisation/GA/WUL	National Diploma in Environmental Management/ + 3 years' Experience. BA/BSc Environmental Management + 3 years' experience. The recommended and/or market related minimum Salary/wages for ELO/EO should be **R17 000.00.**

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Environmental Representative/Environmental Rep	Unauthorised Project	JW EMP	Must hold a Senior Certificate (Matric) and one of the following qualifications. National Diploma in Environmental Management/ BA/BSc Environmental Management or Science/ISO 14001:2015(Introduction; Implementation and Auditing/Certificate in Environmental law/National Certificate in Environmental Management. The recommended and/or market related minimum salary/wages for Environmental Representative should be **R10 000.00.**
Consultant Environmental Control Office	Authorised project (as and when required)	JW EMP and Project Specific approved EMP /Directives/Environmental Authorisation/GA/WUL	Reputable Environmental Consulting Company National Diploma or BA/BSc Environmental Science or Management + 3 years' experience as an independent ECO/Consultant
Landscaping Specialist	Unauthorised and Authorised project	JW EMP and Project Specific approved EMP /Directives/Environmental Authorisation/GA/WUL	Reputable Environmental Consulting firm /Landscaping Company.

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			Landscaping Specialist should at least have BA/BSc Honours Degree or 4-year Degree in Natural Sciences/Ecological. - The Landscaping Specialist must at least be registered with South African Council for Natural Scientific Professions (SACNASP) as a Professional Natural Scientist (Copy of SACNASP Certificate must be submitted). - Specialist should at least have a minimum of five (5) years working experience as landscaping Specialist (See Table).

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4.3 The Contractor shall:

- Be bound to conform to the EMP conditions through his/her contract with Johannesburg Water, and is responsible for ensuring that he adheres to all the conditions of the EMP.
- Thoroughly familiarise with the EMP requirements before construction begins and must request clarification on any aspect of these documents, should they be unclear.
- Be responsible for mitigation and rehabilitating all environmental damage at his/her expense.
- Ensure adherence to, and implementation of, the environmental management specifications.
- Ensure that environmental damage, whether intentional or unintentional, is prevented in the first instance, mitigated and rehabilitated, and must adopt a proactive approach followed by a reactive approach.
- Ensures identification of, and compliance with, all environmental laws, all by laws and regulations.
- Ensure that any instructions (whether verbal or written) issued by the site manager, project manager, site engineer or EO, in terms of the EMP is adhered to.
- Ensure that an environmental compliance report is tabled at each site meeting, which must document all incidents, complaints, and non-compliances, and their close out progress, which has occurred during the period before the site meeting.
- Provide a photographic report to JW upon request showing close out of identified issues.
- Provide any project or compliance information that may be requested by JW in any format as requested.
- Ensure that proposed site camp areas are approved by JW environmental section prior to establishment.
- Ensure compliance with the EMP conditions even if there will be no site camps or the project is an emergency or subject to Directives.
- Take comprehensive site photographs for before, during and after construction.
- Ensure that each individual resident/landowner/stakeholder requirement is documented, pertaining to the area to be disturbed, special features, vegetation to be disturbed, rehabilitation requirements (contractors must state to residents/stakeholders that indigenous vegetation species will be put

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back, however, should residents/stakeholder require non-indigenous species to be replaced, these are to be documented before being affected) prior to any disturbance.

- Provide a detailed, site-specific method statement for rehabilitation, which must be approved by JW Engineer and EO.
- Ensure that a report is tabled at each site meeting, which will document all incidents that have occurred during the period before the site meeting.
- Ensure that incidents register is kept in the site office.
- Ensure that a register of all public complaints is maintained.
- Ensure that all employees, including those of sub-contractors receive Environmental Induction before the commencement of construction in order that they can constructively contribute towards the successful implementation of the EMP (i.e., ensure their staff are appropriately trained as to the environmental obligations).
- Ensure that all disturbed areas are rehabilitated and at least 85% healthy grass/ground cover has established, that rehabilitation is maintained, the sites are free of erosion, waste and pollution of any kind including rubble and spills, and free of weeds and alien invasive species.
- Appoint an Environmental Liaison Officer (ELO) prior Construction for Environmental Authorised Projects.
- Appoint SHE Officer prior Construction for unauthorized projects i.e., the SHE Officer with Environmental Management experience or be trained on Environmental legislation.
- Provide accurate and factual information pertaining to the projects, communications, and discussions at all times.
- Is responsible for NEMA Duty of Care, and Polluter pays principle.

4.4 Environmental Liaison Officer (ELO)/ SHE Officer shall:

- Ensure that the project team is involved in all aspects of project planning that can influence environmental conditions on the site.
- Be permanently on site during the construction phase to oversee the Contractor's internal compliance with the EMP requirements and ensuring that the environmental specifications are adhered to.

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- Assist with day-to-day monitoring of the construction activities. Ensure that any issues raised by the EO will be routed to the SHE Officer for the contractors' attention.
- The ELO/ SHE Officer shall be permanently on site during the construction phase to oversee the Contractor's internal compliance with the EMP requirements and ensuring that the environmental specifications are adhered to.
- Be responsible for keeping detailed records of all site activities that may pertain to the environment and include all these aspects in an environmental register.
- Maintain site documentation and records related to environmental management (EMP, authorisations, permits, way-eaves, method statements, audit reports, monitoring results, receipts for waste removal, environmental file, etc.)
- The ELO/SHE Officer must keep a register of complaints from any community members on environmental issues.
- The ELO /SHE Officer will be required to keep a record of all on-site environmentally related incidents and how these incidents were dealt with.
- Ensure daily implementation of the EMP conditions, and monitoring of the contractor's compliance with EMP conditions, using checklists and visual inspections.
- Provide location details for possible site camp locations to JW environmental section and await approval from this section before establishing.
- Inform JW environmental section when actual work is about to commence.
- Inform JW environmental section of pending completion activities and intention to de-establish, prior.
- Ensure proper rehabilitation is undertaken before site closure.

4.5 Resident Engineer (RE)/ Site Agent shall:

- Liaise with the Contractor and Environmental Officer (EO) on environmental matters, as well as any pertinent engineering matters where these may have environmental consequences.
- Oversee the general compliance of the Contractor with the EMP and other pertinent site specifications.

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- Familiarise him/herself with the EMP specifications and further monitor the Contractor's compliance with the Environmental Specifications daily through the Site Diary and enforce compliance.
- Ensure that Monthly Audits reach the contractor before Monthly Progress Meeting.
- Ensure proper rehabilitation is undertaken before site closure.

4.6 Project Engineer /Inspectors (PE/PI) shall:

- Ensure that there is a sufficient budget for complying with all EMP conditions at the tender stage.
- Ensure sufficient budget is provided for rehabilitation/ Reinstatement.
- Ensure proper rehabilitation is undertaken before site closure.
- Ensure of all specifications and legal constraints specifically with regards to the environment are highlighted to the Contractor(s) so that they are aware of these.
- Ensure that Contractor(s) are made aware of all stipulations within the EMP.
- Ensure that the EMP is correctly implemented throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes.
- Be fully conversant with the EIA for the project, the EMP, the conditions of the Environmental Authorisation (if applicable), and all relevant environmental legislation.
- Ensure compliance monitoring of contractors on a day-to-day basis.
- Ensure adherence and implementation of the tender requirements.
- Ensure reference of specific non-compliance/non-conformance issues to the responsible units and/or contractors.

4.7 Environmental Officers shall:

- Be responsible for informing the contractors of any decisions that are taken concerning environmental management during the project phase.
- This would also include informing the contractors of the necessary corrective actions to be taken, issuing stop work orders and rehabilitation and remediation instructions if necessary.
- Liaise with environmental authorities where necessary.
- Review all the environmental documents submitted by the Contractor, including sign off.

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- Review all the environmental documents from the Contractor, including sign off.
- Conduct environmental monthly audits of all contractors' work on site where necessary
- Maintain site documentation of related to environmental management (EMP, Method statements, audit reports, monitoring results, receipts of waste removal etc.). Documents to be maintained on the relevant site Documents Control Systems.
- Inspect and report on environmental incidents and check corrective actions.
- Conduct environmental incidents enquiries.
- Review and sign off method statements prepared by Contractors.
- Ensure that an environmental compliance monitoring strategy/framework is implemented.

4.8 Environmental Control Officer (ECO)

The role of the ECO shall be to:

- Act as site 'custodian' for the implementation, integration, and maintenance of the EMPr in accordance with the contractual requirements.
- Ensure successful implementation of the EMPr; and
- Ensure that the Contractor, his employees and/or Subcontractors receive the appropriate environmental awareness training prior to commencing activities.

The responsibilities of the ECO will be to:

- Liaise with the JW Environmental Section and Project Engineer on the level of compliance with the EMPr achieved by the Contractor on a regular basis for the duration of the contract.
- Advise the Project Engineer on the interpretation and enforcement of the Environmental Specifications (ES), including evaluation of non-compliances.
- Enforce compliance with the EA and EMP through audit report and checklist
- Supply environmental information as and when required.
- Review and approve Method Statements produced by the Contractor, in conjunction with the PM and EO.
- Monitor any basic physical changes to the environment because of the construction works according to an audit schedule.

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- Attend regular site meetings and project steering committee meetings.
- Undertake regular monthly audits of the construction works and to generate monthly audit reports. These reports are to be forwarded to the JW EO who will communicate the results and conclusions with the principal Contractor.
- Submit audit reports to the authority as per the requirement of issued Environmental Authorisation.
- Communicate frequently and openly with the Contractor and the Project Engineer to ensure effective, proactive environmental management, with the overall objective of preventing or reducing negative environmental impacts and/or enhancing positive environmental impacts.
- Advise the Project Engineer on remedial actions for the protection of the environment in the event of any accidents or emergencies during construction, and to advise on appropriate clean-up activities.
- Review complaints received and made instructions as necessary; and
- Identify and make recommendations for minor amendments to the EMPr as and when required.

4.9 Environmental Representative (Environmental Rep) shall:

- Review the effectiveness of environmental measures in the workspace/construction environment for which he/she was appointed.
- Identify potential impacts in the workplace.
- Investigate environmental incidents and identify root causes.
- Investigate Environmental Complaints.
- Conduct Awareness training.
- Participate in Environmental inspections.
- Ensure compliance with JW EMP and other environmental management related legislations.
- Ensure Proper Rehabilitation is conducted.
- Attend site SHE meetings where Environmental issues are addressed.
- Guide Construction crew/team on environmental requirements as per JW EMP.
- Assist in day-to-day monitoring of construction activities.

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- Assist in implementation of ISO 14001:2015 standard.
- Assist the SHE Officer/EO with preparation of audits /inspections.

5. CONTENTS FOR CONTRACTOR'S ENVIRONMENTAL FILE

The following documents must be submitted by the contractor in the Environmental file before Construction commences on site. The file must be submitted to the Environmental Section prior construction for approval. The Contractor should achieve a minimum score of 80% for the file to be approved (**Refer to Annexure B: Environmental File Specification).**

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6. ENVIRONMENTAL SPECIFICATIONS

Table 2: Environmental Management and Mitigation Measures that must be implemented during the Design Phase and Construction Phase

Design Phase Measures						
Aspects	**ID**	**Mitigation Measure/Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**	**Performance indicators**
Project Planning/Design	**1**	• Proposed project is submitted to Environmental Section for screening (Project scope/layout/Maps), • CAPEX and Ops must ensure that there is budget allocated for environmental management throughout the project life cycle i.e., planned project and Directives.	Johannesburg Water (CAPEX/Ops)	Before project commences	• Screening report • Tender document	Keep the records of the project screening report and scope of work as per Directives
Authorisation	**2**	• Appoint Consulting Company • Ensure that all required licences and permits have been obtained before the start of construction. • Ensure that ECO and/or ELO is appointed as per the authorisation and EMP requirement during project execution (as when and required).	Johannesburg Water (CAPEX/ Environmental Section)	Before construction commences	Keep record of all permits, licences and authorisations	Keep record of all permits, licences and authorisations
Project Handover	**3**	• The scope of a project is outlined by CAPEX Engineer during the handover meeting. • Environmental Management Requirements are outlined during the handover meeting.	Johannesburg Water (CAPEX/ Environmental Section)	Before construction commences	Meeting invite EA/GA/WUL/ Screening report	Keep record of all permits, licences and authorisations
Environmental Awareness Training/Inductions	**4**	• Environmental awareness training is given to the Project Team Leaders • Environmental File Specification provided to the Contractor. • JW Environmental Management Plan and other procedures are provided to the Contractor.	Johannesburg Water (CAPEX/ Environmental Section)	Before construction commences	Meeting invite	Meeting records

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Environmental File & Evaluation	**5**	• Contractor submits environmental file for approval prior work commences on site. • Construction activities/work (including site establishment) should ONLY commence when file is approved.	Appointed Contractor/Environmental Section	Before construction commences	Environmental evaluation report.	Approval/ rejection letter records
Construction Phase Measures						
Aspects	**ID**	**Mitigation Measure/Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**	**Performance indicators**
Site camp establishment	**1**	• Invite the Environmental Officer for the site inspection of proposed site camp prior establishment. • Submit a method statement for Site Camp establishment for approval by JW Environmental Officer/ECO prior commencement of works. • Establish a suitably fenced Site Camp at the start of the contract, which will allow for site offices, vehicle, equipment, material, and waste storage areas to be consolidated as much as possible. Locate the Site Camp at a position approved by the JW EO, at least 100m from watercourses and in an area which is not ecologically sensitive. • Provide water and/or washing facilities at the Site Camp for personnel. • Lim it construction and lay down areas to areas within the development footprint. • Ensure that environmentally friendly on-site sanitation options are selected, and these facilities are properly managed and maintained. • Designated eating areas shall be provided on site. • These eating areas shall be clearly demarcated and shall be provided with bins with lids.	All Contractors	Before commencement of Project	• Visual inspection • Site establishment checklist/Method statement	Method statements approved by CAPEX and the Environmental Officer • Position of Site Camp approved by ECO • Security and access to Site Camp controlled • Clear demarcation of no-go areas as agreed with JW EO. • Detailed site layout plan • Environmental file approval letter.

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		• Staff will be prohibited from consuming meals anywhere other than at these eating areas and that noise is limited. • All eating areas shall include provision for a water and smoking area.				
Environmental Awareness Training	**2**	• Provide environmental awareness training to all personnel on site at the start of their employment. Training should include discussion of: • Potential impact of construction waste and activities on the environment. • Suitable disposal of construction waste and litter. • Key measures in the EMPr relevant to worker's activities. • How incidences and suggestions for improvement can be reported. • Ensure that all attendees remain for the duration of the training and on completion sign an attendance register that clearly indicates participants' names.	All Contractors	• Before workers start working onsite • Before new activities are undertaken	• Check training attendance register • Observe whether activities are executed in line with EMPr requirements	• Proportion of workers that completed. • Environmental training Compliance of workers with EMP
Plant Search and Rescue/Vegetation clearing	**3**	• From information gathered during the plant marking exercise, establish the size. • Requirements for the plant rescue team workforce, and the methodology to be employed during the rescue to maximise the likelihood of success; Document and motivate which species found on site are considered to be conservation worthy. • Follow a multi-pronged approach to maximise the likelihood of success wherever feasible. In addition to transplanting of whole plants, seed can be collected and sown in situ in suitable habitats and/or in an off-site nursery. • Any plants not suitable for transplantation must be considered for transplanting to existing conservation	All Contractors	Before commencement of activities	Visual Inspection/ inspection by Botanist/Ecologist	• Incidents of harm coming to fauna/ flora. • Number of incidents of disturbance of vegetation outside construction site boundary; and • Size of area cleared relative to

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		areas nearby. This could involve growing these plants on in an off-site nursery for a period of time. • Depending on the conservation worthy species found, the location of suitable existing conservation areas nearby and the location of the off-site nursery, the most appropriate plant rescue options must be detailed in the search and rescue plan, and could be a combination of the following options: • All required permits must be obtained from the appropriate authority covering plants to be affected by the plant rescue operation prior to the removal of the plants. • Demarcate the area for construction prior to each phase and prevent access by construction personnel outside of this area. • Appoint a suitably qualified botanist to undertake search and rescue of key plant species in the development footprint where necessary (Where is applicable. Clearly demarcate sensitive areas, including buffers, with appropriate signage. • Do not allow personnel to enter calcrete vegetation areas. • Do not allow personnel to pick or destroy plants outside of the construction footprint. • Limit clearing to those areas within the footprint of construction for each phase. • Restrict construction vehicles to designated roadways. • Do not allow the temporary storage of building material within sensitive areas. **Aftercare and monitoring**				development footprint • Size of area disturbed outside of construction site boundary. • Areas of development footprint must be clearly demarcated

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		• Record numbers and diversity of propagated plants and the health of the same, until they can be planted out; • Aftercare of transplanted plants to be done in accordance with the plant search and rescue plan by an appropriate agent (e.g., staff from the commercial nursery or an appropriately trained onsite Contractor), including watering and alien plant control requirements. If done correctly, the frequency of input will decrease with time. • Record numbers and diversity of transplanted plants and the health of the same. • Monitoring must be undertaken as per requirements of the plant search and rescue plan approved by GDARD, including monitoring of alien plants and maintenance of a photographic record; and • Provide a detailed record (including photographic record) that indicates the success of the plant rescue operation. Records of corrective action taken to improve management of transplanted plants, where relevant, must also be completed. **Applicable Legislation** • National Environmental Management Act: Biodiversity Act (Act 10 of 2004) including Threatened or Protected Species Regulations. • National Environmental Management Act (Act 107 of 1998). • Gauteng Nature Conservation Bill, 2014/Transvaal Nature Conservation Ordinance 12 of 1983; and • National Forests Act (Act 30 of 1998).				

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Excavation	**4**	• The process of excavation and back filling must be carried out as a sequential process following one another as quickly as possible. • Excavations must only remain open for a minimum period of time and during this time they must be clearly demarcated. If excavations place the public at risk these sites must be fenced. • Where possible, close excavations immediately after pipe is laid. • The residents directly affected by open trenches must be notified of the dangers. This will be done during the site-specific phase. • Danger tape shall not be utilised to prevent personnel from open excavations, orange nets should be used for all open excavations on site. Construction vehicles should avoid creating new roads, use existing roads. • Wet exposed surfaces using a water cart, bowser or use a biodegradable and environmentally friendly soil binder to prevent dust emissions. • Dewater excavations regularly and channel water to areas of grass cover. If dewatering is near/within a watercourse and is to be discharged to a watercourse, ensure a silt fence/net and sandbags are used to reduce silt loads. • Topsoil must be cleared (considered to be the upper 150mm of soil surface) and retained as it contains most inorganic matter and nutrients. Topsoil must be kept separate from subsoil and stored in windrows parallel to excavations. • Harvested grass should be retained and used as a mulch to combat erosion.	All Contractors	Throughout construction	Visual inspection	• Daily site inspection. • Damage to the environment (sensitive environment)

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		• Soil should be exposed for the minimum time possible once cleared of indigenous or invasive vegetation. • Avoid prolonged exposure of soils to wind and water erosion when clearing and grubbing. • The stockpiled topsoil (which will be left standing for more than 1 month) must be covered with suitable fabric, and / seeded, to prevent erosion and weed invasion. • Stockpiled topsoil must be covered with suitable fabric to prevent erosion and weed invasion. • No vehicles are allowed to access onto the stockpiles after they have been placed. • Topsoil and subsoil must be kept separate throughout construction and rehabilitation. • A marsh wire or snow netting shall be erected around the exposed excavations to warn the public. • The contractor must rip and rehabilitate temporal roads after project completion. • The Contractor shall be in possession of an emergency oil and chemical spill kit, drip trays and bioremediation substances/enzymes that must be complete and available on site at all times.				
Topsoil and subsoil	**5**	• The contractor should remove 150mm of topsoil and stockpile at a height of not more than 1m. • Topsoil should be temporarily stockpiled, separately from (clay) subsoil and rocky material, when areas are cleared. If mixed with clay sub-soil the usefulness of the topsoil for rehabilitation of the site will be lost. • Stockpiled topsoil should not be compacted and should be replaced as the final soil layer. No	All Contractors	During Vegetation clearance	Visual inspection	• Incident of incorrect storage and harvesting. • Manifestation of alien invasive plants. • Incident of erosions.

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		vehicles are allowed access onto the stockpiles after they have been placed. • Stockpiled soil should be protected by erosion-control berms if exposed for a period of greater than 14 days during the wet season and seeded. • Topsoil must be hydro seeded during shut down in December. • Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. • Topsoil obtained from sites with different soil types must not be mixed. • Topsoil stockpiles must not be contaminated with oil, diesel, petrol, waste or any other foreign matter, which may inhibit the later growth of vegetation and micro-organisms in the soil. • Soil must not be stockpiled on drainage lines or near watercourses without prior consent from the Project Manager. • Soil should be exposed for the minimum time possible once cleared of invasive vegetation, that is the timing of clearing and grubbing should be co-ordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion. • Stockpiled topsoil must be either vegetated with indigenous grasses or covered with a suitable fabric to prevent erosion and invasion by weeds. • Limited vehicular access is allowed across rocky outcrops and ridges. • All cut and fill surfaces need to be stabilized with appropriate material or measures when major civil works are complete. • Erosion and donga crossings must be dealt with as river crossings. Appropriate soil erosion and control				

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		procedures must be applied to all embankments that are disturbed and destabilized as per the Authorisation • All equipment must be inspected regularly for oil or fuel leaks before it is operated. Leakages must be repaired on mobile equipment or containment trays placed underneath immobile equipment until such leakage has been repaired. • Soil contaminated with oil must be appropriately treated and disposed of at a permitted landfill site or the soil can be regenerated using bio-remediation methods. • Runoff must be reduced by channelling water into existing surface drainage system.				
Protection of archaeological and heritage resources	**6**	• Alert the construction workforce of the potential existence of artefacts at the site. • Empower staff to stop works on (chance) discovery of artefacts at the site. • Cease construction on (chance) discovery of archaeological sites of heritage importance or redirect machinery away from finds until an archaeologist is able to make a site inspection and establish the importance of the find and make recommendations for preservation and/or record keeping. • Report the presence of graves or human remains, fragments of fossil bone, ostrich egg and stone fragments to HWC. • Obtain a permit for the removal of artefacts from the site if any are discovered during construction.	All Contractors/Johannesburg Water	• Before Construction commences • During earthworks	Visual inspection	• Discovery of possible archaeological material • Rescue and reporting of identified material when discovered
Protection of paleontological resources	**7**	• Identify a stand-by palaeontologist to inspect fossils if they are discovered during construction activities.	Johannesburg Water	Prior commencement	Visual inspection	• Discovery of possible

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		• Empower staff to stop works on (chance) discovery of fossils at the site. • Alert the construction workforce of the potential existence of fossils at the site. • Cease construction on (chance) discovery of fossils and artefacts of paleontological importance or direct machinery away from finds until the identified palaeontologist is able to make a site inspection and establish the importance of the find and make recommendations for preservation, collection or record keeping.	All Contractors	During earthworks		archaeological material. • Rescue and reporting of identified material when discovered.
Concrete / cement Work/Batching plant	**8**	• Use Ready-Mix concrete rather than batching where possible. • Ensure that no cement truck delivery chutes are cleaned on site. Cleaning operations are to take place off site at a location where wastewater can be disposed of in the correct manner. If this is not possible a suitable washing facility is to be developed on site in consultation with the ECO. • Concrete must be mixed only in an area demarcated for this purpose, ideally on an impervious surface (e.g., cement mixing pit). • Batching operations to take place in a designated area, which will be kept clean at all times. • All concrete spilled outside this area, must be promptly removed by the Contractor and taken to a permitted waste disposal site. • After all concrete mixing is complete; all waste concrete must be removed from the batching area and disposed of at an approved dumpsite. • Ensure separation of clean and dirty water from batching plant.	All Contractors	Throughout construction	Visual inspection and JW EO/ECO approval.	• Number of incidents of batching outside works footprint. • Contamination of water and soil; and • Visible litter / waste on site.

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		• Storm water must not be allowed to flow through the batching area. Water laden with cement must be collected in a retention area for evaporation and not allowed to escape the batching area. • Operators must wear suitable safety clothing. • Wastewater from batching operations to be suitably disposed of. • Waste concrete and cement sludge to be removed on a regular basis (to prevent overflowing) and to be disposed of at a suitable facility. • Unused cement bags will be stored in an area not exposed to the weather and packed neatly to prevent hardening or leakage of cement. • Used cement bags will be stored so as to prevent windblown dust and potential water contamination. Used bags will be disposed of adequately at a licenced waste disposal facility. • Limit concrete batching to single sites where possible. • Concrete transportation will not result in spillage. • Cleaning of equipment and flushing of mixers will not result in pollution, with all contaminated wash water entering the wastewater collection system. • To prevent spillage onto roads, ready mix trucks will rinse off the delivery shoot into a suitable sump prior to leaving the site. The Contractor shall ensure such designated concrete wash bay area's/ sumps are created and that all concrete trucks delivering concrete to site first empty and clean their shoots at this point before leaving the site. The dried waste product shall be handled as construction rubble.				

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		• Suitable screening and containment will be in place to prevent windblown contamination from cement storage, mixing, loading and batching operations. • All contaminated water and fines from exposed aggregate finishes will be collected and stored in sumps and will be adequately disposed of. • All visible remains of excess concrete will be physically removed on completion of the plastering or concrete pouring and disposed of in an acceptable manner. • Any spilled concrete to be cleaned up immediately. • In practice all wastes arising from construction activities are to be handled; transported and disposed of in accordance with the relevant regulations. All efforts should be made to minimise, reclaim or recycle waste, and failing that, dispose of it in a manner licensed by the government for that purpose.				
Water Management	**9**	• Con serve water wherever possible (e.g., ensure that areas are not watered excessively, and all leaking pipes are replaced and repaired immediately). • Adequate erosion, runoff and sedimentation prevention, control and mitigation measures must be instituted at all sensitive areas, such as embankments, slopes, river crossings/watercourses/drainage lines, wetlands, when excavations or disturbance occurs within these areas, within the buffers, beds, and banks. • These control measures must include use of silt fences/traps, sandbags, retention of vegetation, berms, immediate replacement of vegetation. Additionally, reno mattresses, riprap, stone pitching,	All Contractors	Throughout construction/post construction	Visual inspection	• Incidence of storm water contamination. • Visible leaks/ water wastage. • And Visible surface erosion.

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		gabions, use of geotextiles) e.g., biojute must be used at the direction of the JW Engineer. • Adequate sedimentation control measures must be instituted at any river crossings when excavations or disturbance of a riverbanks or riverbeds takes place. • Adequate sedimentation control measures must be implemented where excavations or disturbance of drainage lines of a wetland may take place. • All fuel, chemical, oil, etc. spills must be confined to areas where the drainage of water can be controlled. Use appropriate structures and methods to confine spillages such as the construction of berms and pans, or through the application of surface treatments that neutralise the toxic effects prior to the entry into a water course. • The drip trays and spill kits must be used to contain oil from spilling into the water. Ensure adequate drip trays are available. • During construction through a wetland or watercourse, the majority of the flow of the wetland should be allowed to pass downstream. • Vehicular traffic across wetland and watercourse areas must be avoided. • No dumping of foreign material in streams, rivers and/or wetland areas is allowed. • The wetland area and/or river must not be drained, filled or altered in any way including alteration of a bed and/or, banks, without prior consent from the DWS. The necessary licenses must be obtained in terms of Section 21 and 22 of the National Water Act, 36 of 1998 from DWS. • No fires or open flames are allowed in the vicinity of the wetland, especially during the dry season.				

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		• No swimming, washing (including vehicles and equipment), fishing or related activity is permitted in a wetland or river. • Disturbances to nesting, breeding and roaming sites of animals in or adjacent to wetland areas must be minimized. • Portable Water shall be the last resort info dust suppression on site.				
Air Pollution	**10**	• Speed limits must be implemented in all areas, including public roads and private property to limit the levels of dust pollution. • Dust must be suppressed on access roads and construction sites during dry periods by the regular application of water or a biodegradable soil stabilisation agent. Water used for this purpose must be used in quantities that must not result in the generation of run-off. • Where possible the use of potable water should be minimised for dust suppression purposes, preferably recycled or reused water. • The site-specific investigation will quantify the impact of dust on nearby wetlands, rivers and dams in terms of sedimentation. Mitigation measures identified during the site-specific study must be implemented. • The Contractor must notify the principal of all schools within 50m of the site of proposed activities. The principal must in turn ensure that children with allergies and respiratory ailments take the necessary precautionary measures during the construction period. The Contractor must ensure that construction activities do not disturb school	All Contractors	Throughout construction	Visual inspection	• Visible air pollution.

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		activities e.g., dust clouds may reduce visibility affecting sports activities. • Waste must be disposed of, as soon as possible at a municipal transfer station, skip or on a permitted landfill site. Waste must not be allowed to stand on site to decay, resulting in malodours. • Noise control measures must be implemented. All noise levels must be controlled at the source. All employees must be given the necessary ear protection gear. IAP's must be informed of the excessive noise factors. • The Contractor must inform all adjacent landowners of any after-hour construction activities and any other activity that could cause a nuisance e.g., the application of chemicals to the work surface. Normal working hours must be clearly indicated to adjacent landowners. • No loud music is allowed on site and in construction camps. • No fires are allowed if smoke from such fires will cause a nuisance to IAPs.				
Social and cultural	**11**	• Access by non-construction people onto any construction sites must be restricted. The Contractors activities and movement of staff must be restricted to designated construction areas only. • The Contractors crew must be easily identifiable due to clothing, identification cards or other methods. • Rapid migration of job seekers could lead to squatting and social conflict with resident communities and increase in social pathologies if not properly addressed. The Contractor must ensure that signs indicating the availability of jobs are installed.	All Contractors	Throughout construction	Visual inspection	• Community complaints. • Complaints register. • Daily environmental inspection

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		• Criteria for selection and appointment (by the Contractor) of construction labour must be established to allow for preferential employment of local communities. The Local Authority must be actively involved in the process of appointing temporary labourers. • Sub-Contractors and their employees must comply with all the requirements of this document and supporting documents e.g., the Contract document that applies to the Contractor. Absence of specific reference to the sub-contractor in any specification does not imply that the sub-contractor is not bound by this document. • No member of the construction workforce is allowed to wander around private property, except within the immediate surroundings of the site. • The Contractor must provide suitable sanitation facilities for site staff. Sanitation provided during the construction phase should be managed so that it does not cause environmental health problems. The use of the surrounding veld for toilet purposes is not permitted under any circumstance. • The Contractor must arrange for all his employees and those of his sub-contractors to be informed of the findings of the environmental report before the commencement of construction to ensure: • A basic understanding of the key environmental features of the work site and environments, and • Familiarity with the requirements of this document and the site-specific report. • Supervisory staff of the Contractor or his sub-contractors must not direct any person to undertake any activities which would place such person in				

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		contravention of the specifications of this document endanger his/her life or cause him/her to damage the environment. • The demand for construction materials and supplies will have an effect on the local economy. This impact can be optimised by sourcing and purchasing materials locally and regionally wherever possible, insofar as the material complies with the design specification. • The Contractor must maintain a detailed complaints register. This must be forwarded, together with solutions, to the authorities when requested.				
Aesthetics	**12**	• Scenic Quality • Damage to the natural environment must be minimized. • The contractor may not remove any trees. If trees are in the way of the pipe route or with the development sites, the contractor must inform the environmental section who will then liaise with city parks for permission or recommendation. • Trees and tall woody shrubs must be protected from damage to provide a natural visual shield. Excavated material must not be placed on such plants and movement across them must not be allowed, as far as practical. • The clearing of all sites must be kept to a minimum and surrounding vegetation must, as far as possible, be left intact as a natural shield. • No painting or marking of natural features must be allowed. • Above-ground Structures (reservoirs, water hammer tanks, valve chambers, pump stations etc.)	All Contractors	Throughout construction	• Visual inspection. • Way-leaves	• Daily inspection • Environmental incident.

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		• All above ground structures should be located in areas where the visual impact from roads, houses etc. is minimised. • All above ground structures could be treated or painted to blend in with the natural environment. • Cut and fill areas, river and stream crossings and other soil stabilisation works must be constructed to blend in with the natural environment. • Natural outcrops, rocky ridges and other natural linear features must not be bisected. Vegetation on such features must, as far as possible, not be cut unless absolutely necessary for construction. • Excavated material must be flattened (not compacted) or removed from site. No heaps of spoil material must be left on site once the Contractor has moved to a new construction site. • Any complaints from IAP's regarding the appearance of the construction site must be recorded and addressed promptly by the Contractor.				
Fauna and Flora	**13**	**Flora** • All suitable and rare flora and seeds must be rescued and removed from the site. They must be suitably stored, for future use in rehabilitation. • The felling and/or cutting of trees and clearing of bush must be minimised. • Bush must only be cleared to provide essential access for construction purposes. • The spread of alien vegetation must be minimized. • Any incident of unauthorised removal of plant material, as well as accidental damage to priority plants, must be documented by the Contractor. • Woody vegetative matter stripped during construction must either be spread randomly	All Contractors	Throughout construction	• Visual inspection • Way-leave from City Parks. • Biodiversity permit from Gauteng Department of Rural and Development	• Environmental incident register • Daily inspection • Number of environmental incidents. • Fauna and flora removal and relocation register

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		throughout the surrounding veld to provide biomass for other micro-organisms and habitats for small mammals and birds, or it may be stockpiled for later redistribution over the reinstated top soiled surface. No vegetative matter must be burnt or removed for firewood other than those removed during the grubbing and clearing phase. Such vegetation can be made available to the local inhabitants to be used as firewood. • No tree outside the footprint of the Works area must be damaged. **Fauna** • No species of animal may be poached, snared, hunted, captured, or wilfully damaged or destroyed. • Snakes and other reptiles that may be encountered on the construction site must not be killed unless the animal endangers the life of an employee. • Anthills and/or termite nests that occur must not be disturbed unless it is unavoidable for construction purposes. • Disturbances to nesting sites of birds must be minimized. • The Contractor must ensure that the work site is kept clean and free from rubbish, which could attract pests.				
Infrastructure	**14**	• The relevant authorities must be notified of any interruptions of services, especially the Local Municipality, National Road Agency, Transnet, TELKOM, and ESKOM. In addition, care must be taken to avoid damaging major and minor pipelines and other services. • The integrity of property fences must be maintained.	All Contractors	Throughout construction	• Visual inspection • Wayleaves from different entities.	• Incident register. • Permit/ Way-leave register • Complaints register.

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		• No telephone lines must be dropped during the construction operations, except where prior agreement by relevant parties is obtained. All crossings must be protected, raised or relocated as necessary. • All complaints and/or problems related to impacts on man-made facilities and activities must be promptly addressed by the Contractor and documented. • Proper storage facilities should be provided for the storage of oils, grease, fuels, chemicals and hazardous materials. • The Contractor must ensure that accidental spillage does not pollute soil and water resources. • Fuel stock reconciliation must be done on all underground tanks to ensure no loss of oil, which could pollute groundwater resources. • Cement must be stored and mixed on an impermeable surface. • The Contractor shall ensure that existing services (e.g., roads, pipelines, and power lines and telephone services) are not damaged or disrupted unless required by the contract and with the permission of the RE. • The Contractor shall be responsible for the repair and reinstatement of any existing infrastructure that is damaged or services which are interrupted. • A time limit for the repairs may be stipulated by the RE in consultation with the Contractor.				
Blasting	**15**	• Blasting must not endanger public or private property. • Noise mufflers and/or soft explosives must be used to minimize the impact on animals.	All Contractors	Throughout construction	Visual inspection/ Engineer report	• Incident register. • Complaints register.

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		• All the provisions of the Explosives Act, 26 of 1956 and the Minerals Act, 50 of 1991 must be complied with. • The Contractor must take measures to limit fly rock. • Certificate of competence. In file • Blasting permit must be obtained from the South African police station issued in terms of section 9 of explosive Act, Act 26 of 1956) prior blasting. • Method statement for drilling and blasting (NB: Submitted for acceptance before any works) in file • Provide the MSDS's for the chemicals are to be used. • Proof of notification to the affected community. • The Appropriate PPE.				• Permit register.
Workshops, storage areas and materials handling	**16**	• These areas shall be chosen so as to cause the least impact on the biophysical and social elements of the area. • The siting of workshops, maintenance and refuelling sites and materials storage areas shall not be in the vicinity of sensitive sites e.g., wetlands, cultivated fields or drainage lines, or where local landowners can be disturbed. • Storm water shall be diverted around the storage area. Storm water falling on the storage area shall be discharged if it meets the required water quality standards. • Proper storage facilities, placed on an impermeable surface, shall be provided for the storage of oils, grease, fuels, chemicals, and other hazardous materials to be used during the construction phase of the project. If fuel is required on site, it shall be stored in a secure area in a steel tank supplied and	All Contractors	Throughout Construction	• Visual inspection • Method statement for handling hazardous substances. • MSDS	• Hazardous substances register. • MSDS file • Spill register • Incident register.

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		maintained by the fuel suppliers. Leakage of fuel shall be avoided. • An adequate bund wall, 110% of volume, shall be provided for fuel and diesel areas to accommodate any spillage or overflow from these substances. The area inside the bund wall shall be lined with an impervious lining to prevent infiltration of the fuel into the soil. • In addition, hazard signs indicating the nature of the stored materials shall be displayed on the storage facility or container and Material Safety Data Sheets (MSDS's) will be made available for all hazardous chemicals. Before containers or storage facilities are erected, emergency procedures in the event of misuse or spillage that may negatively affect an individual or the environment will be in place. • The storage facilities (including any tanks) shall be surrounded by a bund wall, in order to ensure that accidental spillage does not pollute local soil or water resources. • The storage areas shall not be utilised for accommodation purposes and shall be access controlled. • The storage area shall be kept tidy, and the area shall be rehabilitated after use. • An inventory of any hazardous chemicals/substances (including that within equipment) kept on site, along with a description of possible ill effects and treatment of health-related afflictions resulting from accidents, shall be kept in the storage area as well as by the appropriate manager. These areas shall be securely fenced.				

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		• Gas welding cylinders and LPG cylinders shall be stored in a secure, well-ventilated area. • A notice board with the contact details of the responsible party shall be displayed at the gate to the storage area. • The contractor shall ensure that any delivery drivers are informed of all procedures and restrictions required to comply with the EMP. Someone with an adequate understanding of the CEMP shall supervise drivers during delivery and off-loading. • All vehicles and machinery will be inspected for any leaks or malfunctions regularly. Vehicle servicing or repairs is prohibited from site, unless in an emergency. • Drip trays shall be inspected and emptied daily and serviced when necessary. In particular drip trays shall be closely monitored during rain events to ensure that they do not overflow. The contents must be disposed of at a recognised site. • All repairs done on machinery using hydrocarbons as fuels or lubricants shall have a drip tray placed strategically to avoid incidental spillage. • Workers shall be made aware of the health risks associated with any hazardous substances used (e.g., smoking near refuelling depots), and shall be provided with appropriate protective clothing / equipment in case of spillages or accidents. • Cement and other potential environmental pollutants shall be stored and mixed on plastic sheeting or ready-mix trucks shall be used. There shall be no opportunity for environmental contamination.				

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		• Workshop areas shall be monitored for oil and fuel spills and such spills shall be cleaned and remediate to the satisfaction of the EO. • The Contractor shall be in possession of an emergency spill kit that must be always complete and available on site.				
Waste Management	**17**	Methods for waste management and waste minimisation shall be implemented from the outset of the contract as per the Waste Management Plan to be submitted to Client. All personnel shall be instructed to dispose of all waste in the proper manner. A waste avoidance and minimisation approach will be encouraged for the duration of the project. The following steps in order will be applied. • Prevention – avoid and minimise waste • Recycle – reuse and recover all general waste • Treat – treatment to reduce toxicity reduce waste quantities • Dispose – waste removal into a registered landfill facility **Solid waste** Waste with the potential for market re-use will be stored in separate containers, this includes, scrap metal, used tyres and paper. This waste will be recycled wherever possible. Solid waste shall be temporarily stored in tip – poof metal drums or waste skips at an approved area on site for collection and disposal. This area shall be away from drainage lines or water courses. • All general waste drums or skips will be appropriately labelled GENERAL WASTE	All Contractors	Throughout Construction	• Visual inspection/Environmental inspection checklist. • Legal Documents: Transport certificate obtained from GDARD for transporting general or hazardous waste. • Transport certificate obtained from City of Johannesburg for transporting general waste within COJ. • Waste manifest/	• Littering • Soil contamination • Water pollution.

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		• A refuse control system shall be established for the collection and removal of refuse to the satisfaction of Client and ECO. • No waste shall be burned at the site offices or anywhere else on the site. • All building rubble shall be a) removed from the site and disposed of at an appropriate dumping site, or b) temporarily stored in a clearly demarcated area on site for future use. • All waste shall be disposed at an appropriate waste disposal facility. **Litter** • No littering by construction workers shall be allowed. During the construction period, the facilities shall be maintained in a neat and tidy condition and the site shall be kept free of litter. • Measures shall be taken to reduce the potential for litter and negligent behaviour with regard to the disposal of all refuse. • Littering, discarding or burying of any materials shall not be allowed on site. **Hazardous waste** • Hazardous waste shall be temporarily stored in tip – poof metal drums or waste skips at an approved area on site for collection and disposal. This area shall be away from drainage lines or water courses. • All hazardous waste drums or skips will be appropriately labelled.			waste disposal certificate/ weighbridge slip.	

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		• Hazardous waste must not be temporary stored on site for a period exceeding 90 days as per the National Environmental Management Waste Act (Act 59 of 2008) as amended in 2014) (Schedule 19 (2)). **HAZARDOUS WASTE.** • Hazardous waste such as bitumen, tar and oil shall be disposed of at a registered waste disposal facility. Special care shall be taken to avoid spillage of tar products such as tar prime or pre-coating fluid to avoid water-soluble phenols from entering the ground or contaminating water. • All used filter materials shall be stored in a secure bin for disposal off site. Any contaminated soil shall be removed and replaced with clean soil. Soil contaminated by oils and lubricants shall be collected and disposed of at a facility designated by the local authority to accept contaminated materials. • Used oil, lubricants, and cleaning materials from the maintenance of vehicles and machinery shall be collected in a holding tank and returned to the supplier. Water and oil shall be separated in an oil trap. Oils collected in this manner shall be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at an approved hazardous waste disposal site. Oil collected by a mobile servicing unit shall be stored in the service unit's sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company. • Sludge should be managed in accordance with the Sludge Guideline 2010.				

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		• Sludge should be kept only at the drying bed and no sludge should be stored at a permeable ground or natural ground. • Hazardous waste shall be disposed of at a registered hazardous waste disposal site, disposal certificates shall be kept in the site file for record. **Medical Waste** • All medical waste will be contained in the special bins provided. All sharp needles must be separated from other medical waste, • All outdated and disused medicines will be disposed of as a hazardous medical waste or returned to the supplier for disposal. (Tablets and syrups will be crushed and/or dissolved before disposal as hazardous waste), • Medical waste used on personnel coming for treatment at the clinic are to be placed on a demarcated container storage room, • The Occupational Health Nurse (OHN) will notify a service provider for removal of the medical waste prior exceeding 90 days. • The service provider to provide Waste Manifest as well as the Safe Disposal Certificate, to the OHN who will maintain the copies of the waste manifest and safe disposal certificate. • The OHN will arrange for an approved hazardous waste disposal company to collect and dispose of this medical waste. The OHN is responsible for and authorised to keep all records in connection herewith (disposal certificates).				

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Ablution facilities	**18**	• Provide ablution facilities (i.e., chemical toilets) for all site staff at a ratio of 1 toilet per 15 workers (absolute minimum 1:25). • Secure all temporary/portable toilets to the ground within the Site Camp to the satisfaction of JW EO/ECO to prevent them toppling due to wind or any other cause. • Maintain toilets in a hygienic state (i.e., toilet dispensers to be provided, toilets to be cleaned and serviced regularly (by registered appropriate waste contractor), and toilets to be emptied before long weekends and builders' holidays). • Remove/ appoint an appropriate supplier to remove accumulations of chemicals and treated sewage from the site and dispose of at an approved waste disposal site or sewage plant. • Ensure that no spillages occur when the toilets are cleaned or emptied. Repeated incidents of spillage of chemicals and or waste (i.e., more than one incident), will require toilets to be placed on a solid base with a sump. • Ablution facilities must be located at least 50m from any watercourse. • Ablution facilities shall be provided on site. • The positioning of the ablution facilities shall be done in consultation with Client and shall be placed so that it cannot contaminate the natural streams and rivers. One toilet shall be provided per 10 staff members on site. Toilets shall be positioned within walking distance of wherever employees are employed on the site. Toilets shall be provided with locks and doors shall be secured to prevent the toilets from blowing over.	All Contractors	Throughout construction	• Visual inspection • Records of waste manifest/disposal certificates/ weighbridge slip	• Incidence of staff not using Facilities • Incidence of pollution

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		• The toilets shall be placed outside of areas susceptible to flooding. • Chemical toilets shall be serviced regularly by an authorised service provider and removed to a registered wastewater treatment works and disposal certificates shall be obtained from the waste disposal facility for each disposal and retained on site. • Polluted run-off must be discharged in the local sewerage main and not overland or into public streams. In instances where a sewerage main is not available, polluted run-off will be collected in sub-surface tanks and a reputable effluent removal contractor will be contracted to dispose of the waste in an environmentally acceptable manner. Official documentation shall be obtained from the waste disposal facility for each disposal and retained on site. • Toilets situated close to the site boundaries or within sight of residential areas shall be hidden behind screens or other cover as approved by the Engineer. • Discharge of waste from toilets into the environment and burial of waste is strictly prohibited. • Only flushable toilets should be utilised on site. • If the Ablution facilities are to be connected to the Municipal sewer line, method statement and a letter for municipal tax and rates should be submitted to JW Environmental section and responsible Depot for approval. • A letter or agreement for disposing waste must be obtained from the applicable WWTW; this must be provided by service provider. Waste manifests, disposal certificates and service certificates are				

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		required; these must be provided by service provider. • The contractor shall not appoint service providers who do not have registration certificates with GDARD and CoJ for transporting hazardous (and general waste), and copies of permits for landfills, and agreement letter from WWTW, to be used for disposals. The contractors themselves are encouraged to register as general and hazardous waste transporters, and open accounts with Pikitup, so disposal slips may be obtained.				
Access road and traffic control	**19**	**Access Roads** • The Contractor and the affected landowner must collaborate on the planning and construction of new access routes and the repair or upgrading of existing routes. • Access to the site must be controlled such that only vehicles and persons directly associated with the work gains access to the site. • Temporary access roads must not be opened until required and must be restored to its former state as soon as the road is no longer needed**.** **Traffic Control** • All reasonable precautions must be taken during construction to avoid severely interrupting the traffic flow on existing roads, especially during peak periods. • Before any work can start the Local Traffic, Department must be consulted about measures to be taken regarding pedestrian and vehicular traffic control and obtain proper road signage's	All Contractors	Throughout construction	• Method statement for access road and traffic control. • Way-leave	• Daily Inspection checklist. • Environmental incident. • Incident register.

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Electrical	**20**	• Measures must be taken during thunderstorms to protect workers and equipment from lightning strikes. • All tall structures must be properly earthed and protected against lightning strikes.	All Contractors	Throughout construction	• Permit • OHS approval letter • Wayleave	• Approval letter • Electrical certificate
Development Footprint	**21**	• The development footprints and disturbed areas surrounding the proposed project infrastructure should be kept at minimum as possible and the areas cleared of natural vegetation and topsoil must be kept to a minimum. • The extent of all development footprint areas and permanent/ temporary structures must be limited to what is essential. • As far as possible, existing roads are to be utilised, to limit cumulative impacts from roads and traffic. • The height of any temporary structures such as topsoil stockpiles should be kept as low as possible below 1m.	All Contractors	Throughout construction	• Agreement letter. • Wayleave	• Incident register. • Complaints register.
Fire Prevention	**22**	• The Contractor must take all the necessary precautions to protect the materials on site and to avoid veld fires. • No fires or open flames are allowed on site unless directly used for construction purposes, • Review all SANS standards relating to fire precautions and fire control namely, SANS 0131-3 Section 8 and SANS 089-1 or as amended. • The Contractor must have fire-fighting equipment and a first aid box available on site and on all vehicles working on site. • All waste bins must be kept away from fuel tank installations.	All Contractors	Throughout construction	• Visual inspection • Emergency Response Plan.	• Fire extinguisher inspection checklist. • Incident register • Mock drill report.

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		• All fuel tanks must be installed above ground, depending on the volume of stored fuel, for easy detection of fuel leaks. • Any welding or other sources of heating of materials must be done in a controlled environment, wherever possible and under appropriate supervision, in such a manner as to minimise the risk of veld fires and/or injury to staff. • Fires lit for comfort (warmth) must be actively discouraged by the Contractor, due to the risk of veld fires and the risk to adjacent properties. Also, no waste material must be burnt.				
Noise Pollution	**23**	• Temporary noise pollution due to construction works should be controlled by proper maintenance of equipment and vehicles and tuning of engines and mufflers. Construction works should be completed in as short a period as possible by assigning qualified engineers and foremen. • It is the responsibility of the Contractor to monitor for the mitigation of such impacts. Noise problems should be reduced to normally acceptable levels by incorporating low-noise equipment in the design and/or locating such mechanical equipment in properly acoustically lined buildings or enclosures. In the presence of adequate buffer zones between the facility and residential areas, noise control measures must be minimized.	All Contractors	Throughout Construction	Random noise measurements	• Results of random noise measurements • Number of registered complaints
Complaints	**24**	Maintain complaints register for all complaints. The register must list: • Complainant name and contact details. • Date complaint was lodged. • Person who recorded the complaint. • Nature of the complaint.	All Contractors	Throughout construction	Complaints register	• Availability of register on site • Designated person to maintain register

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		• Actions taken to investigate the complaint and • outcome of the investigation. • Action taken to remedy the situation. • Date on which feedback was provided to complainant.				• Complaints logged • Complaints followed up and Closed out.
Housekeeping	**25**	• All construction and operational areas must be kept in a neat and orderly condition at all times. • An efficient removal system of waste and rubble must be ensured during all development phases. • All operational facilities, including vehicles, should be actively maintained. • Any areas for material storage, waste sorting and other potentially intrusive activities must be screened from view as far as considered feasible. • Regularly inspect all construction machinery and holding tanks for leaks or damages. • Place generators on drip trays. • Repair any defects as soon as possible. In the case of leaks, ensure that the leaking water or effluent is captured and not released into the environment. • Service and refuel equipment that uses hydrocarbon fuels, oils, lubricants, and other hazardous chemicals at the designated area at the Site Camp only under conditions approved by JW EO/ECO • Ensure that absorbent pads (or equivalent) and/ or drip trays are available to collect any oil, fluid, etc. in the case of a breakdown or emergency repair outside the designated area. Keep a copy of fuels and hazardous substance inventory on site. • Keep spill containment and clean-up equipment at all work sites and for all polluting materials used at the site.	All Contractors	Throughout	Visual inspection of site camp/ construction site	Regular inspection reports by SHE Officer and JW EO

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		• Prevent discharge of any hazardous substances or pollutants, such as cements, concrete, chemicals, and other contaminated wastewater and fuels into the ground, surface, or storm water systems on site. • Control litter and keep construction areas as clean and neat as possible.				
Transportation and refuelling	**26**	• Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures. • Undertake any on-site refuelling and maintenance of vehicles/machinery in designated areas. Line these areas with an impermeable surface and install oil traps. • Ensure that oils and lubricants used for maintenance of equipment in the field are correctly contained. • Use appropriately sized drip trays for all refuelling and/or repairs done on machinery – ensure these are strategically placed to capture any spillage of fuel, oil, etc. • Use drip trays under all equipment and plants that are parked overnight or for long periods. • Store and handle fuels, oils and chemicals so as to avoid the risk of spillage, i.e., in waterproof and impervious	All Contractors	Throughout Construction	Visual inspection of vehicles, barges, machinery and refuelling / maintenance areas	• Incidence of non-compliance • Incidence of leaks and spills • Cost of cleaning up spills
Safety and Security	**27**	• Do not allow any open fires on the site. • Do not allow smoking on the site except within designated areas. Suitable fire-fighting equipment must be readily available in these areas. • Equip all fuel stores and waste storage areas with fire extinguishers.	All Contractors	Throughout construction	• Inspect attendance register for training sessions • Inspect fire extinguishers	• Number of fire incidents • Certified extinguishers in appropriate locations

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		• Ensure that all personnel on site are aware of the location of fire-fighting equipment on the site and how the equipment is operated. • Suitably maintain fire-fighting equipment. • Ensure that emergency procedures (in relation to fire, spills, contamination of the ground, accidents to employees, use of hazardous substances, etc.) are established prior to commencing construction. • Make all emergency procedures available, including responsible personnel, contact details of emergency services, etc. to all the relevant personnel. Clearly demarcate emergency procedures at the relevant locations around the site. • Secure the Site Camp, particularly to restrict • Unauthorised access to fuels and other hazardous substances. • Provide suitable emergency and safety signage on site and demarcate any areas which may pose a safety risk (including hazardous substances, deep excavations, etc.). • Advise the ECO of any emergencies on site, together with a record of action taken.	All Contractors	Before and during construction	and certificates Visual inspection	Number of safety / emergency incidents.
Response to environmental pollution	**28**	• In the event of environmental pollution, e.g., through spillages, immediately stop the activity causing the problem. • Maintain relevant Material Safety Data Sheets (MSDS) at the site for all potentially hazardous substances (as defined in the regulations for hazardous chemical substances). In the event of an emergency, procedures detailed in the MSDS shall be followed. Clean up any spills immediately, through containment and removal of free product and appropriate disposal of contaminated soils.	All Contractors	Throughout construction	• Maintain register of pollution events and response • Following resumption of activities, frequently inspect repaired	• Number of incidents • Time activities stopped • Number of recurring Incidents • Availability and 65completeness of register

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		• Immediately remediate and rehabilitate areas in the event of a spill of an environmentally hazardous substance. • Only resume activity once the problem has been stopped or (in the case of spillages) the pollutant can be captured without reaching the environment. Repair faulty equipment as soon as possible. • Treat hydrocarbon spills, e.g., during refuelling, with adequate absorbent material, which then needs to be disposed of at a suitable landfill. • Ensure a quantity of appropriate remedial agent, capable of containing and/or remediating a hydrocarbon spill is available on site at all times in case of an emergency spill. The material shall be capable of handling a spill of at least 200l. • Report all fuel, oil or hydraulic fluid spills to the JW EO/ECO so that appropriate clean-up measures can be implemented. • Report all incidents within 24 hours to JW environmental section. • All environmental incidents must be investigated within seven (7) working days.			equipment to ensure proper functioning	
Storm Water Management	**28**	**Objective** • To minimise erosion of soil from site during construction. • To minimise deposition of soil into drainage. • Minimise loss of vegetation cover due to construction related activities. **Mitigation Measures** • Identify and demarcate construction areas for general construction work and restrict construction activity to these areas. Prevent unnecessary	All Contractors	Throughout Construction	• Visual inspection. • Storm water management Plan. • Way-leave from JRA	• Daily inspection checklist. • Incident register.

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		destructive activity within construction areas (prevent over-excavations) • Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. All stockpiles must be positioned at least 50 m away from drainage lines and wetlands. • Erosion control measures: Run-off control and attenuation on slopes (sandbags, logs), silt fences, storm water channels and catch-pits, shade nets, soil binding, geofabrics, hydro seeding or mulching over cleared areas. • Control depth of excavations and stability of cut faces/sidewalls. • Compile a comprehensive storm water management plan as part of the final design of the project and implement during construction and operation.				
Re-vegetation, Rehabilitation, Reinstatement	**29**	**Objective** To ensure re-vegetation and rehabilitation of disturbed areas is undertaken **Legislation and Standards** Conservation of Agricultural Resources Act (Act 43 of 1983 Environment Conservation Act (Act 73 of 1989 National Forestry Act (Act 84 of 1998 National Environmental Management Act 107 of 1998 and Gauteng Nature Conservation Bill, 2014. **Mitigation measures** In order to meet this goal, the following objective, actions, and monitoring requirements are relevant: • Disturbed areas must be rehabilitated/re-vegetated with appropriate natural vegetation and/or local	All Contractors	Throughout Construction	• Rehabilitation Plan • JW EMP • Visual inspection • Ecologist Specialist report • Environmental Authorisation/ GA • Practical and completion certificate.	• Daily inspection checklist. • Rehabilitation report • Waste management collection report (Waste Disposal Certificate).

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		seed mix. Re-use native/indigenous plant species removed from disturbance areas in the rehabilitation phase as per the re-vegetation and rehabilitation management plan. • Alien/non-native species must not be used. If these are requested/ required by stakeholders, then this must be documented by contractor. • Re-vegetated areas may have to be protected from wind erosion and maintained until an acceptable plant cover has been achieved. • On-going alien plant monitoring and removal within the disturbed project footprint (where the initial clearing for construction took place) must be undertaken on all areas of natural vegetation on an annual basis. • All temporary facilities, equipment and waste materials must be removed from site and appropriately disposed of. • All temporary access road must be rehabilitated to their original condition • Necessary drainage works and anti-erosion measures must be installed, where required, to minimise loss of topsoil and control erosion. • On-going inspection of rehabilitated areas to determine effectiveness of rehabilitation measures implemented. • On-going alien plant monitoring and removal should be undertaken as per the approved Rehabilitation/Re-vegetation plan. **Management and Mitigation Requirement** • Conduct a detailed search of at the area. As a minimum, this should take place during the			• Community Happy Letters.	

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		spring and summer months prior to impoundment so positive identification of flowering plants can be made. This should be done taking due cognisance of specialist studies already undertaken as part of the EIA process; • Allow time for additional searches if these are deemed necessary, based on progress and diversity of plant species found; • Identify and physically mark all conservation worthy plants found on the ground; and • Capture markers and reference in a retrievable system, so that these can be located again for transplanting (e.g., using a combination of aerial photography, GPS, and GIS, as appropriate).				
Practical and Final completion inspection	**30**	• Ensure that practical inspection is conducted before the Contractor hands over the project back to JW in order to ascertain if the reinstatement or rehabilitation has been done accordingly. • The snag list is to be compiled and accepted by all parties (JW CAPEX Representatives, JW environmental section as applicable, and appointed Contractor) All responsible personnel including Environmental representative sign both practical and final completion letter.	CAPEX/ OHSE& DM/ All Contractors	During the final stage of project	• Meeting invite • Visual inspection	• Meeting invite • Attendance register • Snag list • Signed practical and final completion inspection letter.
Final close out report	**31**	• Conduct final audit on site. • EO must ensure that audit reports are signed by RE/Engineer and Contractor. • Environmental File is returned to JW, after rehabilitation has been deemed successful.	OHSE & DM	During the final stage of project.	• Final audit report. • Signing of Audit reports.	• Final Audit report. • Signed Audit report. • Environmental file.

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Table 3: Environmental Management and Mitigation Measures that must be implemented during the Operational Phase

Operational Phase Measures						
Aspects	**ID**	**Mitigation Measure/Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**	**Performance indicators**
Waste Management	**1**	Sanitation Facilities • Ablution facilities shall be provided on site. • The positioning of the ablution facilities shall be done in consultation with Client and shall be placed so that it cannot contaminate the natural streams and rivers. One toilet shall be provided per 15 staff members on site. Toilets shall be positioned within walking distance of wherever employees are employed on the site. Toilets shall be provided with locks and doors shall be secured to prevent the toilets from blowing over. • The toilets shall be placed outside of areas susceptible to flooding. • Chemical toilets shall be serviced regularly by an authorised service provider and removed to a registered wastewater treatment works and disposal certificates shall be obtained from the waste disposal facility for each disposal and retained on site. • Polluted run-off must be discharged in the local sewerage main and not overland or into public streams. In instances where a sewerage main is not available, polluted run-off will be collected in sub-surface tanks and a reputable effluent removal contractor will be contracted to dispose of the waste in an environmentally acceptable manner. Official documentation shall be obtained from the waste	Johannesburg Water	During operation and maintenance activities	• Visual inspection of Waste collection and disposal areas. • Visual inspection of site. • Check waste disposal slips. • Monitor activities against JW Waste Management Plan. • Waste Inventory Register.	• Presence of litter • Availability of waste bins and skips. • Degree to which rubbish bins and skips are filled • Total volume of general and hazardous waste storage capacity • Total volume of general and hazardous waste stored on site • Degree to which different waste is separated. • Frequency of waste collection. • Total volume of recycled and reused waste.

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		disposal facility for each disposal and retained on site. • Any cooking on Site shall be done on well-maintained gas cookers with fire extinguishers present. No cooking shall be permitted to occur on open fires. • Toilets situated close to the site boundaries or within sight of residential areas shall be hidden behind screens or other cover as approved by the Engineer. • No spillage shall occur when the toilets are cleaned or emptied and the contents shall be properly stored and removed from site. • Discharge of waste from toilets into the environment and burial of waste is strictly prohibited. • All building rubble and rubble from the demolished structures, solid and liquid waste must be disposed of as necessary at an appropriately licensed refuse facility. • Ensure that no refuse wastes are burnt on the premises or on surrounding premises. No fires will be allowed on site. **Contaminated water** •Workshops, refuelling depots and washing areas shall be bunded. •Any wastewater or spilled fuel collected within bunded areas around the refuelling area shall be disposed of as hazardous waste •Wastewater containing hydrocarbons, paints oil etc. shall be treated as hazardous waste				
Protection of Vegetation	**2**	• Limit the footprint of the maintenance and operational activities to the minimum to minimise environmental damage.	Johannesburg Water	• During operation and maintenance activities/.	Visual inspection	• Incidents of vegetation damage.

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		• Designate vegetated areas outside the development footprint as “No go” areas. • Limit the off-road driving within the Johannesburg Water Sites. • Protected or endangered species of plants shall not be removed unless they are interfering with a structure. • All trees and vegetation cleared from the site shall be cut into manageable lengths. • Big trees with large root systems shall be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root system are removed. • Stumps shall be treated with herbicide. • Protected or endangered species of plants shall not be removed unless they are interfering with a structure. • Where such species have to be removed due to interference with a structure, the necessary permission and permits shall be obtained from Provincial Department of Agriculture and Rural Development. • All protected species not to be removed must be clearly marked and such areas fenced off if required. • The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. • No scalping shall be allowed on any part of Johannesburg Water Sites.		• When is necessary?		• Number of incidents of disturbance of vegetation outside site boundary.
Alien invasive/weeds control	**3**	• Some of the areas of JW area are covered with moderate to very dense invasive alien shrubs and trees. Clearing of such vegetation will be necessary	Johannesburg Water	During operation and maintenance activities	• Visual inspection.	• Daily inspections register. • Incident register.

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		to gain access. However, clearing of this vegetation from the entire project area as far as possible will reduce the re-establishment rate of this vegetation over time, and will thus not only benefit the environment put also the proposed project and potential future phases of the project in the long term. • The type of invasive, however, will require regular follow-up eradication of seedlings after clearing, as extensive seedbanks of these species are present underneath present infestations. • Wood from alien vegetation can be used. However, care must be taken not to leave any of the leaf- or seed material on the site where the vegetation was cleared. Rather, identify a particular area that no longer has any indigenous vegetation, demarcate that area and dump excess material of alien species there. • Once the material is sufficiently dry, it should be burned to destroy any regenerating capacity of stems and roots as well as seeds. • Only registered PCO with Certificate for competency to handle the hazardous substances (e.g., Herbicides) is allowed to use herbicide. • Only environmentally friendly herbicide is allowed within JW sites. • MSDS for the herbicides must be kept in the storage area. • Method Statement for applying and handling herbicides and Risk Assessment for applying and handling herbicides. • Appropriate PPE for handling herbicides. • Herbicides stored only in a designated storage.			• Monitoring against Vegetation Management Plan. • PCO certificate.	

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		• Empty containers of herbicides disposed of accordingly to the registered hazardous landfill site. • Proof of disposal provided to JW Environmental Section.				
Sludge Management	**4**	• The sludge must be managed according to the sludge guideline. • All agreements or Contract must be placed in the file. • The sludge must be kept on a designated bunded and concrete lined drying bed.	Johannesburg Water/Bulk Waste	During operations activities	• Visual inspection according to Sludge SOP. • Monitoring against Sludge Guideline. • Monitoring against WUL.	• Sludge test report • Complaints register. • Sludge spill register. • Environmental Officers Internal WUL Audit Report.
Workshop and storage Area	**5**	• The siting of workshops, maintenance and refuelling sites and materials storage areas shall not be in the vicinity of sensitive sites e.g., wetlands, cultivated fields or drainage lines, or where local landowners can be disturbed. • Storm water shall be diverted around the storage area. Storm water falling on the storage area shall be discharged if it meets the required water quality standards. • Proper storage facilities, placed on an impermeable surface, shall be provided for the storage of oils, grease, fuels, chemicals, and other hazardous materials to be used during the construction phase of the project. If fuel is required on site, it shall be stored in a secure area in a steel tank supplied and maintained by the fuel suppliers. Leakage of fuel shall be avoided.	Johannesburg Water	During operations and maintenance activities	• Visual inspection • SOP for handling hazardous substances. • MSDS register	• Workshop and storage register. • MSDS register. • Incident register.

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		• An adequate bund walls, 110% of volume, shall be provided for fuel and diesel areas to accommodate any spillage or overflow from these substances. The area inside the bund wall shall be lined with an impervious lining to prevent infiltration of the fuel into the soil. • In addition, hazard signs indicating the nature of the stored materials shall be displayed on the storage facility or container and Material Safety Data Sheets (MSDS's) will be made available for all hazardous chemicals. Before containers or storage facilities are erected, emergency procedures in the event of misuse or spillage that may negatively affect an individual or the environment will be in place. • The storage facilities (including any tanks) shall be surrounded by a bund wall, in order to ensure that accidental spillage does not pollute local soil or water resources. • The storage areas shall not be utilised for accommodation purposes and shall be access controlled. • The storage area shall be kept tidy, and the area shall be rehabilitated after use. • An inventory of any hazardous chemicals/substances (including that within equipment) kept on site, along with a description of possible ill effects and treatment of health-related afflictions resulting from accidents, shall be kept in the storage area as well as by the appropriate manager. These areas shall be securely fenced. • Gas welding cylinders and LPG cylinders shall be stored in a secure, well-ventilated area.				

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		• A notice board with the contact details of the responsible party shall be displayed at the gate to the storage area. • All vehicles and machinery will be inspected for any leaks or malfunctions regularly. Vehicle servicing or repairs is prohibited from site, unless in an emergency. • Drip trays shall be inspected and emptied daily and serviced when necessary. In particular drip trays shall be closely monitored during rain events to ensure that they do not overflow. The contents must be disposed of at a recognised site. • All repairs done on machinery using hydrocarbons as fuels or lubricants shall have a drip tray placed strategically to avoid incidental spillage. • Workers shall be made aware of the health risks associated with any hazardous substances used (e.g., smoking near refuelling depots), and shall be provided with appropriate protective clothing / equipment in case of spillages or accidents. • Cement shall be mixed on a plank, mental plate or a plank only or ready-mix trucks shall be used, and other potential environmental pollutants shall be stored at the designated area. There shall be no opportunity for environmental contamination. • Workshop areas shall be monitored for oil and fuel spills and such spills shall be cleaned and remediate to the satisfaction of the EO. • The site shall be in possession of an emergency spill kit that must be complete and available at all times on site.				
Complaints	**6**	• Maintain complaints register for all complaints. The register must list:	Johannesburg Water	During operations and maintenance activities	• Complaints register.	• Availability of register on site

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		• Complainant name and contact details. • Date complaint was lodged. • Person who recorded the complaint. • Nature of the complaint. • Actions taken to investigate the complaint and outcome of the investigation. • Action taken to remedy the situation. • Date on which feedback was provided to complainant.			• GDARD complaints reference number.	• Designated person to maintain register • Complaints logged • Complaints followed up and closed out.
Collection of water sample	**7**	• Water sampling shall be undertaken at the selected sampling points as per the WUL. • Any incident or non-compliance with the WUL parameters or DWS Water Quality Guidelines shall be reported accordingly and investigated • Unused sampling bottle shall be disposed of accordingly.	Johannesburg Water/CDYNA	During operation activities	• Visual inspection. • Online Lab reports	• Daily water sample report. • Incident register.
Environmental Incident reporting and Emergency Response and Preparedness	**8**	• NEMA Section 30 and 30A emergency incidents and situations must be reported to GDARD or DEA immediately after as an incident or situation occurs. NWA Section 20 emergency must be reported to DWS, mostly by Operations Department. This can be done via phone, fax, or email. JW must implement measures to contain the incident or situation immediately. Thereafter the Emergency Incident Report (EIR) or Emergency Situation Report (ESR) must be submitted to the authorities ASAP. The reports must provide as much information as possible, if not; the reports can be updated later as the investigation progresses. Not reporting an incident could result in the authorities issuing a directive or a compliance notice to the responsible person.	Johannesburg Water Sites	During operation and maintenance activities.	• Visual inspection. • Flash report/ Incident investigation report. • Section 30A Annexure A. • JW Environmental Emergency Preparedn	• Incident register • Bioremediation report. • Section 30A Directive. • Corrective Action Plan

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		• Important Note: For Section 30A Emergency Situation, an oral or written directive must be obtained from GDARD or DEA before works can be undertaken in the watercourse to avoid undertaking listed activities without obtaining EA. • Johannesburg Water takes responsibility in order to effectively respond to emergency incidences such as fire, hydrocarbon and sewer spills or leakages, disturbance of wildlife and archaeological artefacts. The SHE Rep must conduct daily inspections to ensure that the required equipment needed to handle environmental incidents/ emergencies are readily available and in working condition. Quick response to an incident prevents escalation to an emergency:			ess and Response Procedure.	
9. Water Management • Water is a scarce resource and water shall be conserved wherever possible. • Improved and protected watercourses to Class C classification which is moderately modified in terms of determined class of water resource and resource quality objectives of chapter 3 (Part 2) of National Water Act (Act 36 of 1998). • Demand reduction/ Alternative sources. • Building a water sensitive city. • Well managed and maintained water infrastructure networks**.**						
Water Usage	**9.1**	• The site must be kept tidy and hygienic at all times with special reference to sanitation & water management. • Maintain a monthly water usage. • Reporting of water pipe burst and damaged meters	Johannesburg Water Sites	During operation	• Visual inspection • Meter readings	• Records of Monthly water Usage.
Reduce water demand	**9.2**	• Implement effective demand-side management practices while exploring investment into smart infrastructure and alternative supplies to increase levels of net water savings.	Johannesburg Water (Network)	During operation	• Monthly Monitoring • Monthly water	• Records of percentage reduction on non-revenue water. • Records of Percentage

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		• Establish Task Team with different law enforcement agencies to develop and implement solution for infrastructure abuse problem. • Promote the implementation of Sustainable Urban Drainage System practice.			management report	reduction of Rand Water system input volume.
Incentivise water saving interventions across domestic and economic sector users.	**9.3**	• Implementation of command-and-control base mechanism that promote water saving (CoJ By-laws). • Implementation of incentives base mechanism • Develop partnerships beyond the City to encourage water savings. • Expand current CoJ drought policy to build greater resilience of the water system. • Integrate water conservation requirements in conditions of planning approval. • Develop an awareness and communications campaign using available technology.	Johannesburg Water	CoJ/Operations	• Monthly water management report	• Records of reduction in annual water consumption per capita • Water from alternative sources as % of total water supply
Rehabilitation/ Reinstatement	**10**	• Clean up and remove any spills and contaminated soil in the appropriate manner. • Ensure that no discarded materials are buried on site or on any other land not designated for this purpose. • Rehabilitate any disturbed areas as soon as maintenance or construction in the area is complete. • If disturbed areas are left to rehabilitate naturally, they must be frequently monitored and interventions put in place immediately should it become necessary. Special attention must be given to the potential for soil erosion and the associated environmental degradation. It is also essential to undertake alien vegetation control and management.	Johannesburg Water	During operation and maintenance activities	• EO compliance monitoring. • Visual inspection. • Compliance inspection against rehabilitation plan.	• Inspection report. • Audit report by External Auditor. • Photos before and after.

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					• JW EMP.	

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6.1 Method Statement

The objective is to ensure all construction activities are undertaken with the appropriate level of environmental awareness to minimise environmental risk. The environmental specifications are required to be underpinned by a series of Method statements, within which the Contractors and Service Providers are required to outline how any identified environmental risks will practically be mitigated and managed for the duration of the contract, and how specifications within this EMPr will be met. That is, the Contractor will be required to describe how specified requirements will be achieved through the submission of written Method Statements to Johannesburg Water Environmental Section and ECO.

Method Statement is defined as “a written submission by the Contractor in response to the environmental specification or a request by the Site Manager, setting out the plan, materials, labour and method the Contractor proposes using to conduct an activity, in such detail that the Site Manager and Environmental Officers are able to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications”. The Method Statement must cover applicable details with regard to:

- Construction procedures
- Materials and equipment to be used
- Getting the equipment to and from site
- How the equipment/material will be moved while on-site
- How and where material will be stored
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur
- Timing and location of activities
- Compliance/non-compliance with the Specifications, and
- Any other information deemed necessary by the Johannesburg Water.

The Contractor may not commence the activity covered by the Method Statement until it has been approved by the Site Manager, except in the case of emergency activities and then only with the consent of the Site Manager. Approval of the Method Statement will not absolve the Contractor from their obligations or responsibilities in terms of their contract.

Failure to submit a method statement may result in suspension of the activity concerned until such time as a method statement has been submitted and approved. The EO and ECO should monitor the construction activities to ensure that these are undertaken in accordance with the approved Method Statement.

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6.2 Monitoring

- Regular inspections of the site by EO/SHE and Environmental Reps
- Immediate reporting of ineffective sediment control systems.
- Public complaints register must be developed and maintained on site.

6.2.1 Monitoring Program

OBJECTIVE: Monitor the performance of the control strategies employed against environmental objectives and standards

A monitoring programme must be in place not only to ensure conformance with the EMP, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the environmental authorisation (once issued). Where this is not clearly dictated, Johannesburg Water will determine and stipulate the frequency of monitoring required in consultation with the relevant authority. The contractor project manager will work with the site manager of the contractor to ensure that monitoring is conducted and reported.

The aim of the monitoring and auditing process would be to routinely monitor the implementation of the specified environmental specifications, in order to:

- Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications.
- Ensure adequate and appropriate interventions to address non-compliance.
- Ensure adequate and appropriate interventions to address environmental degradation.
- Provide a mechanism for the lodging and resolution of public complaints.
- Ensure appropriate and adequate record keeping related to environmental compliance.
- Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, to enhance the efficacy of environmental management on site.
- Aid communication and feedback to authorities and stakeholders.

6.2.2 Method of Monitoring

The Environmental Officer will ensure compliance with the EMP and will conduct monitoring activities. The EO will undertake site inspections monthly or as specified in the environmental authorisation once issued.

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6.2.3 Monitoring Reports

Environmental Monthly reports will be compiled by the EO monthly and must be submitted to Environmental Specialist. The report should include details of the activities undertaken in the reporting period, any non-conformances or incidences recorded, corrective action required and details of these non-conformances or incidents which have been closed out.

A document handling system must be established to ensure accurate updating of EMP documents, and availability of all documents required for the effective functioning of the EMP. The complied environmental file must be ISO14001:2015 conformant as per JW environmental file specification (Annexure B). Supplementary EMP documentation could include:

- Method Statements.
- Environmental Action Plan
- Environmental File Site instructions.
- Emergency preparedness and response procedures.
- Record of environmental incidents.
- Non-conformance register
- Training records.
- Site inspection reports.
- Waste Register
- Water Usage Register
- Fauna and Flora Register
- Hazardous chemical Inventory list
- Monitoring reports.
- Auditing reports; and
- Public complaints register (single register for maintained for overall site).

Table 4: Monitoring Programme

ISSUE	FREQUENCIES OF MONITORING	RESPONSIBLE PERSON
WATER		
Prevention of water pollution Prevention of stagnant water on site. Proper functioning of sanitation facilities	Weekly in rainy season Weekly in rainy season Weekly	Contractor's Representative (CR)/ Johannesburg Water

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ISSUE	FREQUENCIES OF MONITORING	RESPONSIBLE PERSON
SOIL		
Surface or gully erosion on site Soil contamination with oils If small, clean up. If large, appoint a suitable contractor for clean-up.	Weekly in rainy season Monthly Immediately	CR/JW CR/JW CR/JW
Air		
Control domestic fires. Heavy vehicle emission control. Dust control of access roads. Wetting when required.	Weekly Monthly Weekly inspection	CR/ JW CR/JW CR
WASTE		
Efficiency of domestic waste collection. Prevention of burning of solid/liquid wastes on site. Proper collection and containment of liquid wastes (petroleum, oils, paints, resins & cooking oils) The recycling and/or disposal thereof. The collection and disposal of construction waste (concrete, wood, steel) Collection of hazardous waste.	Weekly Weekly Monthly Biweekly Monthly Biweekly	CR/JW CR/JW CR/JW CR CR/JW CR/JW
WILDLIFE		
Weed Control Control of illegal hunting or snaring of game, birds, or other wild animals.	On-going On-going	CR/JW CR/JW
SOCIAL		
Inspect overall appearance of site.	Weekly	CR

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ISSUE	FREQUENCIES OF MONITORING	RESPONSIBLE PERSON
(Paint work, cleanliness & housekeeping) Resolve complaints Monitor behaviour of labourers	Daily Daily	CR/JW CR/JW
SAFETY		
Inspect road signs, pedestrian, and vehicle behaviour	At least once a week	CR/JW

6.3 Internal Audits and Reporting

Typically, an audit analyses the results obtained from monitoring, assesses whether objectives and targets have been met and whether there are variances from the stipulated EMP and legal requirements. In addition, the audit assesses whether EMP implementation has been undertaken according to planned arrangements and that the EMP itself is being appropriately updated. The audit should confirm that identified corrective actions have been undertaken and then assess the effectiveness of such actions. The timing of audits should be included in the implementation schedule in the EMP.

The key steps in a successful audit are:

- Establish audit procedures.
- Determine the frequency of audits.
- Ensure that the auditors are competent, in that they must be able to undertake the audit objectively and competently. Audits may be undertaken by internal or external parties, although certain I&AP requirements may define a need for external auditors.
- Maintain records of audits.

A procedure is to be developed by the project management team for conducting EMP audits, and should incorporate processes for scheduling and reporting, as well as the timing and frequency of the audits. This procedure should also address responsibilities and required resources. The EO is usually responsible for the maintenance of the environmental audit information that is required prior, during and

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after an audit. Internal audits must be undertaken by Johannesburg Water Environmental Section on monthly basis.

6.3.1 Monthly compliance rating

A monthly compliance rating will be calculated for each Principal Contractor as per a formula determined by Johannesburg Water SOC Ltd focussing on or incorporating outcomes of assurance (e.g., monthly audit), operational assessments and other requirements, as necessary. Johannesburg Water SOC Ltd reserves the right to adjust the monthly compliance calculation formula as and when required – each revision of the monthly compliance calculation formula will be communicated to the Principal Contractor before implementation (**Each Principal Contractor is required to maintain a minimum compliance rating of 93% (Ninety-Three Percent).**

Table 5: Compliance Rating Protocol

Classification	Scoring	Classification description
Good	**93 – 100%**	Substantial compliance
Average	**80-92%**	Compliance status needs to be improved
Poor	**61-79%**	Methods to ensure compliance require substantial improvement
Very poor	<60%	Methods to ensure compliance failed completely - no system in place

6.3.2 Work Stoppage

Work stoppages will be identified for 2 (two) types of work stoppages to be implemented:

- Overall work stoppage – the Principal Contractor and its Contractors are not allowed to continue with any type of construction / site work up until the work stoppage has been closed-out.
- Activity work stoppage – The Principal Contractor and its Contractors are not allowed to continue with the specific activity / task / job up until the work stoppage has been closed-out (**Overall work stoppages will be issued where non-conformances are identified against the criteria in Annexure C).**

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6.4 Environmental Awareness Plan

OBJECTIVE: Ensure all operation personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm (Environmental Awareness Plan).

To achieve effective environmental management, it is important that Contractors and site employees are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMP. Johannesburg Water is responsible for informing its employees and contractors (transportation contractor) of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. Johannesburg Water's obligations in this regard include the following:

- Employees must have a basic understanding of the key environmental features of the depot and its surrounding environment.
- Ensuring that a copy of the EMP is readily available on-site and that all site staff is aware of the location and has access to the document.
- Employees must be familiar with the requirements of the EMP and the environmental specifications as they apply to the operation of the facility.
- Ensuring that, prior to commencing any new site works, all employees have attended an Environmental Awareness Training course. The course must provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- Awareness of any other environmental matters, which are deemed to be necessary by the depot manager.
- Ensure that construction workers have received basic training in environmental management, including the storage and handling of hazardous substances, minimise of disturbance to sensitive areas (wetland), management of waste and prevention of water pollution
- Records must be kept of those that have completed the relevant training.
- Training should be done either in a written or verbal format but must be in an appropriate format and language for the receiving audience

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- Refresher sessions must be held to ensure the operating staffs are aware of their environmental obligations.

Therefore, prior to the commencement of construction activities on site and before any person commences with work on site thereafter, adequate environmental awareness and responsibility are to be appropriately presented to all staff present onsite, clearly describing their obligations towards environmental controls and methodologies in terms of this EMPr. This training and awareness will be achieved in the following ways:

6.4.1 Environmental Awareness and Training

Environmental Awareness and Training must be undertaken by the Environmental Officer or SHE/ELO and must take the form of an on-site talk and demonstration by the Environmental Officer before the commencement of construction activities on site. A record of attendance of this training must be maintained by the Environmental Liaison Officer/SHE Officer on site.

6.4.2 Formal Environmental Training

NB: JW must ensure that there is a budget allocated for environmental formal training in CAPEX projects for the skills development of contractor staff, development of community where project is being undertaken. The principal Contractor shall identify short courses and include them on the training matrix that can be done on site during project duration. The following are some of the trainings that can be done on site:

- ISO14001:2015 Environmental Management System Awareness
- Handling of beehives
- Snake awareness and handling
- Environmental legal Liability.
- Waste Management
- Environmental Site Representative
- Recycling
- Grass cutting training

The principal Contractor must ensure that they are appointing a registered company that meet all the requirements and before appointment of service provider, the files shall be submitted to Environmental Section for evaluation.

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6.4.3 Induction Training

Environmental induction training must be presented to all persons who are to work on the site, be it for short or long durations. Contractors or Engineers staff, site staff, sub-contractors, or visitors to site. This induction training should include discussing Johannesburg Water's environmental policy and values, the function of the EMP and the importance and reasons for compliance to these. The induction training must highlight overall dos and don'ts on site and clarify the repercussions of not complying with these. The reporting procedure must be explained during the induction as well. Opportunity for questions and clarifications must form part of this training. A record of attendance of this training must be maintained by the SHE officer on site.

6.4.4 Toolbox Talks

Toolbox talks should be held on a scheduled and regular basis (at least once a month) where the foreman/site supervision manager, environmental and safety representative and all employees on site hold talks relating to environmental practices and safety awareness on site. These talks should also include discussions on possible common incidents occurring on site and the prevention of reoccurrence thereof. Records of attendance and the awareness talk subject must be kept on file.

6.5 Erosion Management Plan

The objective to control soil erosion from an ecological perspective is:

- To reduce the effects of raindrop splash erosion on exposed soil surfaces.
- To keep rainwater on the soil surface for as long as possible to increase the infiltration rate and reduce surface runoff.
- To reduce the speed of surface runoff to reduce the erosion effect of the soil surface.
- To provide methods to retain soil, debris, seed banks and organic matter being carried away by runoff.
- To improve water retention of the area (Coetzee, 2005).

a) Areas with a high soil erosion potential on the site

Areas identified as being of high soil erosion potential on the site include:

- Any areas without vegetation cover

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- Excavated areas
- Steep areas
- Areas which undergo overland flow of water.
- Areas close to water
- Irrigated areas
- Compacted areas
- Rivers
- Drainage lines
- Any areas where developments cause water flow to accelerate on a soil surface.

If any erosion features are present as a result of the activities mentioned above the ELO must:

Assess the situation.

- Take photographs of the soil degradation.
- Determine the cause of the soil erosion.
- Inform and show the relevant contractors the soil degradation.
- Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan.
- Monitor that the contractor is taking action to stop the erosion and assist them where needed.
- The progress of the rehabilitation must be monitored weekly and recorded in the site diary.
- All actions with regards to the incidents must be reported on in the monthly Audit report.
- If the erosion incident has not been addressed by the contractor within 14 days of you reporting it, the Johannesburg Water ‘s Environmental Section must be informed.

The contractor/ developer (with the EO’s consultation) must:

- Select a system to treat the erosion
- Design the treatment system
- Implement the system
- Monitor the area to see if the system functions like it should, if it the system fails adapt or adjust the system to ensure erosion is controlled.

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- Monitoring must continue until the area has been stabilized

b) General Erosion

The civil works contractor may use the following instruments to combat erosion when necessary:

- Reno matrices
- Slope attenuation
- Shade catches nets
- Mulching
- Hydro-seeding or transplanting
- Re-vegetating
- Tilling (roughing the surface)

c) Erosion Management control measures

- Areas susceptible to erosion must be protected by appropriate measures and repair of any damage caused by erosion due to construction activities must be undertaken as soon as possible.
- Minimise erosion and sedimentation into water courses through effective stabilisation (gabions and reno-mattresses) and re-vegetation of disturbed riverbanks (Refer to rehabilitation specifications and erosion control measures below).
- Stabilisation of sandy, dispersive slopes or slopes steeper than 1:3 will be required. Ensure that bare soil is covered, and hydro seeded to reduce topsoil loss.
- Ensure that all soil surfaces are protected by vegetation or a covering to avoid the surface being eroded by wind or water.
- Ensure that heavy machinery don't compact areas that are not meant to be compacted as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area.

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d) Surface water control measures

- Prevent the concentration or flow of surface water or storm water down cut or fill slopes or along pipeline routes or roads and ensure measures to prevent erosion are in place prior to construction.
- Storm water and any runoff generated by hard surfaces should be discharged into retention swales or areas with rock riprap.
- These areas should be grassed with indigenous vegetation.
- These energy dissipation structures should be placed in a manner that flows are managed prior to being discharged back into the natural water courses, thus not only preventing erosion, but also supporting the maintenance of natural base flows within these systems, i.e., hydrological regime (water quantity and quality) is maintained.
- Mitigate against siltation and sedimentation using the above-mentioned structures and ensure that all structures do not cause erosion.
- Ensure that all storm water control features have soft engineered areas that attenuate flows, allowing for water to percolate into the local aquifers.
- Minimise and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation.
- Vegetation clearing should occur in parallel with the construction progress to minimize erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment.
- Minimise the diversion of flows into different catchments.
- If implementing dust control measures, prevent over-wetting, saturation and run-off that may cause erosion and sedimentation.
- Water course (stream) crossings should not trap any run-off, thereby creating inundated areas, but allow for free-flowing water courses.

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e) Environmental Incident/Accident

All environmental related incidents should be reported to environmental section. The ELO should compile and keep an Incidents and Accidents Register on the file/book in which all environmental related incidents and accidents are recorded, e.g., chemical spills, fires, accidents involving workers and vehicles, etc.

The following information must be recorded in the Incidents Register:

- The name and contact details of the persons involved
- The person recording the incident
- The date and time of incident
- The nature, extent, and cause of the accident
- The name and contact details of any persons notified of the incident
- The actions taken to deal with the incident and whether the accident has been sufficiently
- Dealt with additional steps required to prevent recurrence of the incident.

7. RECORD KEEPING, COMPLIANCE AND PENALTIES

Various records will be kept on site for monitoring purposes these include but not limited to:

- Copy of Environmental Management Plan
- Approved Environmental Method Statements
- Environmental Authorisation
- Environmental induction attendance register
- Hazardous chemicals register
- Waste disposals register and disposal certificates
- Oil/fuel spill register

Records of non-compliance shall also be kept on record and will include the nature and magnitude of the non-compliance in a register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. External complaints received regarding activities on the construction site pertaining to the environment shall be recorded in public complaints register and

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the response noted with the date and action taken. This record shall be submitted with the monthly reports and a verbal report given at the monthly site meetings. A score of 90% is required for the Monthly Audit undertaken by the Johannesburg Water 's Environmental Officers.

8. DECOMMISSIONING

Objective

- To avoid and or minimise the potential environmental and social impacts associated with the decommissioning phase

Mitigation Measures

Mitigation measures as detailed in the construction phase on the EMP regarding impacts on flora, fauna, habitats, and wetlands would be applicable to this phase.

- Rehabilitation to be undertaken in terms of specifications outlined in the Rehabilitation section of this EMP as well as in terms of any specific requirements applicable at the time.
- Johannesburg Water EO will need to supervise and monitor all decommissioning activities as per the snag list.
- All disturbed areas should be rehabilitated closer to its original state and more.

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Retainable Annexure A (Ref: Annexure 5 of JW 6.4): Acknowledgement of EMP specification by the Contractor.

Environmental Requirement for Contractors and Suppliers working for Johannesburg Capital Expenditure (CAPEX) projects	**Unique no**	**JWEMP:122017**
	Revision no	**00**

I, the undersigned, hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and the consequences of non-compliance. The Contractor furthermore reiterates its commitment to compliance of the requirements contained within the following provided documentation:

Name of the Contractor	
Vendor Number	
Project Number	
Scope of Work	
Declaration by Capital Expenditure Projects Contractor	
• I undertake to adhere to the requirements as set out in: - Johannesburg Water Environmental Management Plan and Waste Management Plan - Environmental requirements for Contractors working on Capital Expenditure Projects • I undertake to comply with all applicable environmental legal and other requirements. • Undertake to comply with Johannesburg Water 's environmental standards, policies, and procedures where applicable. • I pledge to inform all staff of their role in managing environmental impacts on site. • I am fully aware that incidents must be reported within 24 hours of occurrence. • I pledge to always implement environmental best practice on site during the contract. • I pledge that all non-conformances issued to us will be addressed promptly.	

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I ……. hereby acknowledge that I have obtained copies of Johannesburg Water Environmental Management Plan and Waste Management Plan and confirm that I fully understand the contents thereof and the consequences of non-compliance. The Contractor furthermore reiterates their commitments to compliance of the requirements contained within the following provided documentations and conform to all above mentioned requirements.

Signed at …… on this …….. Day of …… 20……...

Contractor Reperesentative Name: Designation:	Signature:	Date:
JW Project Engineer/Manger (Witness) Name:	Signature:	Date:

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Annexure B: Contractors Environmental File Evaluation Form

	CONTRACTORS ENVIRONMENTAL FILE EVALUATION FORM		
	A minimum score of 80% is required on all sections for the approval of the submitted Environmental file System. Failure to achieve the required score will result in non-approval of the Environmental file, and the project will not commence prior file approval.		
ENVIRONMENTAL SYSTEM EVALUATION OUTCOME			
AVERAGE SCORE OBTAINED			**0.00%**
		APPROVED/REJECTED	
EVALUATED BY:	**REVIEWED BY:**	**APPROVED/REJECTED BY:**	**ACKNOWLEDGED BY:**
DESIGNATION:	**DESIGNATION:**	**DESIGNATION:**	**DESIGNATION:**
SIGNATURE:	**SIGNATURE:**	**SIGNATURE:**	**SIGNATURE:**
DATE:	**DATE:**	**DATE:**	**DATE:**

PROJECT DETAILS			
Contract Number			
Project Title			
Name of Contractor			
Is the project screened?	YES/NO	IF NO	Construction activities/work (including site establishment) should ONLY commence when after the project is Screened

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Specialist Studies/Report				
Environmental Authorisation (If applicable)				
Water Use Licence /General Authorisation (If applicable)				

SCORE ANALYSIS		
	Satisfactory (Approved)	Requirements have been met
0.00%	Unsatisfactory (Not Approved)	Requires substantial improvement / partially achieved

ENVIRONMENTAL REQUIRED DOCUMENTS		
1	Copy EMP and signed acknowledgement letter for JW EMP	0
2	SHE/ELO appointment letter	0
3	Contractor Environmental Induction presentation	0
3	Environmental Toolbox talk and copy of attendance register template	0
5	Environmental Objective (Site specific)	0
6	Environmental Policy Statement	0
7	**Registers**	0
3	Legal Register (Site specific)	0
9	Environmental Aspect and Impact register (site specific)	0
10	Permit register	0
11	Non-Conformance Register	0
12	Waste register template	0
13	Complaint register	0
14	Incident register	0

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15	Method statement register	0
16	Hazardous substances register	0
17	Daily Environmental checklist/ weekly checklist and spill kit checklist	0
18	Spill kit checklist	0
19	**Method statements or procedures**	0
20	Document control procedure	0
21	Storm water management plan/ Erosion control	0
22	Alien invasive and weeds control plan	0
23	Hazardous Management Plan/ Procedure (i.e., handling of hazardous substances)	0
24	Method statement for the activities to be undertake/ (include environmental aspects on the technical MS)	0
25	Waste management plan/ Method statement for waste management	0
26	Incident report template (Flash report/Investigation report)	0
3	Emergency Response Plan	0
28	Training Matrix	0
29	Dust Management Plan or Method Statement for dust suppression	0
30	Contractor Audit procedure/template	0
31	Rehabilitation Plan or Method Statement for Rehabilitation/Reinstatement	0
TOTAL		**0**

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Annexure C: Environmental Work instruction

ENVIRONMENTAL MANAGEMENT (EM) SITE INSTRUCTION Document No: JW- EMS-HO—R014

1. All JW rules and regulation including JW Environmental Management Plan and other applicable legislation, standard and by-laws must be adhered to at all times.
2. Copies of Environmental Authorisation, Water Use License/General Authorization, Rehabilitation plan, EMP shall be kept on site **(where applicable).**
3. All JW sites must have waste bins, drip trays, spill kit and designated hazardous storage **(where applicable).**
4. Only registered Waste Service providers who comply with National Environmental Management Waste Act and Municipal By-laws shall be appointed.
5. No burning or burying of waste is allowed on site.
6. The conservation of water and the use of energy efficiently shall be implemented in all JW sites.
7. The letter from City Parks for occupying the open space shall be received and kept in the file and if the land belongs to the private owner, the copy of an agreement letter shall be kept in the file **(where applicable).**
8. The photos are taken before and during and after the project **(where applicable).**
9. The Environmental file must be approved before the commencement of works on site **(where applicable).**
10. The Environmental file will be kept on site all the times and shall be made available to competent authority and JW environmental representative **(where applicable).**
11. Rehabilitation/ reinstatement of the site must be done as per the JW EMP, rehabilitation method statement.
12. The hazardous waste must only be stored not more than 90 days on site as per the legislation.
13. Only asbestos registered service providers shall be appointed to handle and dispose asbestos to registered landfill site.
14. No mixing of general and hazardous waste will be allowed.
15. No cutting of trees is allowed on site without permit.
16. If archaeological artefacts or anything of heritage importance are found at JW sites/ servitude Environmental Section must be informed.
17. Everyone working within JW sites shall familiarize with the EMP requirements and other applicable JW environmental procedures.
18. All the environmental incidents shall be reported within 24 hours to JW environmental Section.

DISCLAIMER

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2.Should the contractor deviate from the conditions and requirements of the EMP and/or Environmental Authorisation (if applicable), the contractor is liable for non-compliances, rectification and associated fines thereof

3. This EMP does not exempt the Contractor from complying with other relevant legislations related to the construction activities.

19. Ensure that all JW employees and its service providers or suppliers receive environmental induction.
20. All work must be carried out under close supervision by the competent persons.
21. Repetitive findings or non-compliances shall be avoided.
22. Topsoil stockpile shall be protected by erosions control berms if it is exposed to a period of 14 days during wet season (where applicable).
23. Only 150mm of topsoil shall be removed and stockpile at a height of not more than 1m.
24. All hazardous material must be stored on a bunded and ventilated storage, and MSDS must be available for all of them.
25. No painting or marking of natural features is allowed on site.
26. Pollution of the environment shall be prevented all the times.
27. No leaking mobile plant is allowed on site.
28. Dust control measures shall be implemented on site (where applicable).
29. No sewer spillage shall spill into the storm water or the watercourse.
30. All environmental related incidents and/or emergencies shall be investigated within 48 hours from the date of notice.
31. Killing of fauna and/or Avifauna is prohibited.
32. Alien invasive and weeds must be eradicated.
33. Fumigation shall be done by trained personnel that is registered with DAFF.
34. No smoking is allowed in restricted areas. All such areas are posted appropriately.
35. Personal protective equipment is required to be worn at all times in production areas.
36. Maintain good housekeeping in your work area.
37. Keep fire lanes, roadways, walkways, and aisles free and clear of material.
38. The use of unsafe or defective equipment or tools is not permitted.
39. A contractor or subcontractor shall leave no unused materials on site. At the completion of a project the contractor shall remove all unused material and all waste shall be properly disposed of at a registered landfill site.
40. Any contractor or subcontractor found to be in violation of any EH&S rules can be ejected or escorted off premises if deemed necessary.
41. This file shall be kept on site and will be available at all times to the JW Reps and authorities (upon request).

ACKNOWLEDGEMENT BY MANAGER/CONTRACTOR

I, _____ the Manager/Contractor, do hereby declare that my site/company

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ENVIRONMENTAL MANAGEMENT PLAN

_____ _____acknowledges having read and understood the conditions contained in this document and furthermore, the employees agree to abide by these conditions.

CONTRACTOR/FACILITY REP.	SIGNATURE	DATE

ENVIRONMENTAL SITE INSTRUCTION		Document No: **JW- EMS-HO—R014**	
Name of Contractor/Facility			
Responsible Manager/ Engineer			
Project No. ***(where applicable):***	Date Issued:	Date of Inspection:	
Environmental Representative:		Designation:	
Should the responsible persons fail to comply with any term of this instruction, JW may demand compliance in writing from the defaulting party. Should the defaulting party fail to comply within the stipulated time frames, JW shall take the necessary steps to remedy the situation.		**PROJECT DESCRIPTION**	
Reference No. of Non-Conformances		**Action Required**	
EM-1.			
EM-2.			

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EM-3.	
EM-4.	
EM-5.	
EM-6.	
EM-7.	
EM-8.	
EM-9.	
EM-10.	

Received & Acknowledged by	**Signature**	**Date**
Responsible Manager/Contractor		
Responsible Consultant ***(where applicable)***		
JW Environmental Representative		
JW Project Inspector / Engineer ***(where applicable)***		
Contractor SHE/EL Officer ***(where applicable)***		

COMMENTS BY RESPONSIBLE MANAGER/ENGINEER:	**Target date for corrections**	
	Accepted/Acknowledged by Manager/Contractor	

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COMMENTS BY CONTRACTOR *(WHERE APPLICABLE)*:	Follow up comments by JW Environmental Representative

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Annexure D: Johannesburg Water General Surface Rehabilitation Specification

Johannesburg Water General Surface Rehabilitation Specification

Doc No: JW-EMS-CAPEX-T040
Effective Date:14/9/2021

No.	Description	Unit	A Quantity	B Master Rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
1	Rehabilitation Plan	**m2**	0	10.05	1	1	0
2	Rehabilitation of disturbed area/s including roads (prepare the ground/level profiling,soil surfaces including	**m2**	0	22.05	1	1	0
2	Replacement/import of topsoil (if required)	**m2**	0	22.05	1	1	0
3	Planting of grass/hydroseeding (Including hydro seeding seed mix ratio).	**m2**	0	22.05	1	1	0
4	Maintainance for 3 month (weed removal, replanting, soil conditioner, erosion repairs ect.)	**m2**	0	17.4	1	1	0
5	Rehabilitation close-out report	**m2**	0	10.05	1	1	0
6	Bioremediation (process to be determined if required)	**m2**	0	22.05	1	1	0
					Sub Total 1		**0**

1	Preliminary and General	0	**weighting factor 2** 1	**0**
2	Contingencies		0	**0**
			Subtotal 2	**0.00**
			VAT (15%)	**0.00**
			Grand Total	**0**

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	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION	
Johannesburg Water	TENDER NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCRIPTION:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

Returnable Annexure A: Acknowledgement of SHE Specification & Annexures

DECLARATION BY CONTRACTOR

I, the undersigned, and representing the tenderer as indicated hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and confirm compliance thereto in the event of being successful:

- OHS Specification (Volume 2)
- Annexure 1: Baseline Risk Assessment
- Annexure 2: Medical Screening Policy
- Annexure 3: Sign off form
- Annexure 4: Environmental Management Plan

We furthermore commit to:

- Comply with all applicable SHE related legal and other requirements.
- Inform all staff of their role in managing environmental impacts and safety hazards on site.

Signed at …… on this …….. Day of …… 20……...

Name of tenderer	
Name of Authorized person	
Authorized Signature*	

Signature must be as per form JW 3.3 as applicable

Johannesburg Water	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

BASELINE RISK ASSESSMENT

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: TRANSPORTATION OF MATERIALS TO SITE

Task	Hazard	Risk	Consequence	Rating	Controls
Transportation of material to site	✓ Unsafe road conditions ✓ Un-road worthy vehicles ✓ Equipment and material not safely secured ✓ Incompetent drivers ✓ Driving under the influence of alcohol ✓ Inclement weather ✓ Speeding ✓ Slippery road	✓ Overturning vehicles ✓ Vehicle collisions ✓ Bumping pedestrians / employees	✓ Injuries ✓ Property damages ✓ Third party liability	**M**	✓ Adherence to the speed limit ✓ Only competent/ authorised drivers should operate the vehicle ✓ Inspection of vehicles ✓ Equipment and material to be properly secured ✓ Alcohol testing to be done ✓ The road to be paved to prevent accidents ✓ Traffic control to be implemented to avoid collisions
Offloading of material	✓ Faulty lifting machinery & equipment ✓ Suspended load ✓ Poor housekeeping	✓ Malfunctioning ✓ Falling on employees ✓ Obstructed walkways by materials	✓ Injuries	**M**	✓ Inspect lifting equipment prior to use. ✓ Ensure the safe working load prior to use ✓ Train the employees in manual lifting ✓ Ensure proper housekeeping ✓ The correct PPE must be worn ✓ Designate the stacking areas and put signs ✓ Stacking and storage inspector must be appointed and in charge

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: SITE ESTABLISHMENT

Task	Hazard	Risk	Consequence	Rating	Controls
Site establishment	✓ Sharp objects/ wires ✓ Uneven surface ✓ Faulty connection ✓ Poor ergonomics ✓ Falling objects ✓ Inadequate security services ✓ Not enough ablution facilities	✓ Cuts ✓ Slips and trips ✓ Damage to services ✓ Using the environment as ablution facilities	✓ Injuries ✓ Back strains and injuries ✓ Crime, theft, fights ✓ Contracting of communicable diseases ✓ Soil, water pollution	**M**	✓ Supervisors to plan during site set up and induct employees ✓ A competent electrician must be appointed to connect electrical wires to the site offices and Distribution Board. ✓ Ensure there are welfare facilities on site for health and hygiene purposes ✓ Awareness on hygiene and use of ablution facilities ✓ Detailed Risk Assessment must be drawn before any work commences on site.
Installing containers	✓ Using lifting equipment ✓ Faulty equipment ✓ Faulty slings / chains	✓ Wind ✓ Incompetent personnel ✓ Heavy load ✓ Failing of lifting equipment	✓ Serious injuries ✓ Property damage	**H**	✓ Check wind speed prior to using the crane. ✓ Inspect the crane, slings and chains before use. ✓ Load test the crane before use ✓ Only carry loads certified to be carried by the crane
Entry and exit	✓ No access control	✓ Unauthorised entry into the construction site	✓ Injuries ✓ Theft	**M**	✓ Appoint a full time, registered security guard on site

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: SITE ESTABLISHMENT

Task	Hazard	Risk	Consequence	Rating	Controls
Electrical installation	✓ Electricity ✓ Incompetent personnel ✓ Wrong tools ✓ Damaged cables	✓ Contact with live electricity ✓ Incompetent person connecting electricity ✓ Electric shocks	✓ Electrocution ✓ Serious injuries	**H**	✓ Follow lock out procedure ✓ Ensure that equipment are earthed to an approved earthing point ✓ Ensure a zero potential test is performed for electricity is isolated ✓ Inspect all tools ✓ Use correct tools for the job ✓ Appoint a competent electrician/ technician ✓ Wear task specific PPE ✓ Ensure that there are no exposed wires on the cables
Stacking and storage	✓ Unsafe stacks of materials or pallets	✓ Falling of pallets and material on employees	✓ Injuries ✓ Property damage	**H**	✓ Supervision of all stacking of materials on site ✓ Materials of same base and heights stacked together ✓ Barricade the stacking area ✓ Unsafe stacks to be removed immediately ✓ Never stack materials during knocking off time or late at night ✓ Use task specific PPE

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: UNDERGROUND SERVICES

Task	Hazard	Risk	Consequence	Rating	Controls
Working close to Eskom line	✓ High voltage	✓ Electrocution	✓ Fatalities ✓ Power cuts ✓ Property damages	**H**	✓ Proper scanning of services prior to starting with excavations ✓ Obtain wayleaves from Eskom prior to starting with work ✓ Do not use lifting equipment in close proximity to power lines unless authorized to do so. ✓ Appoint an OHRVS to supervise all work done in close proximity to power lines ✓ Contact Eskom if services are identified for isolation ✓ Develop a method statement and risk assessment ✓ Train employees in the method statement as well as risk assessment ✓ Develop emergency response procedures for explosions
Working close to gas lines	✓ Gas leaks	✓ Explosion ✓ Suffocation ✓ Inhalation	✓ Fatalities ✓ Property damages		✓ Proper scanning of services prior to starting with excavations ✓ Obtain wayleaves from service provider prior to starting with work ✓ Develop a method statement and risk assessment ✓ Develop emergency response procedures for leaks and explosions

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: EXCAVATION

Task	Hazard	Risk	Consequence	Rating	Controls
Excavation	✓ Deep excavations ✓	✓ Collapse ✓ Falling ✓ Unsafe entry and exit	Fatalities	**H**	✓ Recommendations from the Geotech survey should be followed. ✓ Shoring of the excavation ✓ No unauthorised entry into the project site. ✓ Fencing off of the excavation and prompt supervision of the area. ✓ Full time security on site to monitor entry and exit. ✓ Safe method of entry and exit to be provided for employees ✓ Spoil material to be stored at least 2m away from the excavation ✓ Signage to be displayed indicating deep excavations ✓ Tracked excavator to be used where shallow soft rock is found
	✓ Incompetent operator ✓ Faulty excavator	✓ Overturning ✓ Bumping against people	✓ Serious injuries	**H**	✓ Only competent personnel may operate the excavator ✓ All excavators must be inspected prior to use

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: EXCAVATION

Task	Hazard	Risk	Consequence	Rating	Controls
Mechanical excavation	✓ Ignition on	✓ Accidental movement	✓ Fatalities ✓ Property damages	**H**	✓ Operators should ensure that the ignition is off prior to leaving the plant. ✓ Keys should be removed from the ignition and returned to the office for safekeeping,
Deep excavation	✓ Lack of safety signage	✓ Employees / passersby falling into excavations	✓ Fatalities	**H**	✓ Ensure that deep excavation signage is placed and visible. ✓ Deep excavations must be fenced off and access controlled.
	✓ Spoil material	✓ Collapse of excavation walls. ✓ Entrapment	✓ Fatalities	**H**	✓ Excavated soil to be placed at least 2m away from the excavation wall.
	✓ Underground service	✓ Contact with plant	✓ Injuries ✓ Property damages ✓ Electrocution	**H**	✓ All underground services to be identified and marked prior to excavation. ✓ Wayleaves from all service providers to be obtained prior to starting with excavations.
	✓ Unsafe access and exit	✓ Falling	✓ Injuries	**H**	✓ TLB / Excavator may not be used by employees to access and exit the excavation

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: EXCAVATION

Task	Hazard	Risk	Consequence	Rating	Controls
	✓ High water table	✓ Water ingress	✓ Drowning		✓ Continuous dewatering should be done where groundwater is encountered. ✓ Trenches should not be opened for longer periods, except with prior written consent ✓ Excavations must be inspected periodically and results recorded in an inspection checklist. ✓ Where there is uncertainty about the safety of the excavation, the declaration shall be made by a registered Engineering Technologist on the safety of the excavation. ✓ Backfilling should be done as per the relevant SANS code. ✓ If saturation of the trench occurs, sidewalls should be either battered or supported laterally.
	✓ Open excavations	✓ Falling of employees ✓ Collapse	✓ Injuries		✓ Trenches should not be opened for more than 3 days to prevent deterioration in trench stability and to reduce the risk of persons and motorists falling inside.

Johannesburg Water	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: PIPE JACKING

Task	Hazard	Risk	Consequence	Rating	Controls
✓ Pipe jacking	✓ Working in confined spaces	✓ Lack of oxygen ✓ Harmful gases ✓ Entrapment	✓ Asphyxiation ✓ Serious injuries ✓ Fatalities	**H**	✓ Develop a confined space procedure. ✓ Develop a permit to work system. ✓ Only authorized and trained personnel to enter confined spaces. ✓ Ensure that the gases are purged before entry. ✓ Provide employee with oxygen mask ✓ Have an employee trained in first aid ready. ✓ Confined space may not be smaller than 800mm in diameter.
	✓ Working at heights	✓ Falling	✓ Fatalities ✓ Serious injuries	**H**	✓ Proper PPE to be issued ✓ Provide rigid edge protection.
	✓ Lifting operations	✓ People hit by load ✓ Collapsing of pipe ✓ Incorrect slinging	✓ Injuries	**M**	✓ No people are allowed to be at the jacking site. ✓ Slinger to be identifiable and wear reflective PPE. ✓ Lifting machinery to be inspected prior to use. ✓ Lifting machinery to be load tested.
	✓ Deep excavation	✓ Falling	✓ Fatalities	**H**	✓ Barricade the jacking pit ✓ No unauthorized entry ✓ Site should be fenced off and locked out. ✓ Signage should be put up
	✓ Jetting rig	✓ Crushing by horizontal move of the rig; ✓ People hit by drop load	✓ Injuries	**M**	✓ Enter the shaft only once the load has reached the bottom. ✓ Signaler to make the people in the shaft aware of the moving load. ✓

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
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	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: MECHANICAL LIFTING

Task	Hazard	Risk	Consequence	Rating	Controls
Lifting using a crane	✓ Overhead lines	✓ Contact with crane	✓ Electrocution ✓ Property damages	**H**	✓ All lifting activities to be planned at least 2m away from overhead lines ✓ Obtain wayleaves from Eskom ✓ Appoint ORHVS
	✓ Wind / Unfavourable weather	✓ Deflection ✓ Loss of control	✓ Injuries ✓ Property damages	**H**	✓ Do not use during unfavourable weather conditions
	✓ Incompetent operator	✓ Loss of control ✓ Hitting structures and people	✓ Injuries ✓ Property damages	**H**	✓ Only trained and competent operators many operate the crane
	✓ Overloading	✓ Collapse of material	✓ Injuries ✓ Property damages	**H**	✓ Display safe working load on the crane
	✓ Faulty crane	✓ Malfunctioning	✓ Injuries ✓ Property damages	**H**	✓ Cranes to be inspected by competent persons prior to being used ✓ All faulty cranes to be tagged and locked out

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
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	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: ASBESTOS REMOVAL

Task	Hazard	Risk	Consequence	Rating	Controls
Removal of asbestos pipe	✓ Asbestos cement dust	✓ Inhalation of asbestos fibers	✓ Asbestosis	**H**	✓ No asbestos pipe should be cut. The entire length of pipe should be removed (remove clamps) ✓ Appoint a registered Asbestos Contractor
Disposal of asbestos pipe	✓ Asbestos fibers	✓ Inhalation of fibers ✓ Incorrect disposal	✓ Asbestosis ✓	**H**	✓ Appoint a registered Asbestos Contractor for the removal and disposal of asbestos and asbestos containing waste. ✓ Appoint an AIA to conduct an asbestos survey to determine the level of exposure of the employees. ✓ Obtain a clearance certificate from the AIA ✓ Obtain a safe disposal certificate from the Asbestos contractor and keep records.
Disposal of asbestos pipe	✓ Asbestos waste	✓ Inhalation of asbestos dust ✓ Contamination of materials	✓ Lung infections	**M**	✓ Ensure that asbestos waste is removed within 90 days of accumulation by a registered asbestos contractor. ✓ Provide employees with suitable dust masks ✓ Demarcate and cover asbestos waste (soils)

Johannesburg Water	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: PIPE LAYING & WELDING

Task	Hazard	Risk	Consequence	Rating	Controls
Pipe laying	✓ Steel ✓ Employees working around the excavation	✓ Static electricity ✓ Rough edges ✓ Heavy steel ✓ Hit by pipe	✓ Electrocution ✓ Injuries	**M**	✓ Ensure that pipes are earthed ✓ Provide gloves to employees ✓ Heavy pipes to be lifted mechanically
Pipe laying	✓ Crane	✓ Failure of the crane ✓ Employees	✓ Fatalities	**H**	✓ Inspect the crane prior to use. ✓ Only trained and competent person to operate the crane ✓ Employees to steer clear of lifting operations ✓ Faulty cranes to be tagged and not used ✓ Wind speed and direction to be considered before using the crane ✓ Crane to be load tested ✓ Only certified loads to be carried on the crane
Tie ins & pressure testing	✓ Pressurized water	✓ Hitting employees ✓ Burst	✓ Fatalities ✓ High water losses	**E**	✓ Ensure that the water is shut down ✓ Ensure that the correct class of pipe is used as well as valve specifications are correct ✓ Develop and follow a method statement ✓ Use only competent person to perform the task. ✓ Don’t exceed pipe operating pressure, ensure pipe is correct diameter and is not damaged.

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
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	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: PIPE LAYING & WELDING

Task	✓ Hazard	✓ Risk	✓ Consequence	Rating	✓ Controls
Pipe welding	✓ Welding equipment	✓ Poor maintenance	✓ Injuries	M	✓ Welding equipment is visually checked before each use;
	✓ Welding	✓ Sparks	✓ Fire	H	✓ Welding screens to be used
		✓ Sparks	✓ Burns	L	✓ Fire resistant overalls and apron to be worn. ✓ Develop method statement for welding inside the pipe
		✓ Glare	✓ Arc eyes	M	✓ Welding glasses to be used
	✓ Confined space	✓ Entrapment ✓ Inability to move	✓ Injuries ✓ Suffocation	H	✓ Develop method statement for welding inside the pipe. ✓ Ensure that the welder is able to fit in properly inside the pipe and move with ease ✓ Use a different method of welding where the pipe's internal diameter is less than 800mm.
Compacting	✓ Compactor ✓ Noise ✓ Dust ✓ Vibration	✓ In-competent employee using the compactor ✓ Hearing loss ✓ Hand-arm vibration syndrome ✓ Collapsing excavation wall ✓ Inhalation of dust	✓ Injuries Respiratory problems	M	✓ Use of earmuffs by compactor operator ✓ Dust mask to be worn by compactor operator ✓ Compactor operator to be declared competent before using the machine

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: MECHANICAL WORKS

Task	Hazard	Risk	Consequence	Rating	Controls
Installation of pumps and valves	Heavy pumps and valves	Falling	✓ Injuries ✓ Property damages	**M**	✓ Use proper lifting equipment ✓ Ensure that only the relevant people are in the work area. ✓ Ensure that lifting equipment is load tested. ✓ Only competent personnel to undertake this task
	Steel fixing	✓ Falling ✓ Slip	Injuries	**L**	✓ PPE, including safety boots and goggles must be used
Cutting and drilling	✓ Drilling ✓ Drill bit ✓ Drill sharp metal fibres ✓ High Noise Levels ✓ Cutting Grinder/Disc	✓ Vibration ✓ Cutting edges ✓ Eye penetration ✓ Finger cuts ✓ Expose to high noise level area ✓ Uncontrolled disc ✓ Electrical equipment failure ✓ Sharp window edges	✓ Damaged hearing ✓ Carpal tunnel syndrome ✓ Cuts/ injuries ✓ Eye irritation / blindness ✓ Injuries ✓ Eye injuries	**M**	✓ Use hearing protection when exposed to excessive noise levels (greater than 85 dB over an 8-hour work period) ✓ Assess noise level with sound level meter if possibility exists that level may exceed 85dB. ✓ Rotate drilling tasks to minimize worker exposure to equipment vibration. ✓ Use right size of a drill to drill different layers of the ground ✓ Assess manual guide carefully to ensure correct usage of portable electrical devices.

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: MECHANICAL WORKS

Task	Hazard	Risk	Consequence	Rating	Controls
Fueling the generator	✓ Spillages	✓ Slips, trips, falls	✓ Injuries	**L**	✓ Prevent spillages ✓ Use drip trays ✓ Use funnels for fueling
		✓ Fire	✓ Injuries	**M**	✓ No smoking allowed near the generator
	✓ Diesel fumes	✓ Inhalation	✓ Respiratory problems	**L**	✓ Provide employees with respirators
		✓ Skin contact	✓ Skin irritation	**L**	✓ Provide employees with gloves, safety boots and overalls
	✓ Running engine	✓ Explosion	✓ Injuries	**M**	✓ Switch engine off before refueling and make sure fuel cap is replaced. ✓ No smoking allowed near the generator
Running the generator engine	✓ Noise	✓ Over-exposure	✓ Noise-induced hearing loss	**M**	✓ Provide employees with hearing protection ✓ Provide rest periods for employees
	✓ Vibration	✓ Over exposure	✓ Raynaud's Syndrome	**L**	✓ Provide employees with vibration gloves. ✓ Rotate employees or provide rest periods.
	✓ Fumes	✓ Inhalation	✓ Respiratory problems	**L**	✓ Provide employees with respirators ✓ Never use indoors

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
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ACTIVITY: GENERAL ACTIVITIES ON SITE

Task	Hazard	Risk	Consequence	Rating	Controls
Traffic Management	✓ Moving vehicles and pedestrians ✓ Improperly placed signage ✓ Incorrect signage displayed ✓ Poor communication between flagmen	✓ Road accidents ✓ People getting knocked down by cars	✓ Fatalities ✓ Serious injuries ✓ Property damages	**H**	✓ Adhere to traffic management procedures ✓ Ensure good communication between flagmen ✓ Display correct road signage ✓ Employees should wear reflective PPE ✓ Keep area clean & clear of obstacles.
Reinstatement	✓ Inadequate compaction ✓ Construction refuse ✓ Inadequate re-surfacing High ✓ Ground collapse ✓ Hydraulic / pneumatic pressures	✓ Uneven surfaces	✓ Injuries	**L**	✓ Compaction to specified standard. ✓ Site cleared of debris and refuse. ✓ Re-surface appropriately. ✓ Do not leave gaps in turf or leave uneven surface. ✓ Erect fence around hazardous areas until restored and safe. ✓ Ensure plugs and compressors are installed and secured against movement. ✓ Release air before removing plugs. ✓ Clear area of pipe ends being tested.

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

ACTIVITY: GENERAL ACTIVITIES ON SITE

Task	Hazard	Risk	Consequence	Rating	Controls
✓ Working on site	✓ Unhappy community ✓ Criminals	✓ Community coming to site ✓ Violence against employees	✓ Property damages ✓ Serious injuries	**H**	✓ Develop an emergency response procedure ✓ Meet with the community and all stakeholders prior to commencement of the project ✓ Keep all gates locked at all times ✓ Have the contact details of the nearest police station / JMPD offices ✓ Liaise with CLO, ward governance and councilor ✓ Stop work and evacuate employees where possible ✓ Have 24/7 security on site
	✓ Unfavourable weather conditions	✓ Exposure to temperature extremes	✓ Heat exhaustion ✓ Frost bite	**M**	✓ Provide employees with water for cooling down. ✓ Provide employees with warm jackets during winter and gloves ✓ Provide 5-minute rest periods for every 30 minutes of exposure to temperature extremes.
	✓ Housekeeping	✓ Trips and falls	✓ Injuries	**M**	✓ Ensure that proper housekeeping is maintained on site at all times.
Storage of HCS	✓ Burning or fires on site ✓ Improper labelling of chemical containers	✓ Property damage ✓ Accidental consumption of flammable liquids	✓ Serious injuries ✓ Illnesses	**M**	✓ A well ventilated cage may be used for storage of all the HCS and flammables ✓ HCS supervisor must record all quantities on a register. ✓ Label containers correctly ✓ Display HCS signage

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION: BASELINE RISK ASSESSMENT	
Johannesburg Water	PROJECT NUMBER:	JW 14358
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	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

RISK ASSESSMENT MATRIX

Likelihood	**Consequences**				
	Insignificant (minor problem easily handled by normal day to day processes	Minor (Some disruption possible e.g.,damage equal to R150k	Moderate (significant time / resources required. E.g., damage equal to R500k	Major (Operations severely damaged. E.g., damages equal to R1m	Catastrophic (business survival is at risk. Damage equal to R5m – 10m
Almost certain (90% chance)	High	High	Extreme	Extreme	Extreme
Likely (between 50-90%)	Moderate	High	High	Extreme	Extreme
Moderate (between 10-50%)	Low	Moderate	High	Extreme	Extreme
Unlikely (between 3-10%)	Low	Low	Moderate	High	Extreme
Rare (<3%)	Low	Low	Moderate	High	High

JOHANNESBURG WATER (SOC) LTD

MEDICAL SCREENING POLICY

JW 14358: CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

NOTICE

It is the Contractor's responsibility to ensure that medical surveillance requirements specified in the Occupational Health and Safety Act (85/1993) and Regulations and any other applicable legal and Johannesburg Water's requirements are fully complied with.

This document is meant to facilitate the Contractor's compliance to applicable requirements and does not replace the applicable legal requirements.

This document may be revised at any time to include applicable legal requirements not currently included that may come to the attention of Johannesburg Water in future. The Contractor will accordingly be responsible to comply with the revised requirements as might be necessary.

Where methods to ensure legal compliance have been specified in this document, Contractors may submit alternative detailed method statements for consideration and approval by Johannesburg Water. Johannesburg Water may, at its sole discretion, reject or accept such alternative methods.

1 PURPOSE OF THE MEDICAL SURVEILLANCE REQUIREMENTS PROCEDURE

The purpose of this Medical Surveillance Requirements Procedure is to facilitate the achievement of legal compliance relating to medical surveillance by all Consultants, Contractors, Subcontractors and suppliers that will be working on the Johannesburg Water project and to ensure that employees are fit to work in the roles that they have been employed to execute and remain so for their duration on the project site.

This document represents the minimum requirements for medical surveillance and does not replace applicable legal requirements.

2 MEDICAL SURVEILLANCE OBJECTIVES

The Johannesburg Water main objectives for medical surveillance are:

a) To ensure compliance with all applicable medical surveillance legal requirements.
b) To ensure compliance with all Johannesburg Water's requirements regarding medical surveillance.
c) To ensure that employees are fit to execute the work for which they have been employed.
d) To prevent employees from acquiring occupational diseases or illnesses.
e) To ensure early detection and treatment of occupational diseases and to prevent the aggravation of existing medical conditions.
f) To ensure that employees on departure from the project have not contracted any occupational diseases and to enable any such condition that arises to be suitably addressed.

All contractors are required to demonstrate total commitment towards the achievement of these objectives.

3 GENERAL REQUIREMENTS

3.1 The Principal Contractor shall ensure that a medical surveillance programme is implemented for all employees.

3.2 An initial health evaluation shall be carried out by an occupational health practitioner immediately after a person commences employment, where any exposure exists or may exist, which comprises:

- an evaluation of the employees medical and occupational history;
- a physical examination; and
- any other essential examination which in the opinion of the occupational health practitioner is desirable in order to enable the practitioner to do a proper evaluation.

3.3 Medical surveillance & Immunization shall be done accredited institutions or occupational health doctor, including, but not limited to:

a) Audiograms.
b) A cardio-respiratory examination, including full size chest x-rays (If lung function tests are abnormal)
c) Lung function tests.
d) Eye/ sight tests.
e) A general physical examination.
f) A review of previous medical history.
g) Blood pressure tests
h) Glucose tests
i) Vaccination (Hepatitis A & Typhoid)

Copies of all medical certificates shall be submitted to the Johannesburg Water Project Specialist or Appointed OHS Agent to prior to site establishment and before an employee is allowed to come onto site.

Specific attention shall be given to the physical and psychological fitness of people who will be required to work in elevated positions and operators of mobile machinery.

An exit medical certificate shall be obtained for all workers at the end of the contract and for all workers who leave the employment of the Contractor before the end of the Project. Copies of all

exit medical certificates shall be submitted to the Johannesburg Water Project Specialist or Appointed OHS Agent.

Medical surveillance shall address all occupational health risks to which the employee is exposed, identified through the risk assessment referred to in section 4 below.

Retention monies will be withheld if the exit medical is not complete for all employees.

The cost of all medical examinations will be borne by the Contractor as provision is made on the bill of quantities.

4 OCCUPATIONAL HEALTH RISK ASSESSMENT

4.1 The Contractor shall conduct an occupational health risk assessment prior to site establishment.

4.2 The Contractor shall ensure that, as far as is reasonably practicable, ergonomic related hazards are analyzed, evaluated and addressed in the risk assessment.

4.3 The methodology used by the contractor to assess occupational health risks associated with their activities shall be submitted to Johannesburg Water for approval by the Johannesburg Water Project Specialist or Appointed OHS Agent prior to site establishment. The methodology should take the following into consideration, among others:

a) Legal requirements.
b) Normal activities undertaken by the contractor.
c) Abnormal situations (e.g. unanticipated breakdown of equipment etc).
d) Emergency situations (e.g. fires, exposure to chemicals).
e) Changes in work procedures and methods.
f) Previous experience.

4.4 A risk register that will include the following shall be submitted to the Johannesburg Water Project Specialist or Appointed OHS Agent before site establishment.

a) All occupational health risks identified during the occupational health risk assessment.
b) A list of the occupational health risks that have been identified as being significant.

c) Reference to the method statements, measures or procedures that will be followed to either eliminate or reduce the significant risks to tolerable levels.

4.5 The Contractor shall, in writing, clearly explain how each occupational health risk assessed to be significant will be addressed to eliminate or reduce it to a tolerable level and submit it for approval by the Johannesburg Water Project Specialist or Appointed OHS Agent before site establishment. This may be through method statements or written operational control procedures. Associated responsibilities and authorities shall be clearly defined. All method statements shall reflect at least:

a) When the activities relating to the method statement will be conducted (timing).
b) Materials to be used.
c) Equipment and staffing requirements.
d) The proposed construction procedure designed to implement the relevant requirements.
e) The system to be implemented to ensure compliance with the method statement.
f) Any other information deemed to be necessary by the Johannesburg Water Project Specialist or Appointed OHS Agent and/or the contractor's responsible person.

4.6 For significant occupational health risks identified after site establishment, method statements shall be submitted to the Johannesburg Water Project Specialist or Appointed OHS Agent at least 10 working days before the start of the associated activity, when possible.

4.7 All changes to approved method statements or procedures shall be approved in writing by the Johannesburg Water Project Specialist or Appointed OHS Agent.

4.8 The contractor's Responsible Person shall retain records of any amendments and shall ensure that only the most current approved version of any method statement or procedure is used.

4.9 Every occupational health risk that is identified during the risk assessment process shall be conveyed to every employee whose work is associated with the risk. This may be done in the form of a toolbox talk but does not replace the toolbox talk entirely. Each employee shall sign to confirm an understanding of the occupational health risks in the tasks.

4.10 Occupational health risk assessments may be combined with safety and environmental risk assessments, but the consideration of occupational health issues shall be clearly reflected in the records generated and maintained.

4.11 The occupational health risk assessment process and effective implementation of measures to eliminate or reduce identified risks is the responsibility of the Contractor. Johannesburg Water will closely monitor the effectiveness of implemented measures.

Acknowledgement of JW Medical Screening Policy

Name of Contractor

I, the undersigned, hereby acknowledge that I have obtained copies of JW Medical Screening Policy and confirm that I fully understand them and the consequences of non-compliance.

Signed at …… on this …….. Day of …… 20……..

Signature of Contractor / Mandatory **Date**

---------- **----------**

Signature of 16.2 / Construction Manager **Date**

---------- **----------**

Witness 1 …… **Witness 2 ……**

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

VOLUME 2

Occupational Health & Safety Specification

JW 14358

CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

Prepared by: OHS Department PO Box 61542 Marshalltown 2107 Tel: +27 11 688 1476	**PRINCIPAL CONTRACTOR:**	
	CEO (16.1 APPOINTEE):	
	TELEPHONE NUMBER:	
	FAX NUMBER	
	E-MAIL ADDRESS:	
	SIGNATURE:	

	OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION	
Johannesburg Water	PROJECT NUMBER:	JW 14358
	PROJECT LOCATION:	WOODMEAD
	PROJECT DESCR:	CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

General Notification

This document forms an integral part of the Contract Specification and, in particular, shall constitute the Client's (Johannesburg Water SOC Ltd.) Occupational Health & Safety (OHS) Specification, as required by the Construction Regulations, 2014, as promulgated under the Occupational Health and Safety Act (Act no. 85 of 1993). The Specification shall furthermore be applied for the management of Mandatories performing activities for or on behalf of Johannesburg Water SOC Ltd, irrespective whether the contract work constitutes construction work or not.

The Contract Specification is contained in Volume 1 of the contract documents in Part 3: Scope of Work.

Acknowledgements

This Occupational Health & Safety (OHS) Specification was developed by the internal OHS Department for the sole use by Johannesburg Water SOC Ltd. The issue date of this OHS Specification is September 2016.

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ABBREVIATIONS

Abbreviation	Description
CR	Construction Regulations
COID	Compensation for Occupational Injuries and Diseases
DoL	Department of Labour
GAR	General Administrative Regulations
GMR	General Machinery Regulations
GSR	General Safety Regulations
HCS	Hazardous Chemical Substances
HIRA	Hazard Identification and Risk Assessment
JW	Johannesburg Water (SOC) Ltd
SDS	Safety Data Sheet
OHS	Occupational Health and Safety
PPE	Personal Protective Equipment
PER	Pressure Equipment Regulations
SANS	South African National Standards

SABS	South African Bureau Standard
SOC	State Owned Company

DEFINITIONS

Word / Phrase	Definition
"WCL 1", "WCL 2" and "WCL 22"	Means the prescribed forms for reporting of incidents and occupational diseases referred to in the Compensation for Occupational Injuries and Diseases Act.
Competent Person	A person who has in respect of the work or task to be performed the required knowledge, training, experience and, where applicable, qualifications specific to that work or task: provided that where appropriate, qualifications and training are registered in terms of the provisions of the National Qualification Framework Act, 2000 (Act 67 of 2000).
Construction work	Any work in connection with: a) The construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure b) the construction, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system or any similar civil engineering structure; or the moving of earth, clearing of land, the making of an excavation, piling, or any similar type of work
Contractor (inclusive of Principal Contractor)	Any organization, person, entity performing activities for or on behalf of Johannesburg Water SOC Ltd.
Corrective Action	Action to eliminate the cause of a detected nonconformity or other undesirable situation.
Employee	Any person who is employed by or works for an employer and who receives or is entitled to receive any remuneration or who works under the direction or supervision of an employer or any other person
Employer	Any person who employs or provides work for any person and remunerates that person or expressly or tacitly undertakes to remunerate him, but excludes a labour broker as defined in section I (1) of the Labour Relations Act, 1956 (Act No. 28 of 1956)
Hazard	Means a source of or exposure to danger.
Hazard identification	The identification and documenting of existing or expected hazards to the health and safety of persons, which are normally associated with the type of construction work being executed or to be executed.
Incident	Means an incident as contemplated in section 24 (1) of the OHS Act 85 of 1993.
Machinery	means any article or combination of articles assembled, arranged or connected and which is used or intended to be used for converting any form of energy to performing work, or which is used or intended to be used, whether incidental thereto or not, for developing, receiving, storing, containing, confining, transforming, transmitting, transferring or controlling any form of energy
Mandatory	Includes an agent, a contractor or a subcontractor for work, but without derogating from his status in his own right as an employer or a user
Medical surveillance	Means a planned programme or periodic examination (which may include clinical examinations, biological monitoring or medical tests) of employees by an occupational health practitioner or, in prescribed cases, by an occupational medicine practitioner.
Method Statement	A document detailing the key activities to be performed in order to reduce as reasonably as practicable the hazards identified in any risk assessment.
Principal Contractor	Any employer who performs work and is appointed by the Client to be in overall control and management of the contract work (inclusive of Mandatories).
SHE File	A file or other record in permanent form, containing the information required as contemplated in the S.H.E Specification Document and legal requirements applicable to work activities.

SHE Plan	A documented plan which seeks to address all hazards identified means and ways to control and eliminate such to ensure compliance to the S.H.E Specification.
Workplace	Any physical location in which work related activities are performed under the control of the organization.

1. Introduction

In terms of Section 37 of the Occupational Health and Safety Act (Act no. 85 of 1993), Johannesburg Water SOC Ltd is required to control persons/organizations conducting activities for or on their behalf (Mandatories) and the Construction Regulations promulgated under the Occupational Health and Safety Act (Act no. 85 of 1993), is requiring Johannesburg Water SOC) Ltd. to compile an occupational health and safety specification for any intended project classified as construction work and to provide the specification to prospective tenderers / Mandatories.

The dual objective of this specification is to ensure that the Mandatories and Principal Contractors (herein after called Principal Contractor (including Mandatories)) entering into a contractual agreement/relationship with Johannesburg Water SOC Ltd. achieves and maintains an acceptable level of occupational health, safety and environmental performance whilst conducting activities to perform the contract work.

This document forms an integral part of the Contract Specification and, in particular, shall be the OCCUPATIONAL HEALTH & SAFETY (OHS) SPECIFICATION FOR CONSTRUCTION WORK. The Contract Specification is contained in Volume 1 of the contract documents. The principal and other contractors shall ensure that this specification is included with any contract/s that they may have with other contractors and/or suppliers that are engaged for the provision of labour, goods or services for this project. The Principal Contractor and its Contractors shall furthermore implement any reasonable practicable means to ensure compliance to this Occupational Health & Safety (OHS) Specification and any other applicable legislation on their organization and/or activities performed by or for them. This OHS Specification will be read in conjunction, where issued and applicable, with the Environmental Specification issued for listed activities requiring environmental authorization by a relevant authority.

Compliance with this OHS specification does not absolve the Principal Contractor from complying with any other applicable minimum legal requirement and the Principal Contractor remains responsible for the sustainable integrity of the environment and the health and safety of its employees, mandatories as well as any persons affected by activities conducted for or on behalf of Johannesburg Water SOC Ltd (SOC) Ltd..

1.1 Johannesburg Water SOC Ltd's commitment to Occupational Health, Safety & Environmental (SHE) Management

Johannesburg Water SOC Ltd is committed to responsible occupational health, safety and environmental management. This commitment is essential to protect the environment, employees, Mandatories, visitors and provide a work environment conducive to health and safety. Principal Contractors and their Contractors shall demonstrate their commitment and concern by:

- Ensuring that decisions and practices affecting occupational health, safety and environmental performance are consistent with the issued SHE specification;
- Ensuring adequate resources are made available for the effective implementation of occupational health, safety and environmental control and mitigation measures;
- Participating in hazard identification and risk assessments and design safety reviews;
- Communicating occupational health, safety and environmental management processes, strategies and control measures with all levels of employees, contractor and/or visitors;
- Ensuring visible leadership at all sites;
- Promoting and enforcing the use of correct types of Personal Protective Equipment (PPE);
- Reporting and investigation of incidents and accidents and ensuring actions are identified and implemented to prevent similar types of incidents reoccurring;
- Participating in Client audits and meetings and ensuring required actions are implemented within reasonable time frames on the site/project;

- Recognizing and commending safe work practices and coaching employees who require guidance;
- Applying and enforcing consequence management from deviations and transgressions of/from compliance to this SHE Specification noted and/or observed, where applicable;
- Carrying out safety observations, implement corrective and preventative actions and giving immediate feedback;
- Encouraging employee participation in the formulation of work instructions and safety rules.

1.2 Scope of Occupational Health, Safety and Environmental (SHE) Specification

The scope of this Occupational Health, Safety and Environmental (SHE) Specification is to address the reasonable and foreseeable aspects of occupational health, safety and environmental management, which will be affected by the contract work.

The specification will provide the requirements that the Principal Contractor and other Contractors shall comply with in order to reduce the risks associated with the contract work, and that may lead to incidents causing injury and/or ill health or degradation of the environment, to a level as low as reasonably practicable and possible.

In particular, Johannesburg Water SOC Ltd will ensure that it shall not appoint any Principal Contractor unless it is reasonably satisfied that the contractor which it intends to appoint has the necessary competencies and resources to carry out the work safely.

1.3 Omissions from SHE Specification

Where any omission from the SHE Specification is identified, applicable legal requirements will constitute the minimum standard for compliance to the relevant omission. The responsibility will be on the Principal Contractor to provide assurance to Johannesburg Water SOC Ltd on compliance to the applicable legal requirements related to the activity / task / process.

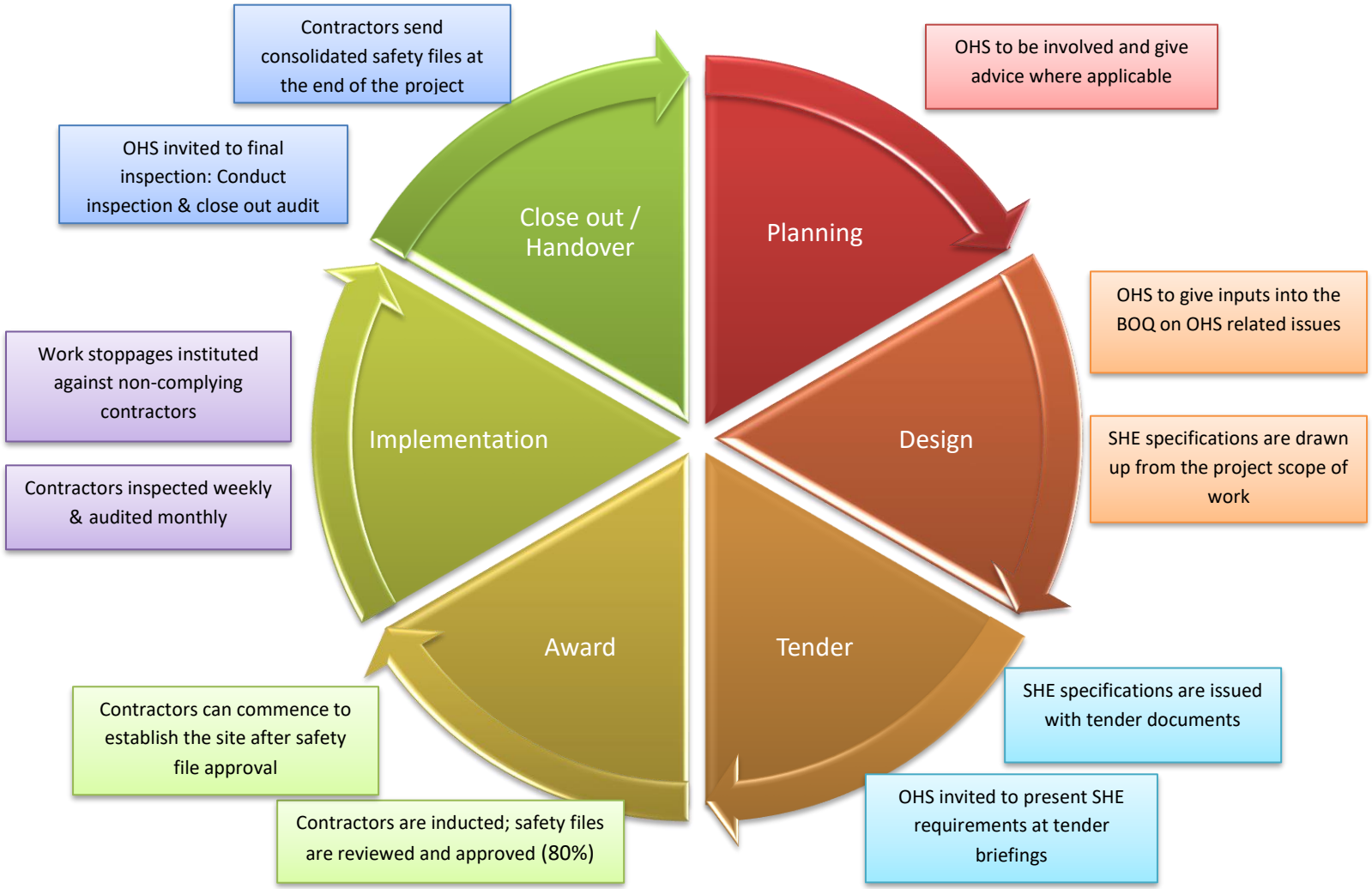
1.4 Change management

Whenever Johannesburg Water SOC Ltd identifies the need to change or review the SHE Specification, approved changes and revisions will be communicated to the Principal Contractor. A cost analysis on the implementation of the proposed changes / revisions will be calculated through a collaborative processes between Johannesburg Water SOC Ltd and the Principal Contractor – where the approved changes and/or revisions has no cost implication for the Principal Contractor the Principal Contractor will be required to accept the approved changes / revisions and ensure implementation within the SHE Plan / File framework.

2 Overview of contractor management process

The contractor management process consists of the following phases:

- Tender briefing and tender documentation;
- Competency evaluation of Principal Contractors (integrated into Supply Chain Management processes);
- Appointed contractor to attend SHE system induction;
- Preparation of SHE File by Principal Contractor;
- Evaluation of SHE File;
- Principal Contractor engagement phase;
- Project close-out and submission of consolidated Health & Safety File.


Contractors send consolidated safety files at the end of the project
OHS invited to final inspection: Conduct inspection & close out audit
Close out / Handover
OHS to be involved and give advice where applicable
Planning
OHS to give inputs into the BOQ on OHS related issues
Design
SHE specifications are drawn up from the project scope of work
Work stoppages instituted against non-complying contractors
Contractors inspected weekly & audited monthly
Implementation
Tender
SHE specifications are issued with tender documents
OHS invited to present SHE requirements at tender briefings
Award
Contractors can commence to establish the site after safety file approval
Contractors are inducted; safety files are reviewed and approved (80%)

2. SHE DOCUMENTATION

2.1 Safety file

The Principal Contractor will prepare a SHE File containing the processes / procedures and templates to be applied during the project period for the scope of work. The Principal Contractor will be evaluated during the contract period against the submitted SHE File.

Ata minimum the SHE File will contain the following documentation:

- Notification of construction work to the relevant Department of Labour (stamped on each page)
- Scope of work to be performed;
- Personnel list (Principal Contractor employees);
- OH&S / SHE Policy and other Policies;
- Updated copy of the Occupational Health and Safety Act (Act no. 85 of 1993) and its Regulations; COID Act.
- Proof of valid registration and good standing with the Compensation Commissioner or another licensed Insurer;
- SHE Plan agreed with Johannesburg Water SOC Ltd.
- Approved risk assessments, review and monitoring plans and safe work procedures (method statements);
- A list of contractors (sub-contractors) including copies of the agreements between the parties and the type of work being done by each contractor;
- All written designations and appointments for project scope of work (CV and competency copies);
- Management structure (inclusive of OH&S responsibility & meeting structure);
- Induction training and site SHE rules;
- Occupational health and safety training matrix / plan;
- Arrangements with contractors and/or mandatories;
- Description of security measures;
- The following registers (as applicable to contract scope of work):
    - Accident and/or incident notifications, investigation & control register;
    - Occupational health and safety representatives inspection register;
    - Template for entry into confined space;
    - Toolbox talks pro-forma;
    - Fall protection inspections template;
    - First-aid box content template;
    - Record of first-aid treatment template;
    - Fire equipment inspection and maintenance template;
    - Ladder inspection template;
    - Machine safety inspections template (including machine guards, lock-outs etcetera);
    - Inspection templates for lifting machines and –tackle (including daily inspections by drivers/operators);
    - Inspection templates of scaffolding;
    - Inspections templates of structures;
    - Templates of issuing of Personal Protective Equipment;
    - Monthly reporting and recording of statistics templates;
    - Keeping of any other record in terms of applicable legislation falling within the scope of SHE Legislation applicable to the project and the Principal Contractor / Contractor's activities and organization.
- Emergency preparedness and response programmes;
- Medical examination tests

2.2 Principal contractor appointment

- The principal contractor will be appointed in terms of Construction Regulations 2014, Reg 5(1) k
- All responsibilities imposed on the contractor by the Regulations will be applicable
- The duties will include:

a) Prepare a site specific SHE file based on client SHE specification and project scope.
b) Have an updated Letter of Good standing.
c) Ensure the necessary legal appointment letters are compiled and signed by affected parties.
d) Ensure SHE file submitted before work commences to Johannesburg Water for evaluation and approval.
e) Must ensure an organizational medical programme for its employees is in place. This must address pre-employment, periodic examination, and exit examinations.
f) Ensure all employees undergo medical examination and are declared fit for the job they are employed for by a Medical Practitioner.
g) All employees undergo his control undergo company specific induction and Johannesburg water induction.
h) Ensure before work commences employees are trained on the health and safety risks associated with the work they are conducting.
i) Ensure employees are trained on company procedures, policies, method statements and informed of the Johannesburg Water SHE requirements as per the specification.
j) Ensure legislative requirements are complied with during the duration of the contract and ensure that their employees comply also.
k) Sign the 37 (2) Agreement between Johannesburg Water and themselves before any work commences and kept on their SHE file.
l) Ensure that 37(2) Agreement(s) are signed between themselves and their sub-contractors.
m) Ensure that sub-contractors have valid Compensation Commissioner Letter of Good Standing.
n) Have a disciplinary procedure to address those found to be transgressing requirements of SHE specification, SHE plan, site rules or any other OHS act and its Regulation requirement.
o) Prevent any employee or visitor who is under the influence of any alcohol or drugs (in state of intoxication) from being allowed to site.
p) Ensure the safety of employees who are taking legal medication.
q) Must hand over a consolidated SHE file at the end of the contract.
r) Stop his/her employees who are doing unsafe acts or who are creating an unsafe environment.
s) Investigate all incidents and report to Johannesburg water and ensure all reportable incidents as per the legislative requirement are complied with.
t) Ensure work is supervised by competent personnel and that work is done by competent employees.
u) Ensure pre-task risk assessment is done by a competent person and that employees are informed of the pre-task risks and the risk control measures.
v) Ensure tool box talks are conducted to communicate SHE issues in connection to the work being done and any other aspects.
w) Ensue that appointed personnel as per the SHE file are executing their duties as per the legal appointment.
x) Ensure first aid kit is made available in case of any emergency.
y) Ensure that housekeeping is maintained in good condition and that materials are store/stacked properly is designated areas.
z) Have sufficient waste receptacles and ensure the correct disposal of the different wastes.
aa) Proof of hazardous waste disposal to be requested from disposal site and to be kept inside SHE file.
bb) Take reasonable steps to ensure that each appointed sub-contractor health and safety plan is implemented and maintained on the site and SHE File documentation is up to date.
cc) Stop any work from being executed which is not in accordance with the client's health and safety specification and the principal contractor's health and safety plan for the site or which poses a threat to the health and safety of persons.
dd) Must maintain an up to date list of all the sub-contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done; and
ee) Ensure that all his or her employees have a valid medical certificate of fitness.

2.3 37.2 Agreement

- Johannesburg Water will enter into a 37(2) Agreement with all the appointed contractors
- A copy of the 37(2) Agreement must be kept in the SHE file of the contractor at all times.

- It is the responsibility of the contractor to ensure that there are 37(2) agreements between themselves and all their appointed sub-contractors.

2.4 SHE Plan

- The contractor shall prepare a SHE plan to address and manage all applicable sources of risk that are identified during the execution of the project. The SHE plan shall incorporate the requirements as listed in the SHE specification.
- A copy of the SHE plan shall be submitted together with SHE file for review and approval.
- It is the contractor responsibility to ensure they sub-contractor compiles a SHE plan that in line with the SHE specification requirement of Johannesburg Water.

2.5 Legislative framework

All contractors shall comply with legislation pertaining to this contract, including but not limited to:

- Constitution of the Republic of South Africa
- Occupational Health and Safety Act and its associated Regulations
- National Environmental Management Framework Legislation
- National Road Traffic Act
- Applicable South African National Standards (SANS)
- Compensation of Occupational Injuries and Diseases Act (COID)
- Local by-laws and provincial ordinances

2.6 SHE Policy

A SHE policy is a statement of intent and a commitment by the organization Chief Executive or Managing Director (OHS Act 16(1) appointee) in relation to requirements applicable to their Safety, Health and Environmental legal obligation, relevant SHE roles and responsibilities, and contractual obligations to the Client.
The contractor and their sub-contractor companies shall each have a documented SHE Policy authorized by their Chief Executive/Managing Director (OHS Act Section 16 (1) Appointee). The SHE Policy must meet the following minimum requirements;

- Organizational Mission and Goal.
- State the overall SHE objectives within the project.
- Show commitment to the prevention of injuries and ill-health.
- Show commitment to the protection of environment and the conservation of natural resources.
- Must be reviewed at predetermined intervals, or when there is change in work process, serious incident occurs.
- The SHE Policy must be in line with ISO 45001 and ISO 14001 requirements and guidance documentation.
- Must be authorized by contractor CEO.

2.7 Appointments and competencies

- The contractor and its appointed sub-contractor must make the relevant legislative and non-statutory appointments, which must be maintained valid for the entire contract duration.
- All appointees shall be suitably trained and certified competent for the responsibilities they are assigned for.
- Copies of all relevant appointments and the relevant competence certificates must be kept in the relevant SHE file.

2.8 Supervision of construction work

- The principal contractor shall ensure that the construction manager and construction health and safety officer are appointed for a ***single site*** on a full time basis.
- Where the total number of employees on site exceeds 75, the contractor shall appoint 2 Safety Officers and an Assistant Construction Manager.

- In the event that the appointed Safety Officer / Construction Manager cannot come to work for more than 5 days, the contractor must ensure that a substitute is appointed until they are back on site.
- JW should be informed in writing of the absence of the above-mentioned on site.

Appointment index

Appointment	Legislative Ref	Competency requirements (Min)
Alternate Construction Manager	CR 8.1	N.Dip Eng + 4yrs exp
Assistant Construction Manager	CR 8.2	N.Dip Eng + 4yrs exp
Assistant Construction Supervisor	CR 8.8	-
Bulk mixing plant	CR 20	Certificate
Confined Space Supervisor	GSR 5	Certificate + Proven experience
Construction Manager	CR 8.1	N.Dip Eng + 4yrs exp Full time on site
Construction Health , Safety & Environmental Officer	CR 8.5 & JW Requirement	N.Dip Safety + 2yrs exp; OR N.Dip Enviro + 3yrs exp; OR NEBOSH / SAMTRAC + 4yrs exp Full time on site Experience in enviro / certificate **Fully registered with SACPCMP as CHSO**
Construction supervisor	CR 8.7	3 yrs experience
Construction vehicle & mobile plant supervisor	CR 23.1	Certificate
Electrical installation and appliances inspector	CR 24	
Emergency, security and fire coordinator	CR 29	Certificate
Excavation supervisor (including piling)	CR 13	3yrs exp / N.Dip building
Fall protection supervisor	CR 10.1	Certificate
First-aiders	GSR 3	Certificate
Fire fighting equipment inspector	CR 29	Certificate
General Machinery Supervisor	GMR 2.1/7	GCC (GMR 2.1)/ 3yrs exp (GMR 2.7)
Temporary work supervisor (Formwork)	CR 12.2	N.Dip building + 4yrs exp
Hazardous chemical substances supervisor	HCS Regs	Certificate
Incident investigator	GAR 9.2	Certificate
Ladder inspector	GSR 13A	-
Lifting machines and equipment inspector	DMR 18.5	Certificate + 3yrs experience
Materials hoist inspector	CR 19.8	Certificate
Occupational health and safety committee	OHS Act 19	-
Occupational health and safety representatives	OHS Act 17	Certificate
Risk assessor	CR 9.1	Certificate

Stacking and storage supervisor	CR 28	Certificate
Structures supervisor	CR 11.2	N.Dip building + 4yrs exp
Suspended platform supervisor	CR 17.1	Certificate
Welding supervisor	GSR 9	Certificate

2.9 Insurances

- The principal contractor and all his appointed contractors shall be registered with an appropriate compensation commissioner and have available a valid letter of good standing at all times.
- The obligation lies with the contractor to ensure that the Letter of Good Standing remains valid throughout the entire duration of the project.
- A copy of the said letter must be filed in all SHE files and made available during inspections and audits.

2.10 Costing for SHE

The contractor is responsible for ensuring that SHE costing is taken into consideration for the entire project/contract as this will ensure they comply with the SHE legislative requirements.

2.11 Sub-contractors

- Whenever the Principal Contractor appoints contractors or sub-contractors, it is a requirement that an Occupational Health and Safety Act (Act no. 85 of 1993) Section 37(2) agreement (i.e. Agreement with Mandatory) is entered into between the Principal Contractor and Contractors.
- The Principal Contractor will ensure that all appointed contractors comply with the Johannesburg Water SOC Ltd SHE Specification requirements.
- The Principal Contractor will establish a procedure on sub-contractor management and assurance on compliance to the established procedure will be provided to Johannesburg Water SOC Ltd on a monthly basis.
- Principal Contractors are required to formally notify Johannesburg Water SOC Ltd before appointing subcontractors.
- Johannesburg Water SOC Ltd shall approve all specialist subcontractors to be appointed and/or engaged by the Principal Contractor.

The Principal Contractor shall:

- Ensure prior to work commencing on the site that every contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for Occupational Injuries and Diseases Act, 1993;
- Appoint each contractor in writing for the part of the project on the construction site;
- Take reasonable steps to ensure that each contractor's health and safety plan is implemented and maintained on the construction site;
- Ensure that the periodic site audits and document verification are conducted at intervals mutually agreed upon between the principal contractor and any contractor, but at least once every 30 days;
- Stop any contractor from executing construction work which is not in accordance with the client's health and safety specifications and the principal contractor's health and safety plan for the site or which poses a threat to the health and safety of persons;
- Include and make available a comprehensive and updated list of all the contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done; and
- Ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner in the form of Annexure 3.

2.12 Notification of construction work

- There will not be a requirement for submitting a notification of construction work to Department of Employment and Labour.
- The Construction Work Permit will be applicable instead.

2.13 Construction work permit

- There will be a requirement for a construction work permit for this based on the number of days on site as well as project value.
- The permit can only be applied for after a contractor has been appointed, and the process will take approximately 30 days or more if requirements are not met.
- The Client will appoint a PrCHSA (Professional Construction Health and Safety Agent) registered with the SACPCMP to oversee the permit application process, and the contractor will be required to provide supporting documents for the application of the permit.

3. ORGANISATIONAL STRUCTURE

- The contractor shall develop and submit together with SHE file an organizational organogram related to the contractor, listing all the levels of responsibility from the Chief Executive down to the supervisor(s) responsible for the project.
- The organogram diagram must list all relevant positions, names of appointees and legal appointments.
- The contractor is responsible for updating the organogram timeously when there are changes to the appointments.
- All appointed sub-contractors are also required to compile their own organograms.

4. COMMITMENT TO SHE

- Visible commitment is essential to providing a safe working environment.
- Managers, supervisors and employees at all levels must demonstrate their commitment by being proactively involved in the day to day SHE operations.
- Legislation requires that each employee takes reasonable care of themselves and their fellow workers

5. HIRA

Annexure 1: List of possible hazards emanating from projects and activities conducted for or on behalf of Johannesburg Water SOC Ltd includes an assessment of site specific health and safety hazards and risks and environmental aspects and impacts that have been identified by Johannesburg Water SOC Ltd as possibly applicable to the contract work for this project. It is by no means exhaustive and is offered as assistance to the tenderers and contractors.

Development of risk assessments

Every Contractor performing construction work shall, before the commencement of any construction work or work associated with the construction work, and during construction work, ensure that a risk assessment is undertaken by a competent person, appointed in writing, and the risk assessment shall form part of the SHE plan to be applied on the site. Risk assessments shall identify occupational health and safety hazards and risks and environmental aspects and impacts emanating from the activity to be performed by the Principal Contractor / Contractor.

The risk assessment (inclusive of impact assessment) shall include (at a minimum):

- Identification of the relevant Johannesburg Water SOC Ltd Project with regard to JW Number, Project name and area;
- Date on which risk assessments were conducted / reviewed;
- The identification of the risks / hazards and aspects / impacts to which persons may be exposed to per activity;
- The analysis and evaluation of the risks / hazards and aspects / impacts identified;
- Existing control measures and proposed corrective measures;
- A plan to review the risk assessments as the work progresses and changes are introduced;
- Identification of significant risks (e.g. high; exceeding 75%);
- A documented plan of Safe Working Procedures (SWP)', and its relevance to the risk assessment, inclusive of method statements, to mitigate, reduce or control the risks and hazards that have been identified;

- A plan to monitor the application of the Safe Working Procedures (SWP);
- Signature of appointed competent person conducting risk assessment; and
- Signature of approval by Principal Contractor management and employees involved in risk assessment.

Based on the risk assessments, the Principal Contractor must develop a set of site-specific occupational SHE rules that will be applied to regulate the health, safety and environmental hazards/aspects of the construction work.

The risk assessments, together with the site-specific occupational health and safety rules, must be submitted to Johannesburg Water SOC Ltd before mobilisation on site commences. These will be included in the SHE plan. The Contractor shall ensure through his risk management process the hierarchy of controls stipulated as follows, are implemented:

- ***Eliminate*** - The complete elimination of the hazard.
- ***Substitute*** - Replacing the material or process with a less hazardous one.
- ***Redesign*** - Redesign the equipment or work process.
- ***Separate*** - Isolating the hazard by guarding or enclosing it.
- ***Administrate*** - Providing control such as training, procedures etc.
- ***Personal Protective Equipment (PPE)*** - Use of appropriate and properly fitted PPE where other controls are not practical. (PPE as the last resort)

The Principal Contractor will be required to carry out the following three forms of risk assessment:

- Baseline risk assessment;
- Issue based risk assessment;
- Continuous risk assessments.

Baseline risk assessments

The Principal Contractor is required to develop a baseline risk assessment taking the resources, competency levels, nature and scale of their organization into consideration for submission during SHE File evaluation phase. The hazards and risks to which persons, plant, vehicles and facilities may be exposed during the construction should be identified and evaluated. The aspects and impacts resulting in environmental pollution or degradation should also be identified and evaluated. Measures to reduce or control these risks or hazards should be defined during this assessment. The effectiveness of the measures defined and the baseline risk assessment prepared shall be monitored and reviewed from time to time to ensure that it remains relevant and accurate.

Issue based risk assessments

The Contractor will be required to carry out separate risk assessments during construction of the project when methods and procedures are varied, for example when:

- Designs are amended;
- New machines are introduced;
- Plant is periodically cleaned and maintained;
- Plant is started-up or shut-down;
- Systems of work change or operations alter;
- Indents or near-misses occur; or
- Technological developments invalidate prior risk assessments.

Continuous risk assessments

The Occupational Health and Safety Act (Act no. 85 of 1993) specifically requires that employers shall provide and maintain working environments that are safe and without risk to health. The general awareness of hazards needs to be raised as work ethic to maintain a safe and risk free environment on an on-going basis. This is achieved by continuous risk assessments, a form of risk assessment that takes place as an integral part of day-to-day management. Examples of continuous risk assessments include:

- Maintaining general hazard awareness, and
- Pre-work risk assessments / Daily Safety Task Instructions.

Occupational health and safety risks or environmental impacts that are identified during the risk assessment process shall be communicated before the commencement of the said activity to every employee whose work is associated with the risk. Each employee shall sign to confirm understanding of the safety, health or environmental risks in the tasks.

Review of risk assessments

The Principal Contractor is required to review the hazards identified, the risk assessments and the Safe Work Procedures as the contract work develops and progresses and each time changes are made to the designs, plans and construction methods and/or processes. Revisions to the approved risk assessments and Safe Work Procedures will be presented at each production planning and progress meeting.

Risk assessments are to be reviewed whenever there is change on the scope of work, process, and accidents or when required by Johannesburg Water SOC Ltd

The Principal Contractor must provide Johannesburg Water SOC Ltd, other contractors and all other concerned or affected parties with copies of any changes, alterations or amendments to risk assessments and Safe Work Procedures within 14 days of such changes.

6. SAFE WORK PROCEDURES / METHOD STATEMENTS

Method statements or written safe work procedures shall be documented for all high risk activities:

- Design change or scope change/addition
- Change in job or task
- Introduction of new machinery, equipment or substance.

Method statements or written safe work procedures shall identify following:

- Tasks that are to be undertaken
- The hazards and associated risks of the task(s)
- The control measures for the task(s)
- The equipment and substances that are associated with task(s)
- Any training or qualification needed to do the task
- Personal protective equipment to be worn.

7. INCIDENT MANAGEMENT

7.1 Reporting of accidents and incidents

The Principal Contractor must report all incidents where an employee is injured on duty to the extent that he:

- Dies
- Becomes unconscious
- Loses a limb or part of a limb
- Is injured or becomes ill to such a degree that he is likely either to die or to suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or continue with the activity for which he was usually employed

Or where -

- A major incident occurred
- The health or safety of any person was endangered
- Where a dangerous substance was spilled
- The uncontrolled release of any substance under pressure took place
- Machinery or any part of machinery fractured or failed resulting in flying, falling or uncontrolled moving objects
- Machinery ran out of control

to Johannesburg Water SOC Ltd within two days and to the Provincial Director of the Department of Labour within seven days from date of incident (Section 24 of the Occupational Health and Safety Act (Act no. 85 of 1993) and General Administrative Regulations), except that, where a person has died, has become unconscious for any reason

or has lost a limb or part of a limb or may die or suffer a permanent physical defect, the incident must be reported to both Johannesburg Water SOC Ltd and the Provincial Director of the Department of Labour forthwith by telephone, telefax or e-mail.

- All other reports required by this specification must also be completed. Reporting of accidents / incidents to Johannesburg Water SOC Ltd will be on the prescribed format.
- The Principal Contractor is required to provide Johannesburg Water SOC Ltd with copies of all statutory reports required in terms of the Occupational Health and Safety Act (Act no. 85 of 1993) within 7 days of the incident occurring.
- The Principal Contractor is required to provide Johannesburg Water SOC Ltd with copies of all internal and external accident/incident investigation reports, within 7 days of the incident occurring.

7.2 Accident and incident investigation

- The Principal Contractor is responsible for the investigation of all accidents and/or incidents where employees and non-employees were injured to the extent that they had to receive medical treatment other than first aid.
- The results of the investigation are to be entered into the accident and/or incident register. The Principal Contractor is responsible for the investigation of all incidents, including those described in Section 24 (1) (b) and (c) of the Occupational Health and Safety Act (Act no. 85 of 1993) and for keeping a record of the results of the investigations including the steps taken to prevent similar accidents in future.
- The Principal Contractor is responsible for the investigation of all road traffic accidents, related to the construction activities, and for keeping a record of the results of the investigations including the steps taken to prevent similar accidents in future.
- Johannesburg Water SOC Ltd reserves the right to hold its own investigation into an incident or call for an independent external investigation.

7.3 Close out

- All incident investigation reports will be closed out once all the recommendations to prevent further incidents have been implemented.
- A copy of the investigation report must be handed to JW Safety Officer conducting the investigation.

8. MEDICAL SCREENING REQUIREMENTS

- The Principal Contractor shall ensure that a medical surveillance programme is implemented for all employees.
- An initial health evaluation shall be carried out by an occupational health practitioner immediately, before after a person commences employment, where any exposure exists or may exist, which comprises:
  - an evaluation of the employees medical and occupational history;
  - a physical examination; and
  - any other essential examination which in the opinion of the occupational health practitioner is desirable in order to enable the practitioner to do a proper evaluation.
- Medical surveillance and immunisation shall be done accredited at / by institutions or occupational health personnel, including, but not limited to:
  - Audiograms.
  - A cardio-respiratory examination / Lung function test;
  - Chest X-rays
  - Eye/ sight tests.
  - A general physical examination;
  - A review of previous medical history.
  - Glucose levels
  - Blood pressure

- An entry medical certificate shall be obtained for all workers prior to commencing with site activities from approved medical institution. Copies of all medical certificates shall be retained in the SHE File prior to site establishment and before an employee is allowed to come onto site.
- Specific attention shall be given to the physical and psychological fitness of people who will be required to work in elevated positions and operators of mobile machinery.
- An exit medical certificate shall be obtained for all workers at the end of the contract and for all workers who leave the employment of the Contractor before the end of the Project. Copies of all exit medical certificates shall be submitted to the Johannesburg Water SOC Ltd Project Specialist or Appointed OHS Agent.

9 EMERGENCY MANAGEMENT

The Principal Contractor must appoint a competent person to act as emergency controller and/or coordinator.

The Principal Contractor must conduct an emergency identification exercise and establish what emergencies could possibly develop. He must then develop detailed contingency plans and emergency procedures, taking into account any emergency plan that Johannesburg Water SOC Ltd may have in place.

In the event where a contractor incorporates the services of a 3rd party service provider for the provision of Emergency Response Services, the following criteria must be met:

- Identification of 3rd party emergency response services (organization & contact details);
- Notification of contractor to 3rd party emergency response service of incorporation of services into contractor's emergency response plan (written agreement / signed letter).

The Principal Contractor and the other contractors must hold regular practice drills of contingency plans and emergency procedures to test them and familiarise employees with them.

First-aid

The Principal Contractor must provide first-aid equipment (including a stretcher) and have qualified first-aider(s) on site as required by General Safety Regulations promulgated in terms of the Occupational Health and Safety Act (Act no. 85 of 1993).

The contingency plan of the Principal Contractor must include arrangements for the speedy and timeous transporting of injured and/or ill person(s) to a medical facility or of getting emergency medical aid to person(s) who may require it.

The Principal Contractor must have written arrangements in place with his other contractors regarding the responsibility of the other contractors towards their own injured and/or ill employees.

10 SHE TRAINING

All employees in jobs requiring training in terms of the Occupational Health and Safety Act (Act no 85 of 1993) and any other applicable legislative requirements are to be in possession of valid proof of training. Other occupational health, safety and environmental training requirements of the Occupational Health and Safety Act (Act no 85 of 1993) and Construction Regulations can include:

- General induction;
- Site and job specific induction, including visitors;
- Occupational health and safety representatives;
- Training of the legal and nominated appointees;
- Operators and drivers of construction vehicles and mobile plant;
- Basic fire prevention and protection;
- Basic first-aid;
- Storekeeping methods and safe stacking; and
- Emergency planning and coordination

- Incident investigation
- Risk Assessment
- Planned job observations (supervisors)

All operators, drivers and users of construction vehicles, mobile plant and other equipment are to be in possession of valid proof of training and, where applicable, valid licenses.

12.1 General Job training

The contractor is required to ensure that before an employee commences work their direct supervisor or line manager who is responsible for the employee has informed the employees of his scope of authority, hazards and risks associated with the work to be performed as well as the safety control measure(s). This will involve discussion in connection with ay work standard, job description or company policy or procedure.

12.2 Awareness and promotion

The Principal Contractor is required to have a promotion and awareness programme in place to create an occupational health and safety culture within employees. The following are some of the methods that may be used:

- Toolbox talks;
- Posters;
- Videos;
- Competitions;
- Suggestion schemes;
- Participative employee activities such as “occupational health and safety circles”.

The Principal Contractor is, at a minimum, required to provide awareness programmes to employees on the following:

- General Health and Safety Awareness
- Environmental Awareness;
- HIV / AIDS awareness.

12.3 General competence requirement

The Principal Contractor shall ensure that his personnel and other contractors’ personnel are trained and competent to carry out work safely and without risk to health has been completed before work commences. The Principal Contractor shall ensure that follow-up and refresher training is conducted as the work progresses and whenever the scope or nature of the work changes.

A “**competent person**” in relation to construction work, means any person having the knowledge, training and experience specific to the work or task being performed: Provided that where appropriate qualifications and training are registered in terms of the provisions of the South African Qualifications Authority Act, 1995 (Act No. 58 of 1995), these qualifications and training shall be deemed to be the required qualifications and training. It is the responsibility of the Contractor to determine whether any appropriate qualifications and training are registered in terms of the provisions of the South African Qualifications Authority Act.

Records of all training must be kept in the SHE File. The contents of the file will be audited from time to time.

At a minimum, the Principal Contractor will provide training on Safe Work Procedures / Safe Operating Standards to personnel responsible for performing the related task. Records of training on Safe Work Procedures / Safe Operating Standards will be retained. Competence and skill levels by the employees responsible for performing the task on the implementation of the Safe Work Procedures / Safe Operating Standards will be measured through Planned Job Observations.

12.4 Site-specific induction training

The Principal Contractor will be required to develop a project specific induction-training course based on the baseline risk assessment for the contract work. He will ensure that all his employees and other contractors and their employees have received training on the submitted induction-training programme.

All employees of the principal and other contractors are to be in possession of proof (on person) that they have attended a site-specific occupational health and safety induction-training course.

No contractor shall allow or permit any employee, visitor or any other person to enter the site, unless such employee or person has undergone health, safety and environmental induction training pertaining to the hazards prevalent on the site at the time of entry.

Where the Principal Contractor is required to operate within Johannesburg Water SOC Ltd Depot's the Principal Contractor will ensure that all employees undergo the Johannesburg Water SOC Ltd induction.

11 PPE REQUIREMENTS

- The Principal Contractor is required to continuously identify the hazards in the workplace and deal with them. He must either remove them or, where impracticable take steps to protect workers and make it possible for them to work safely and without risk to health under the hazardous conditions.
- The Principal Contractor will establish a Personal Protective Equipment Policy and a Personal Protective Equipment study will be conducted to determine the types of Personal Protective Equipment (PPE) to be supplied related to the hazards and risks emanating from the tasks.
- Cognisance shall be given to the gender of individuals required to where PPE; size required by the employee and size issued.
- Personal protective equipment should, however, be the last resort and there should always first be an attempt to apply engineering and other solutions to mitigating hazardous situations before the issuing of personal protective equipment is considered.
- Where it is not possible to create an absolutely safe and healthy workplace the Principal Contractor is required to inform employees regarding this and issue, free of charge, suitable equipment to protect them from any hazards being present and that allows them to work safely and without risk to health in the hazardous environment.
- It is a further requirement that the Principal Contractor maintains the equipment, instructs and trains the employees in the use of the equipment and ensures that the employees use the prescribed equipment.
- Employees do not have the right to refuse to use and/or wear the equipment prescribed by the employer and, if it is impossible for an employee to use or wear the prescribed protective equipment through health or any other reason, the employee cannot be allowed to continue working under the hazardous condition(s) for which the equipment was prescribed. An alternative solution has to be found that may include relocating the employee.
- The Principal Contractor may not charge any fee for protective equipment prescribed by him but may charge for equipment under the following conditions:
    - Where the employee requests additional issue in excess of what is prescribed;
    - Where the employee has patently abused or neglected the equipment leading to early failure; and
    - Where the employee has lost the equipment.

All employees shall, as a minimum, be required to wear the following personal protective equipment on any of Johannesburg Water SOC Ltd's projects:

- Protective overalls;
- Protective footwear;
- Protective headwear; and
- Eye, face and ear protection.
- NO SHORTS OR DRESSES WILL BE ALLOWED ON SITE!!!

All Personal Protective Equipment will clearly display the branding components of the Principal Contractor's organization (e.g. Name of Organization, logo).

12 DISCIPLINARY PROCESSES

- The contractor is required to implement disciplinary process in order to enforce compliance with requirements.
- All sub-contractors are required to have the same.

13 SITE RULES

- The Principal Contractor must develop a set of site-specific OH&S rules that will be applied to regulate the Health and Safety Plan and associated aspects of the construction.
- When required for a site by law, visitors and non-employees upon entering the site shall be issued with the proper Personal Protective Equipment (PPE) as and when necessary**.**

14 PUBLIC HEALTH AND SAFETY

The Principal Contractor is responsible for ensuring that non-employees affected by the construction work are made aware of the dangers likely to arise from the construction work as well as the precautionary measures to be observed to avoid or minimise those dangers. This includes:

- Non- employees entering the site for whatever reason;
- The surrounding community; and
- Passers-by the site.

- The Principal Contractor shall organize the site in such a manner that pedestrians and vehicles can move safely and without risks to health, including sufficient and suitable traffic routes and safe walkways with relevant signage.
- Appropriate signage must be posted to this effect and all employees on site must be instructed to ensure that non-employees are protected at all times.
- All non-employees entering the site must receive induction into the hazards and risks of the site and the control measures to be observed.
- The Principal Contractor shall recognize that the Community Liaison Officer (CLO) is the link between Johannesburg Water SOC Ltd and the community and provide all reasonable support to the Community Liaison Officer to ensure relevant responsibilities are fulfilled and positive relationships with the community are maintained.
- Where activities are performed close to public routes, the Principal Contractor will establish a traffic management plan incorporating the requirements of relevant by-laws. At a minimum, barricading, warning signage and flagmen will be provided to ensure the protection of workers from vehicles in transit. Where required, the Principal Contractor will interact with the local traffic department to establish minimum requirements to be implemented on public routes.

15 REFUSAL TO WORK

- Section 14 of the OHS Act states that employees shall carry out any lawful orders given to them, suggesting that they have the right to refuse to obey any unlawful order or work instruction.
- In terms of legal and JW requirements, if an employee has reasonable belief that the work to be carried out is likely to endanger themselves or other persons in any way, he/she has the right to refuse to work.
- An employee may also refuse to work in term of Section 29 of NEMA, if the work would result in imminent and serious threat to the environment.

- All contractors shall ensure that their employees are conversant with hazards associated with their work and work environment, and be aware of the precautionary measures to take.
- The contractor must ensure that all refusals to work are investigated promptly and resolved timeously.

16 SECURITY

The Principal Contractor must establish site access rules and implement and maintain these throughout the construction period. Access control must, amongst other, include the rule that non-employees will not be allowed on site unaccompanied.

The Principal Contractor must develop a set of security rules and procedures and maintain these throughout the construction period.

The Principal Contractor shall:

- Provide a guardhouse for security personnel. The guardhouse should be in good condition and at-least meet minimum requirements as per Environmental Regulations for Workplaces as promulgated under the Occupational Health and Safety Act (Act no. 85 of 1993).
- Supply an access card containing the name, surname, employee number and photograph for all appointed employees (full or part time) for the site.
- Ensure that no person enters the construction site without wearing the necessary Personal Protective Equipment (PPE).
- Ensure that no children are allowed on the construction site.
- Ensure that no family members are sleeping over on the construction site.
- Ensure that no pets are allowed on the construction site.

17 ACCOMMODATION ON SITE

No employees shall be accommodated on site.

18 WELFARE FACILITIES

The provision of toilets for each sex is required in terms of the National Building Regulations and Construction Regulation 28. Chemical toilets are allowed instead of the water borne sewerage type. Toilets have to be provided at a ratio of 1 toilet per 30 workers. The Principal Contractor shall provide flushing toilets on the construction premises.

- At least cold-water showers for each sex have to be provided at a ratio of 1 shower per 15 workers.
- Some form of screened off changing facility must be provided separately for each sex.
- Some form of eating facility sheltered from the sun, wind and rain must be provided.

The employer needs to provide his employees with the following:

- Potable water for drinking;
- Water and soap for hand washing
- Toilet paper

19 COMPLIANCE MONITORING

19.1 Inspections

- Contractors will be inspected at least once per week by the JW Project Inspectors.
- Feedback of the inspections will be issued immediately on work instructions, and a formal report sent within 7 days of conducting the inspection to all relevant stakeholders.

- Johannesburg Water SOC Ltd. reserves the right to conduct other ad-hoc assessments and inspections as deemed necessary.
- This may include, amongst other measures, site safety walks. Corrective actions will be identified by Johannesburg Water SOC Ltd. and the Principal Contractor's representative and implemented by the Principal Contractor (at no cost to Johannesburg Water SOC Ltd.) to ensure SHE Performance improvement.

19.2 Monthly audits

- Monthly audits will be conducted within periods not exceeding 30 days.
- The Principal Contractor is to conduct his own monthly internal audits and inspections to verify compliance with his own occupational health and safety plan and management system as well as compliance with the requirements of the Johannesburg Water SOC Ltd. SHE Specification.
- The Principal Contractor will also assess and inspect the compliance of other contractors under its control. Management members of the Principal Contractor will be involved in the internal assessments and inspections.

19.3 Monthly compliance rating

A monthly compliance rating will be calculated for each Principal Contractor as per a formula determined by Johannesburg Water SOC Ltd focussing on or incorporating outcomes of assurance (e.g. monthly audit), operational (e.g. behavioural based safety inspection) assessments and other requirements, as necessary. Johannesburg Water SOC Ltd reserves the right to adjust the monthly compliance calculation formula as and when required – each revision of the monthly compliance calculation formula will be communicated to the Principal Contractor before implementation.

Each Principal Contractor is required to maintain a minimum compliance rating of 93% (Ninety Three Percent).

Scoring	Classification	Classification description
93% -100%	Good	Substantial compliance
80% -92%	Average	Compliance status needs to be improved
60% - 79%	Poor	Methods to ensure compliance require substantial improvement - operations with substantial non-compliance risks
<60%	Very poor	Methods to ensure compliance failed completely - troubled operation with severe non-compliance risks

19.4 Work stoppages

Work stoppages will be identified for 2 (two) types of work stoppages to be implemented:

- Overall work stoppage – the Principal Contractor and its Contractors are not allowed to continue with any type of construction / site work up until the work stoppage has been closed-out;
- Activity work stoppage – The Principal Contractor and its Contractors are not allowed to continue with the specific activity / task / job up until the work stoppage has been closed-out.

Overall work stoppages will be issued where non-conformances are identified against the criteria in the following table.

NR	DESCRIPTION OF AUDIT NON-CONFORMANCE / NON-COMPLIANCE
1	**NOTIFICATION OF CONSTRUCTION WORK**
1.1	Local Department of Labour not notified of construction work before commencement of construction activities
1.2	Notification of construction work not stamped by local Department of Labour (no faxed copies)
1.3	Copy of notification of construction work not available on site
2	**PROOF OF REGISTRATION WITH COMPENSATION COMMISSIONER**
2.1	Proof of registration with Compensation Commissioner or other insurer not available
2.2	Registration with Compensation Commissioner or other insurer not valid and up-to-date
3	**POLICY COMMITMENT & SHE SPECIFICATION**
3.1	SHE Plan not compiled, approved by contractor management and available on site
4	**SECTION 37(2) AGREEMENT**
4.1	Signed section 37(2) Agreement not signed and available on site
5	**RISK ASSESSMENTS**
5.1	Risk assessments not developed/ not applicable to scope of work issued by Client
6	**CONSTRUCTION MANAGER**
6.1	No construction manager appointed / available on site
6.2	Appointed construction manager does not meet requirements
6.3	Proof of competency not available on-site
7	**SITE SAFETY OFFICER**
7.1	No safety officer appointed/ available on site
7.2	Safety officer does not meet requirements
8	**SHE FILE**
8.1	No file on site

Activity work stoppages will be issued where non-conformance are identified per activity where the health and safety of employees or the public is compromised.

20.4 Non-compliance management process

The following actions will be instituted where non-conformances are identified in terms of compliance to relevant legislative requirements and the Johannesburg Water SOC Ltd SHE Specification.

CRITERIA	ACTION TO BE INSTITUTED	RESPONSIBLE PARTY
Compliance rating: 93-100%	Non-conformance closure	Principal Contractor / Contractor
Compliance rating: 80-92%	Letter of compliance improvement to Principal Contractor	Johannesburg Water SOC Ltd

CRITERIA	ACTION TO BE INSTITUTED	RESPONSIBLE PARTY
	Non-conformance closure	Principal Contractor / Contractor
Compliance rating: 60-79%	Non-compliance hearing	Johannesburg Water SOC Ltd
	Letter of commitment for performance improvement	Principal Contractor / Contractor
	Non-conformance closure	Principal Contractor / Contractor
Compliance rating: <60%	Non-compliance hearing	Johannesburg Water SOC Ltd
	Letter of commitment for performance improvement	Principal Contractor / Contractor
	Non-conformance closure	Principal Contractor / Contractor
	Supply Chain Management to be informed of non-compliance standing	Johannesburg Water SOC Ltd
3 x Work stoppages	Non-compliance hearing	Johannesburg Water SOC Ltd
	Letter of commitment for performance improvement	Principal Contractor / Contractor
	Non-conformance closure	Principal Contractor / Contractor
	Supply Chain Management to be informed of non-compliance standing	Johannesburg Water SOC Ltd
3 x Non-conformance to <93% monthly compliance rating	Non-compliance hearing	Johannesburg Water SOC Ltd
	Letter of commitment for performance improvement	Principal Contractor / Contractor
	Non-conformance closure	Principal Contractor / Contractor
	Supply Chain Management to be informed of non-compliance standing	Johannesburg Water SOC Ltd
3 x consecutive repeat findings	Non-compliance hearing	Johannesburg Water SOC Ltd
	Letter of commitment for performance improvement	Principal Contractor / Contractor
	Non-conformance closure	Principal Contractor / Contractor
	Escalation to SCMU & CAPEX	Johannesburg Water SOC Ltd

20 OPERATIONAL REQUIREMENTS

20.1 EXCAVATIONS

- Where excavations will exceed 1.5 m in depth the contractor will be required to submit a method statement to Johannesburg Water SOC Ltd for approval before commencing with the excavation and Johannesburg Water SOC Ltd will issue a permit to proceed once the risk assessment and method statement is approved.
- Excavations must be limited to 100m per day, or equated to the amount of work to be done for the day.
- All open excavations shall be closed within 3 days of excavation. No excavation will remain open beyond 3 days or during holidays.

- Excavation work must be carried out under the supervision of a competent person, who has been appointed in writing, with at least two years' experience in excavation work. Before excavation work begins the stability of the ground must be evaluated.
- Whilst excavation work is being performed, the contractor must take suitable and sufficient steps to prevent any person from being buried or trapped by a fall or dislodgement of material.
- No person may be required or permitted to work in an excavation that has not been adequately shored or braced.
- Where the excavation is in stable material and where the sides of the excavation are sloped back to at least the angle of repose of the excavated material, shoring or bracing may be left out but only after written permission has been obtained from the appointed competent person.
- Shoring and bracing must be designed and constructed to safely support the sides of the excavation.
- Where uncertainty exists regarding the stability of the soil the opinion of a competent professional engineer or professional technologist must be obtained whose opinion will be decisive. The opinion must be in writing and signed by the engineer or technologist as well as the appointed competent person.
- No load or material may be placed near the edge of an excavation unless suitable shoring has been installed to be able to carry the additional load.
- Neighbouring/adjoining buildings, structures or roads that may be affected or endangered by the excavation must be suitably protected.
- Every excavation must be provided with means of access that must be within 6 metres of any worker within the excavation.
- The location and nature of any existing services such as water, electricity, gas etc. must be established before any excavation is commenced with and any service that may be affected by the excavation must be protected and made safe for workers in the excavation.
- The appointed competent person must inspect every excavation, including the shoring and bracing or any other method to prevent collapse, as follows:
    - Daily before work commences
    - After every blasting operation
    - After an unexpected collapse of the excavation
    - After substantial damage to any supports
    - After rain
- The results of any inspections must be recorded in a register kept on site and in the safety file.
- Every excavation accessible to the public or that is adjacent to a public road or thoroughfare or that threatens the safety of persons, must be adequately barricaded or fenced to at least one meter high and as close to the excavation as practicable, regardless of the depth of the excavation.
- Every excavation must be provided with warning lights or visible boundary indicators after dark or when visibility is poor.
- Upon entering an excavation the requirements of General Safety Regulation 5, work in confined spaces, must be observed:
- Any confined space may only be entered after the air quality has been tested to ensure that it is safe to breathe and does not contain any flammable or noxious air mixture.
- The confined space must be purged and ventilated of any hazardous or flammable gas, vapour, dust or fumes.
- The safe atmosphere must be maintained and, where necessary.
- Employees are to be provided with breathing apparatus and must wear a safety harness with a rope with the free end of the rope being continuously attended to by a person outside the confined space.

- Furthermore, an additional person, trained in resuscitation, to be in full-time attendance immediately outside the confined space.
- Additional serviceable breathing and rescue apparatus is kept immediately outside the confined space for rescue purposes.
- All pipes, ducts etc. that may leak into the confined space to be blanked off sufficiently to prevent any leakage or seepage.
- The employer must ensure that all employees have left the confined space after the completion of work.
- Where flammable gas is present in a confined space no work may be performed in close proximity to the flammable atmosphere.
- Excavations and other openings must be provided with sufficient barriers to prevent construction vehicles and mobile plant from falling into them.
- Excavations left open for extended periods of time (exceeding 48 hours) must be approved the relevant Engineer / Construction Supervisor.

20.2 EXISTING SERVICES

- The Contractor shall note that although the drawings have been prepared using available information they show only the approximate positions of existing services where applicable.
- The information is supplied in good faith but shall be used as a guide only and does not relieve the Contractor of his responsibility to exercise due caution when working in areas where existing services can reasonably be expected, nor his obligation to liaise with the authorities in this regard and the obtaining of the necessary work permits and wayleaves.
- The Contractor shall be responsible to locate and safeguard any existing service he may encounter during construction. The Contractor shall be responsible for any damage to such existing services and works in the execution of this contract and shall reimburse the Employer, authority or the owner concerned for any repairs required following damages due to the Contractor's negligence.
- The Contractor shall be responsible for immediately notifying the Engineer and the authorities concerned regarding any damage caused to public services and existing works.
- Any alterations to public services shall be carried out by the Authority concerned unless the Contractor is instructed otherwise.

20.3 SETTING OUT OF WORKS

- Reference and level beacons will be shown to the Contractor by the Engineer at the commencement of the Contract and the Contractor will be responsible for transferring the datum to the Site of Works.
- The Contractor shall check the condition and accuracy of all reference and level beacons and satisfy himself that they have not been disturbed and are true with regard to position and level. A beacon that has been disturbed shall not be used until its true position and level have been re-established and the new values have been certified by the Engineer. The Contractor shall thereafter be held entirely responsible for the protection of all reference and level beacons.
- The Contractor shall employ a capable surveyor to set out the Works to the required lines and levels. The Engineer shall be informed immediately should any discrepancy be discovered between the levels or dimensions obtained by the Contractor and those shown on the drawings.
- Where a beacon is likely to be disturbed during construction operations, the Contractor shall establish suitable reference beacons at locations where they will not be disturbed during construction. No beacons shall be

covered over, disturbed or destroyed before accurate reference beacons have been established and details of the positions and levels of such beacons have been submitted to the Engineer. The Contractor's reference beacons shall be of at least the same accuracy and sturdiness of construction as the existing beacons.

- The Contractor shall submit the method of setting out he proposes to employ to the Engineer. Accurate control of line and level shall be provided by the Contractor at all stages of construction.
- Work set out by the Contractor may be checked by the Engineer and any errors found shall be rectified by the Contractor at his own expense. The Contractor shall supply any instrument, equipment, material and labour required by the Engineer for this survey work. Any assistance, including checking given to the Contractor by the Engineer or any setting out done by the Engineer for Contractor shall not be held as relieving the Contractor of his responsibility for the accurate construction of the Works.
- The Contractor's survey instruments and survey equipment shall be suitable for the accurate setting out of the Works and shall be subject to the approval of the Engineer. They shall furthermore be checked and correctly adjusted by the authorized agents before the commencement of the contract and subsequently when required by the Engineer and when otherwise necessary.
- Survey work shall not be measured and paid for directly and compensation for the work involved in setting out shall be deemed to be covered by the rates tendered and paid for the various items of work included under the contract.

20.4 CONFINED SPACE ENTRY

- Enclosed space work necessitates a Confined Space Permit. This may only be obtained from the authorized person nominated in writing.
- The responsibility for safe procedure, both at the time of entry and during the entire operation of entering and working in confined spaces, rests with the Contractor.
- The Contractor shall be sure that adequate steps have been taken to eliminate or control hazards.
- Before working in an area that contains dust, the area is to be ventilated and hosed down to settle and dampen the dust.
- The Contractor shall provide all necessary equipment to manage confined spaces, including all necessary monitoring and rescue equipment (such as tripods, breathing equipment and the like).
- The Contractor shall ensure all persons working in a confined space or managing entry to a confined space are appropriately trained.
- Compulsory - Continuous monitoring, trained rescue teams, radio communication & adequate ventilation.

Pump sumps & valve chambers

Ventilation

- All available manholes or ventilation covers must be removed and the compartment ventilated for 10 (ten) to 15 (fifteen) minutes, using compressed air or a portable blower.
- Such ventilation must be continued while personnel are in the compartment.
- Ensure that exhaust fumes from blower do not enter the confined space.
- Before entering any sump or compartment, the atmosphere must be tested by the Principal Contractor's competent person (trained by the supplier of the gas monitoring equipment) by lowering the gas monitoring equipment to the bottom of the sump or compartment by means of a rope.
- A register must be kept indicating that the atmosphere has been tested and that the sump or compartment is fit to work in.
- The Principal Contractor's construction supervisor must check and co-sign this register each time he visits a site to ensure that the atmosphere is continuously being monitored.

Entering sump

- When entering a sump the person entering the sump must wear the safety harness, gas detector as well as a self-rescuer.
- A lifeline must be attached to the safety harness and a person on the surface must be in continuous contact with the person in the sump.
- At least one person on the surface must be trained in basic first aid and CPR and a first aid kit with resuscitation equipment must be available outside the entrance of the confined space for emergencies.
- Should the alarm sound when a person is in the confined space, the area must be evacuated immediately and the atmosphere re-tested and certified safe before re-entry into the confined space.
- In no circumstance shall any person remain within a sump for a period of more than one hour at a time.
- A five-minute rest on the surface must be taken after this period before re-entering.
- No naked lights, smoking or unprotected electrical apparatus which may cause sparks, shall be permitted in any sump or in their vicinity.

Confined spaces & water chambers

General

- All employees working in confined spaces or sewer manholes must be issued with gas monitoring equipment and safety harnesses and self- rescuers where applicable.
- All these employees must be trained in their use.
- Where over pumping between manholes is involved, only leakage free pumping machines and conveyance tubes will be allowed.
- Under no circumstances may any confined space be entered unless it has been certified safe to work in.
- Safety harnesses and attachments must be checked for damage to webbing, metal fittings and ropes on a monthly basis and the findings recorded in a register.
- Should a harness be damaged, it must be reported to the construction supervisor immediately.

The following records shall be taken and maintained by the Principal Contractor:

- Confined space entry permits
- Confined space entry registers
- Safety harness registers

Ventilation

- All available manholes or ventilation covers must be removed and the chamber ventilated for 10 (ten) to 15 (fifteen) minutes, using compressed air or a portable blower.
- Such ventilation must be continued while personnel are in the chamber.
- Ensure that exhaust fumes from blower do not enter the confined space.
- Before entering any chamber, the atmosphere must be tested by the Principal Contractor's competent person (trained by the supplier of the gas monitoring equipment) by lowering the gas monitoring equipment to the bottom of the chamber by means of a rope.
- A register must be kept indicating that the atmosphere has been tested and that the area is fit to work in.
- The Principal Contractor's construction supervisor must check and co-sign this register every time he visits the site to ensure that the atmosphere is continuously being monitored.
- Fumes must be extracted from the chamber while welding.

Entering chamber

- When entering a chamber the person entering the chamber must wear a safety harness as well as the gas detector.
- A lifeline must be attached to the safety harness and a person on the surface must be in continuous contact with the person in the manhole.
- At least one person on the surface must be trained in basic first aid and CPR and a first aid kit with resuscitation equipment must be available outside the entrance of the confined space for emergencies.

- In no circumstances shall any person remain within a chamber for a period of more than one hour at a time. A five-minute rest on the surface must be taken after this period before re-entering.
- Should the alarm sound when a person is in the confined space, the area must be evacuated immediately and the atmosphere re-tested and certified safe before re-entry into the confined space.
- When the activity to undertake inside the pipeline includes the use of any hazardous chemical substances or substances, which might cause hazardous fumes or gasses the contractor, must comply with 5.24 Hazardous Chemical Substances.

Safety equipment

- All teams must be issued with gas monitoring equipment and safety harnesses and self-rescuers where applicable.
- All employees must be trained in the use thereof.

20.5 BARRICADING

- Barricading plans are to be presented by the Principal Contractor for any major operations involving site works for approval by Johannesburg Water SOC Ltd. Where areas are unsafe, they should be enclosed with barricading. Examples are people working overhead, welding splatter etc.
- Where there is a risk of injury, the area should be barricaded off with secure solid barricades.
- Barricading for the prevention of access into areas with a potential risk of injury shall as a minimum be constructed of a handrail, knee-rail and appropriately supported as to prevent any person from falling into the restricted/risk area.
- Appropriate signage shall be affixed to the barricade indicating the risk associated (i.e. deep excavation, lifting operations etc.) and the responsible Supervisor and contact details shall be displayed. All barricading shall have a “No Entry” signs on all sides and at each change of direction. Signage shall be placed at 20 m intervals where lengths exceed. All signage shall be a minimum size of 290 mm x 290 mm.
- Danger tape shall not be utilised to prevent personnel from entering into areas.
- Where no risk exists of injury to personnel such as stacking and storage areas, the use of wire for hand and knee rails netting shall be acceptable to demarcate the area.
- All barricades will have a dedicated entrance where it is required that personnel enter the areas.
- Appropriate signage shall be placed at the entrance indicating which Contractor has right of entry.
- It is the Contractor’s responsibility to remove all redundant barricades directly after use. The Contractor’s Safety Officers will maintain a marked-up site plan indicating where barricades are erected.
- It will be a requirement that the contractor protects employees against contact with exposed rebar and poles by the installation of rebar-caps on all exposed areas where there is a potential that an employee could be injured.

20.6 SYMBOLIC SIGNGAGE

Contractors shall use mandatory and prescribed symbolic safety signs at their lay down and site areas. The display of the following signs is mandatory:

- “Radio-Active Material” symbolic signs at radioactive storage areas.
- “Eye Protection” symbolic signs shall be displayed at all grinding machines and at any area where it is mandatory to wear eye protection or where there is danger of an eye injury being sustained.
- “Ear Protection” symbolic signs shall be displayed at all areas where there is a danger of noise induced hearing loss being sustained.
- Every separate room of a workplace shall be consecutively numbered.
- All toilets or urinals shall be marked in a conspicuous place with painted or stencilled letters to indicate the sex for which they are intended.
- The location of every first aid box is to be clearly indicated by means of a sign.
- In any room, cabinet or enclosure where flammable substances are used or stored shall be fixed a suitable and conspicuous sign prohibiting smoking or the use of naked flames in the area.

- At the entrance to premises where machinery is used
- Restricted access on "Authorised Person Only" signs on entry. "No person shall enter the workplace or premises without the permission of the employer or user of the machinery".
- At every place where machinery is used a notice (English & Pictograms) shall be posted.
- Explosive Power Tool shall have a sign warning people when it is in use.
- Electrical Control Gear. A notice shall be posted so as to warn against the re-closing of a switch of control gear whilst a person is working on such equipment.
- Emergency contact telephone numbers.
- Adequate scaffolding signs. (When applicable).
- Adequate fire fighting equipment signs.
- Speed limit signs.
- Warning notices at openings through which people may fall.
- Risk based signage depending on the task being performed e.g.:
    - "Men working above", "Men working below', "Road closed – detour", "Excavation in progress", "No walkway" etc.;
- No-entry signs to incomplete platforms

The Principal Contractor shall install a notification board indicating the following information at the site entrance:

- Johannesburg Water SOC Ltd project number;
- Principal Contractor identification details (name, telephone number)
- Name and contact details of Construction Supervisor;
- Name and contact details of site safety officer;
- Monthly compliance rating;
- Lost Time Injury Rate;

The Principal Contractor will ensure that information on the notification board is kept up-to-date.

20.7 USE AND STORAGE OF FLAMMABLES

The Principal Contractor to ensure that:

- No person is required or permitted to work in a place where there is the danger of fire or an explosion due to flammable vapours being present unless adequate precautions are taken;
- No flammable material is used or applied e.g. in spray painting, unless in a room or cabinet or other enclosure specially designed and constructed for the purpose unless there is no danger of fire or explosion due to the application of adequate ventilation;
- The workplace is effectively ventilated. Where this cannot be achieved:
    - Employees must wear suitable respiratory equipment
    - No smoking or other source of ignition is allowed in the area
    - The area is conspicuously demarcated as "flammable"
- Flammables stored on a construction site are stored in a well-ventilated, reasonably fire-resistant container, cage or room that is kept locked with access control measures in place. Sufficient fire fighting equipment is installed and fire prevention methods practiced. Proper housekeeping may achieve this;
- Flammables stored in a permanent flammable store are stored so that no fire or explosion is caused.
- Stored in a locked and well-ventilated reasonably fire resistant container, cage or room conspicuously demarcated as "Flammable Store – No Smoking or Naked Lights"
- The flammables store to be constructed of two-hour fire retardant walls and roof and separated from adjoining rooms or workplaces by means of a two-hour fire retardant fire wall
- Adequate and suitable fire fighting equipment installed around the flammables store and marked with the prescribed signs
- All electrical switches and fittings to be of a flameproof design
- Any work done with tools in a flammable store or work areas to be of a non-sparking nature
- No Class A combustibles such as paper, cardboard, wood, plastic, straw and the like to be stored together with flammables

- The flammable store to be designed and constructed such that in the event of spillage of liquids the store is able to contain the full quantity + 10% of the liquids stored
- A sign indicating the capacity of the store to be displayed on the door
- Only one day's quantity of flammable is to be kept in the workplace;
- Containers (including empty containers) to be kept closed to prevent fumes/vapours from escaping and accumulating in low lying areas;
- Metal containers to be bonded to earth whilst decanting to prevent build-up of static forces; and
- Welding and other flammable gases to be stored segregated according to the type of gas and empty and full cylinders.

20.8 HAZARDOUS CHEMICAL SUBSTANCES

The Principal Contractor must ensure that:

- Employees receive the necessary information and training to be able to use and store hazardous chemical substances safely;
- Employees obey lawful instructions regarding:
    - The wearing and use of protective equipment
    - The use and storage of hazardous chemical substances
    - The prevention of the release of hazardous chemical substances
    - The wearing of exposure monitoring and measuring equipment
    - The cleaning up and disposal of materials containing hazardous chemical substances
    - Housekeeping, personal hygiene and the protection of the environment
- The risk assessments required in terms of Construction Regulation include employee exposure to hazardous chemical substances and that the necessary measures be taken to protect persons from being detrimentally affected by hazardous chemical substances present or used in the workplace;
- Suppliers provide the necessary information in the form of a material safety data sheet regarding a hazardous chemical substances required to ensure the safe use and storage of that substances;
- An up-to-date list is kept on site of hazardous chemical substances stored and used together with the material safety data sheet of the hazardous chemical substances;
- Hazardous chemical substances containers be clearly marked with the contents and main hazardous category e.g. "Flammable" or "Corrosive" and the reference number of the hazardous chemical substances on the list indicated above;
- Hazardous chemical substances, for example asbestos dust, are not cleared by using compressed air but should be vacuumed;
- No person eats or drinks in a hazardous chemical substances workplace; and
- Hazardous chemical substances waste is disposed of safely in terms of hazardous waste disposal requirements.
- MSDS's to be in 16 point format- available on site

20.9 FIRE PREVENTION AND PROTECTION

The Principal Contractor must ensure that:

- The risk of fire is avoided;
- Sufficient and suitable storage for flammables is provided;
- Sources of ignition are removed wherever flammable or highly combustible material is present in the workplace, for example:
    - Notices prohibiting smoking are displayed and enforced
    - Welding and flame cutting is only allowed under controlled conditions that includes written hot work permits
    - Only spark-free hand and power tools are used
    - No grinding, cutting and shaping of ferrous metals is allowed using electrically driven power tools that produce sparks

  - Flameproof switches and fittings are to be used in the flammable atmosphere
  - Good housekeeping is maintained to prevent the accumulation of unnecessary combustibles
  - Adequate ventilation is maintained
  - Adequate and suitable fixed and portable fire fighting equipment is provided and maintained in good working order.
- Maintenance must include:
  - Regular inspection of fire equipment by a competent person appointed in writing and keeping a register
  - Annual inspection and service by an accredited service provider
- All employees are instructed in the use of the fire fighting equipment and know how to attempt to extinguish a fire;
- A sufficient number of employees are appointed and trained to act as an emergency team to deal with fires and other emergencies;
- Employees are informed regarding emergency evacuation procedures and escape routes;
- Emergency escape routes are kept clear at all times and clearly marked;
- Evacuation assembly points are demarcated;
- Evacuation is practiced to ensure that all persons are evacuated timeously;
- Roll call is held after evacuation to account for all personnel and ensure that no-one has been left behind; and
- A siren or alarm is fitted which is clearly audible to all persons on site.

20.10 STACKING AND STORAGE

The Principal Contractor must ensure that:

- A competent person is appointed in writing to supervise all stacking and storage on a construction site;
- Adequate storage areas are provided and demarcated;
- The storage areas are kept neat and under control;
- The base of any stack is level and capable of sustaining the weight exerted on it by the stack;
- The items in the lower layers can support the weight exerted by the top layers;
- Cartons and other containers that may become unstable due to wet conditions are kept dry;
- Pallets and containers are in good condition and no material is allowed to spill out;
- The height of any stack does not exceed 3 times the base unless stepped back at least half the depth of a single container at least every fifth tier or the approval of an inspector has been obtained to build the stacks higher with the aid of a machine. The operator of the machine must be protected against items falling from overhead off the stack and no items may overhang;
- The articles that make up a single tier are consistently of the same size, shape and mass;
- Structures for supporting stacks are structurally sound and able to support the mass of the stack;
- No articles are removed from the bottom of the stack first but from the top tier first;
- Anybody climbing onto a stack must do it in a safe manner, taking reasonable safety precautions, and ensuring that the stack is stable and capable of supporting him or her
- Stacks that are in danger of collapsing are broken down and restacked;
- Stability of stacks are not threatened by vehicles or other moving plant and machinery;
- Stacks are built in a header and stretcher fashion and that corners are securely bonded;
- Stacks are stepped back at least half the depth of a single container at least every fifth tier; and
- Persons climbing onto stacks do not approach unguarded moving machinery or electrical installations.
- Laydown area is allocated for Contractor-supplied items.
- At all times, the Contractor shall be responsible for the safe and adequate storage of all materials and equipment on site which he is to install, whether they are supplied by himself or others.
- The safe handling, unloading and loading of material receipts and dispatches at site or storage areas shall be the Contractors' responsibility.

The Contractor shall provide a suitable and adequate lock-up store for the storage of items of equipment and material, which would be damaged or pilfered if stored in the open. The Principal Contractor shall provide all facilities required for weather-proofing, dust proofing or vermin proofing.

The Contractor is responsible for the proper storage and maintenance of all equipment until issue of the Certificate of Practical Completion.

All equipment and materials will be stored on suitable wood poles or pallets which will not protrude more than a meter from any of the stored material. Safe access ways shall be maintained between all stored items preventing employees from having to climb over or under equipment to retrieve the necessary.

20.11 HOUSEKEEPING

The Principal Contractor to ensure that:

- Housekeeping is continuously implemented and maintained;
- Materials and equipment are properly stored;
- Scrap, waste and debris is removed regularly;
- Materials placed for use are placed safely and not allowed to accumulate or cause obstruction to the free-flow of pedestrians and vehicular traffic;
- Waste and debris not to be removed from heights by throwing but rather by chute or crane;
- Where practicable, construction sites are fenced off to prevent entry of unauthorised persons;
- Catch platforms or nets are erected over entry and exit ways or over places where persons are working to prevent them being struck by falling objects;
- An unimpeded work space is maintained for every employee;
- Every workplace is kept clean, orderly and free of tools, materials and the like that are not required for the work being done;
- As far as is practicable, every floor, walkway, stair, passage and gangway is kept in good state of repair, skid-free and free of obstruction, waste and materials;
- The walls and roof of every indoors workplace sound and leak-free; and
- Openings in floors, hatchways, stairways and open sides of floors or buildings are barricaded, fenced, boarded over or provided with protection to prevent persons from falling.

20.12 PUBLIC HEALTH AND SAFETY

The Principal Contractor is responsible for ensuring that non-employees affected by the construction work are made aware of the dangers likely to arise from the construction work as well as the precautionary measures to be observed to avoid or minimise those dangers. This includes:

- Non- employees entering the site for whatever reason;
- The surrounding community; and
- Passers-by the site.

- The Principal Contractor shall organize the site in such a manner that pedestrians and vehicles can move safely and without risks to health, including sufficient and suitable traffic routes and safe walkways with relevant signage.
- Appropriate signage must be posted to this effect and all employees on site must be instructed to ensure that non-employees are protected at all times. All non-employees entering the site must receive induction into the hazards and risks of the site and the control measures to be observed.
- The Principal Contractor shall recognize that the Community Liaison Officer (CLO) is the link between Johannesburg Water SOC Ltd and the community and provide all reasonable support to the Community Liaison Officer to ensure relevant responsibilities are fulfilled and positive relationships with the community are maintained.

20.13 TRAFFIC MANAGEMENT

- Where activities are performed close to public routes, the Principal Contractor will establish a traffic management plan incorporating the requirements of relevant by-laws.
- At a minimum, barricading, warning signage and flagmen will be provided to ensure the protection of workers from vehicles in transit.
- Where required, the Principal Contractor will interact with the local traffic department to establish minimum requirements to be implemented on public routes.

20.14 HAND TOOLS

The Principal Contractor must inspect all hand tools before it is brought onto the site.

- As far as possible all hand tools must be numbered and placed on register to be inspected monthly by a person designated to do so.
- Any tools found to be in an unsafe condition must immediately be removed from service and either discarded or rectified.
- No chisels with “mushroomed” heads must be used.
- No hammer shall be used with a cracked or damaged handle.
- All files must be fitted with handles.
- All trolleys, pushcarts, etc. used on site must be identifiable, placed on register and inspected at least once every month.
- Non-sparking tools must be used in areas where the risk of fire or explosion is present.
- No homemade hand tools are allowed on the project.
- All tools shall be attached to a suitable lanyard when utilised in elevated positions

20.15 PORTABLE ELECTRICAL EQUIPMENT

Portable electrical tools and equipment includes every unit that takes electrical power from a 15 ampere plug point and is moved around for use in the workplace for example; drills, saws, grindstones, portable lights, etcetera. Other electrical appliances such as fridges, hotplates, heaters, and etcetera must be inspected and maintained to the same standards as portable electrical tools and appliances.

The use, inspection and maintenance of portable electrical tools and equipment shall be as follows:

- Periodical inspections must be carried out by a competent person appointed in writing;
- Inspection results must be recorded in a register;
- Only competent authorised persons are allowed to use portable electrical tools and equipment; and
- The correct protective equipment must be worn or used whilst operating portable electrical tools and equipment.

This equipment:

- Must be maintained in good condition at all times to prevent an electrical shock to the user;
- The main power source should incorporate an earth leakage protection device or receive power through a double wound transformer or be double insulated and clearly marked as such; and
- All equipment must be fitted with a switch to allow for safe and easy starting and stopping.

The following requirements apply to portable lights:

- Must be fitted with a robust non-hygroscopic non-conducting handle;
- Live metal parts or parts which may become live must be protected against contact;
- The lamp must be protected by a strong guard;
- The cable lead-in must withstand rough handling;
- Inspections must be undertaken that concentrate on plug, cord, switch and any obvious faults;
- A register be kept for each piece of equipment with findings of regular inspections undertaken to evaluate the condition of these lights; and
- When used in wet/damp/metal container conditions, the lamp must be protected.

20.16 LIFTING EQUIPMENT & MACHINERY

Lifting equipment must be designed and constructed in accordance with the manufactures/designers specifications as well as generally accepted technical standards and operated, used, inspected and maintained in accordance with the manufactures requirements as well as that of the of Driven Machinery Regulations promulgated in terms of the Occupational Health and Safety Act (Act no 85 of 1993).

The Driven Machinery Regulations requires that:

- Lifting equipment is clearly and conspicuously marked with the maximum mass load (MML) that it is designed to carry safely. When the MML varies with the conditions of use a table showing the maximum mass load with respect to every variable condition shall be posted up by the user in a conspicuous, place easily visible to the operator and the table shall be used by the driver/operator;
- Each winch on a lifting machine must at all times have, at least, three full turns of rope on the drum when the winch has been run to its lowest limit;
- Lifting equipment shall be fitted with a brake or other device capable of holding the MML. This brake or device shall automatically prevent the downward movement of the load when the lifting power is interrupted;
- Lifting equipment shall be fitted with a load limiting device that automatically arrest the lift when the load reaches its highest safe position or when the mass of the load is greater than the MML;
- Every chain or rope on a lifting machine that forms an integral part of the machine must have a factor of safety as prescribed by the manufacturer of the machine. Where no standard is available the factor of safety must be:
    - chains – 4 (four)
    - steel wire ropes 5 (five)
    - fibre ropes- 10 (ten)
- Every hook or load attaching device must be designed to prevent the load from slipping off or disconnecting;
- Every lifting machine must be inspected and load tested by a competent person every time it has been dismantled and re-erected and every 12 months after that. The load test must be in accordance with the manufacturer's requirements or to 110% of the MML. In addition, all ropes, chains, hooks or other attaching devices, sheaves, brakes and safety devices forming an integral part of a lifting machine must be inspected every 6 months by a competent person;
- All maintenance, repairs, alterations and inspection results must be recorded in a log book and each lifting machine must have its own log book; and
- No person may be lifted by a lifting machine not designed for lifting persons unless in a cradle approved by the inspector of the Department of Labour.

<u>General requirements for cranes and lifting equipment</u>

All documentation must be provided to the Johannesburg Water SOC Ltd Project Engineer prior to mobilisation. Failure to do so and the resulting cost of any delays and/or remedial activities will be for the Contractor's account.

All crane operators must be authorised by the relevant Engineer before they may operate a crane or lifting machine. The Load charts must be displayed at the crane.

Daily pre-use inspections of the cranes must be done and be kept on the file. The inspections must be logged in a logbook. The area in which a lift is performed must always be barricaded to prevent employees from entering.

A crane or lifting machine must not be left unattended and the keys may never be left in the ignition when the operator is not present. Properly constructed out rigger pads must be used when soil is uneven or unstable. (Only sleepers or appropriately designed steel plate pads may be used for this purpose).

Only a competent rigger may direct a lift of any kind unless the following requirements are met. Rigger assistants used for performing lifting operations shall be limited to lifts with all of the following requirements:

- Lifts lower than 5 tons

- Easy lifts that does not require the load to be lifted over structures, equipment or machinery
- Equipment that is not critical
- Rigging configuration that requires the attachment of several parts of lifting equipment such as chain blocks to adjust the angle of loads.
- All safety devices on a crane or lifting machine must be functional.

Certification will be required for record purpose, and shall cover the following:

- A Brake or other device capable of holding the maximum mass should the power fail, or which is such that it shall automatically prevent the uncontrolled downward movement of the load when the raising effort is interrupted; and
- A Limiting device which shall automatically arrest the driving effort when:
- The Hook or Load attachment point of the Power Driven lifting machine reaches its highest safe position; and
- In the case of a Winch Operated lifting machine with a lifting capacity of 5000kg or more, the load is greater than the rated mass load of such machine.

The user shall ensure that every lifting machine is operated by an Operator specifically trained for a particular type of lifting machine; the user shall not require or permit a person to operate such lifting machine unless the operator is in possession of a certificate of training, issued by an accredited person or organisation.

No Crane shall be used at arrival on site before copies of all documentation have been handed over to the Johannesburg Water SOC Ltd and the Crane have been checked by a person duly authorised and signed off as acceptable. Copies of all documentation shall be kept in the SHE File at all times.

No Crane shall be used without a pre-use check and findings entered on an approved checklist. Before any cranes are established on site the following must be inspected and approved:

- Operator's licences
- Training certificates
- Medical fitness certificate.
- The cranes load test certificate.
- Rope test certificates including Mill / Destructive test.
- The lifting gear load test certificates.
- The load limiting device calibration certificate.
- Proof that the hooks have been measured for spreading.
- The service inspection history.
- Monthly comprehensive inspection certificate
- Operation and maintenance Manuals and crane condition.

<u>Cranes and Lifting Machines</u>

A contractor shall ensure that where tower cranes are used:

- Account is taken of the effects of wind forces on the structure;
- Account is taken of the bearing capacity of the ground on which the tower crane is to stand;
- The bases for the tower cranes and tracks for rail-mounted tower cranes are firm and level;
- The tower cranes are erected at a safe distance from excavations;
- There is sufficient clear space available for erection, operation and dismantling;
- The tower crane operators are competent to carry out the work safely; and
- The tower crane operators are physically and psychologically fit to work in such an environment by being in possession of a medical certificate of fitness."

No user shall use or permit any person to use a Jib-Crane with a lifting capacity of 5000kg or more at a minimum Jib radius, unless it is provided with:

- A load indicator that shall indicate to the operator of the Jib-Crane the mass of the load being lifted, provided that such a device shall not require manual adjustment from the application of the load, to the Jib-Crane, until the release of the load.
- A Limiting Device, which shall automatically arrest the driving effort whenever the load is lifted, is greater than the rated mass load of the Jib-Crane.

Mobile Crane near Power Lines

No mobile cranes are to be used near overhead power lines until the Johannesburg Water SOC Ltd representative has been notified and provided safe access conditions and a valid permit to work is obtained. Mobile cranes shall be effectively earthed when working in the vicinity of electrical wires. Assume that all electrical equipment and wires are live and avoid them.

Lifting tackle

The following requirements will apply to lifting tackle:

- Manufactured of sound material, well-constructed and free from patent defects;
- Clearly and conspicuously marked with an identity number;
- MML factor of safety:
  - Natural fibre ropes - 10(ten)
  - Man-made fibre ropes and woven webbing - 06(six)
  - Steel wire ropes – single rope - 06(six)
  - Steel wire ropes – combination slings - 08(eight)
  - Mild Steel chains - 05(five)
  - High tensile/alloy steel chains - 04(four)
- Steel wire ropes must be examined by a competent person every three months and the results recorded in a designated logbook. The ropes must be discarded (not used any further for lifting purposes) when wear and corrosion is evident.

20.17 LADDERS

The following requirements for ladders will apply:

- All ladders used on the site shall be constructed and used in compliance with the OH&S Act and Regulations.
- Ladders, which provide access to a working platform, shall extend one metre above the platform where it provides access, and shall be secured to prevent slipping.
- Timber ladders shall not be painted other than with clear preserving oils, clear varnishes or clear plastics.
- Ladders, which are in a damaged condition, shall not be used and shall be labelled accordingly and removed from the Premises.
- All Ladders shall be numbered, logged in a register, and inspected monthly.
- A ladder in use shall be held by an assistant and/or properly tied down in position.
- Only ladders that do not conduct electricity shall be used in live electrical sub-stations and switching rooms.
- Ladders shall be removed after use and stored in an appropriate facility as to not expose them unnecessarily to the elements or potential damage by surrounding activities.

20.18 CONSTRUCTION VEHICLES AND MOBILE PLANT

Johannesburg Water SOC Ltd will inspect construction vehicles and mobile plant prior to being allowed on a project site. Suppliers of hired vehicles, plant and equipment will be required to comply with this specification as well as the Occupational Health and Safety Act (Act no. 85 of 1993) and Regulations.

Construction vehicles and mobile plant to be:

- Of acceptable design and construction;
- Maintained in good working order;

- Used in accordance with their design and intention for which they were designed;
- Operated and/or driven by trained, competent and authorised operators/drivers. No unauthorised persons are to be allowed to drive construction vehicles and mobile plant;
- Provided with safe and suitable means of access;
- Fitted with adequate signalling devices to make movement safe including reversing;
- Provided with roll-over protection (where applicable);
- Inspected daily before start-up by the driver, operator and/or user and the findings recorded in a register/log book;
- Fitted with two head and two tail lights that are in good working condition and must be used whilst operating under poor visibility conditions;
- When used for transporting persons must have seats firmly secured and sufficient for the number of persons being transported.

Operators and drivers of construction vehicles and mobile plant must be in possession of a valid medical certificate declaring the operator and/or driver physically and psychologically fit to operate or drive construction vehicles and mobile plant.

No loose tools, materials etc. are allowed in the driver and/or operators compartment/cabin or in the compartment in which any other persons are transported.

No person shall ride on any construction vehicle or mobile plant otherwise than in a safe place provided thereon for that purpose. Employees shall only be transported if provision for seating and safety belts has been provided with an adequate canopy or rollover protection.

All construction vehicles and mobile plant left unattended at night, adjacent to a freeway in normal use or adjacent to construction areas where work is in progress, must have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, in order to identify the location of the vehicles or plant.

Bulldozers, scrapers, loaders, and other similar mobile plant must, when being repaired or when not in use, be fully lowered or blocked with controls in a neutral position, motors stopped and brakes set.

Self-Propelled Mobile Machinery

All Self-Propelled Mobile Machinery must be inspected daily and the findings recorded in a register. Pre-use inspection checklist shall identify critical items that would stop the operator from operating machinery should a defect be detected.

All operators shall be tested on their ability to operate machinery and equipment inspected prior to be used on any of the premises by the Johannesburg Water SOC Ltd Project Inspectors and Responsible Engineer. Relief drivers shall be made available for mobile machinery where there is a need for on-going operations and the contractor shall establish a rotation schedule.

All Drivers/Operators shall be appointed under the applicable legislation prior to operating any type of mobile equipment or machinery:

- If Driver/Operator does not adhere to the rules and regulations his appointment as operator shall be cancelled and he shall not be able to carry on with his duty.
- No Driver/Operator shall be appointed without proof of training, driver's licence or letter of competency.
- No training of Drivers/Operators on Site.
- No passengers on dump truck, Loaders or Excavators.
- No eating or drinking allowed while operating equipment.
- No vehicle shall be left unattended with engine running or key in ignition.
- Drivers may use no cellular phones during operations.

Equipment Approval

Authorization for the use of equipment shall be given in writing only after the following minimum requirements and documentation have been verified and shall as a minimum include the following:

- Minimum two lights in front and rear of vehicle
- Communications system (where required);
- Reflective Taping;
- First-aid kit, fire-fighting equipment and emergency roadside triangles;
- Tyres in good condition;
- Windscreen clear of cracks;
- Safety belts fitted for all occupants;
- Signage for clear identification;
- Windscreen wipers;
- Warning hooter and reverse alarm;
- Rotating warning lights (where applicable);
- Maximum number of persons indicated;
- Equipment free of oil and other leaks;
- Maintenance/Service & Equipment manuals available;

Operator Approval

Authorization for operators for the use of equipment shall be given in writing only after the following minimum requirements and documentation have been verified and shall as a minimum include the following:

- Operator's Certificate (accredited training organisation);
- Operators Licence appropriate to the nature of the Mobile equipment;
- Operator's knowledge tested and familiar with the controls for the vehicle;
- Public driver's permit where required;
- Medical fitness certificate.

20.19 Fall protection (Working in elevated positions)

A pre-emptive risk assessment will be required for any work to be carried out above **two metres** from the ground or any floor level. This work will be classified as "work in elevated positions".

As far as is practicable, any person working in an elevated position will work from a platform, ladder or other device that is at least as safe as if he is working at ground level. Whilst working in this position he shall be wearing a single belt with lanyard to prevent the person falling from the platform, ladder or other device. This safety belt will be, as far as is possible, secured to a point away from the edge over which the person might fall and the lanyard must be of such a length and strength that the person will not be able to move over the edge.

Alternatively, any platform, slab, deck or surface forming an edge over which a person may fall may be fitted with suitable guard rails at two different heights as prescribed in the relevant South African National Standard for the design, erection, use and inspection of access scaffolding.

Where the requirement in the paragraph above is not practicable, the person will be provided with a full body harness that will be worn at all times and shall be attached above the wearer's head at all times. The lanyard must be fitted with a shock-absorbing device or the person must be attached to a fall arrest system (anchorage connector; body wear; and connecting device) approved by Johannesburg Water SOC Ltd.

Where the requirements in the paragraph above are not practicable, a suitable catch net must be erected.

Employees working in elevated positions must be trained to work without risk to their health and safety or to the health and safety of others and be declared medically and psychologically fit to perform work at elevated positions.
Where work on roofs is carried out, the risk assessment must take into account the possibility of persons falling through fragile material, i.e. skylights and openings in the roof.

Access scaffolding

Access scaffolding must be erected, used and maintained safely in accordance with Construction Regulations and relevant SA Bureau of Standards Code of Practice.

Detailed consideration must be given to all scaffolding to ensure that it is properly planned to meet the working requirements, designed to carry the necessary loadings and maintained in a sound condition. Sufficient material must be available to erect the scaffolding properly.

Scaffolding must only be erected, altered or dismantled by persons who have adequate training and experience and are competent in this type of work and under the continuous supervision of such a person.

20.20 Structures

The Principal Contractor must ensure that:

- Only skilled employees are allowed to erect structures and that the skills of these employees are verified at regular intervals.
- Steps are taken to ensure that no structure becomes unstable or collapses due to construction work being performed on it or in the vicinity of it.
- No structure is overloaded to the extent that it becomes unsafe.
- He has received from the designer the following information:
    - Information on known or anticipated hazards relating to the construction work and the relevant information required for the safe execution of the construction work.
    - A geo-scientific report (where applicable).
    - The loading the structure is designed to bear.
    - The methods and sequence of the construction process.

All drawings relating to the design are on site and available for inspection.

20.21 Explosive powered tools

Every explosive powered tool must be:

- Provided with a guard around the muzzle to confine flying fragments or particles; and
- Must be fitted with a firing mechanism that will prevent the explosive powered tool from firing unless it is pushed against the surface and at the right angle. Where the explosive powered tool is fitted with an intermediate piston between the charge and the nail this requirement is waived.

The Principal Contractor or user must ensure that:

- Only the correct type of cartridge is used;
- The explosive powered tool is cleaned and inspected daily before use by an appointed competent person. The competent person will keep a register with the findings of his inspection and the details of cleaning, service and repairs;
- The safety devices are in good working order before the explosive powered tool is used;
- When the explosive powered tool is not being used it is stored in an unloaded condition together with the cartridges in a safe and secure place inaccessible to unauthorised persons;
- A warning notice is displayed at the point where the explosive powered tool is in use;
- The issue and return of cartridges must be by issue/returns register signed by both issuer and user and empty cartridge cases must be returned with unspent cartridges;
- Users and operators of the explosive powered tool have received the necessary training and has been authorised as competent to use/operate the explosive powered tool; and

- Users and operators must wear the prescribed personal protective equipment whilst using and/or operating the tool.

20.22 Bulk mixing plants (Batch plants)

- All contractors shall ensure that all bulk mixing plants are operated and supervised by a competent person who has been appointed in writing.
- All contractors shall ensure that the placement and erection of a bulk mixing plant complies with the requirements set out by the manufacturer and that such plant is erected as designed.
- All contractors shall ensure that all devices to start and stop a bulk mixing plant are provided and that these devices are:
- Placed in an easily accessible position; and
- Constructed in such a manner as to prevent accidental starting.
- The contractor shall ensure that the machinery and plant selected is suitable for the task and that all dangerous moving parts of a mixer are placed beyond the reach of persons by means of doors, covers or other similar means.
- No person shall be permitted to remove or modify any guard or safety equipment relating to a bulk mixing plant, unless authorized to do so by the appointed person.
- The contractor shall ensure that all persons authorized to operate the bulk mixing plant are fully aware of all the dangers involved in the operation thereof and conversant with the precautionary measures to be taken in the interest of health and safety.
- No person supervising or operating a bulk mixing plant shall authorize any other person to operate the plant, unless such person is competent to operate machinery.
- The contractor shall ensure that all precautionary measures as stipulated for confined spaces in “good safe practices” are adhered to when entering any silo.
- The contractor shall ensure that a record is kept of any repairs or maintenance to a bulk mixing plant and that it is made available, on site, to an inspector, client, client’s agent or employee upon request.
- The contractor shall ensure that all lifting machines and lifting tackle used in the operation of a bulk mixing plant complies with the requirements of the Regulations promulgated.
- The contractor shall ensure that all precautionary measures are adhered to regarding the usage of electrical equipment in explosive atmospheres, when entering a silo, as contemplated in the Regulations.

20.23 Working in proximity to Eskom power lines

- No mechanical equipment, including mechanical excavators, may be used under or in close proximity to Eskom's services without the prior approval of Eskom's authorized representatives. No excavations may be executed closer than 3 meters from any of Eskom underground electric power cables and 10 meters from Eskom overhead electrical power lines unless Eskom authorized representative is on site.
- No excavations may take place closer than 5m from any overhead line infrastructure (poles and stays and only excavation by hand will be allowed. Only excavation by hand will be allowed on the same route and in close proximity to the Eskom’s 132 kV cables.
- The use of explosives of any type within 500 meters of Eskom’s services shall only occur with Eskom’s previous written permission. If such permission is granted the applicant must give at least fourteen working days prior notice of the commencement of blasting. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued in terms of the blasting process.
- The contractor shall be liable for any death or injury to any person or for the loss of or damage to any property caused in whatsoever manner by the contractor, his employees, agents or sub-contractors. The contractor’s attention is drawn to section 27(3) of the Electricity Act 1987.
- The contractor is advised to negotiate a proper route with the CNC (Customer Network Centre. Lat Long co-ordinates of all proposed routes to be provided on site and during the application process. The contractor is

required to provide the same to the CNC on site during the signing of the Stakeholder On-Site Risk Identification Form.

- Parallel encroachment into overhead power line servitudes is limited to one meter from the boundary of the servitude. (Where applicable for underground pipelines only.)
- All Eskom servitudes to be kept clear of any obstacles and other services. No dumping, manholes and illegal structures whether occupied by equipment or humans, shall be allowed directly underneath or within Eskom servitude areas.
- Eskom Overhead Lines, Cables and Eskom Plant to be adequately protected against other services and water sources.
- Adequate protection fence should be installed around all Eskom Overhead Structures. The type of fence will be proposed and approved by Eskom CNC / Engineering as listed above.
- Interlocking bricks to be used along all roads and reserves as to ensure Eskom cables could be easily accessed for maintenance and repair / emergency purposes. No roads should be tarred with Eskom cables within the road.
- For developer projects and other works that might affect access to Eskom mini-subs, an appropriate fence with access / gate as approved by the CNC should be installed on street front side.
- The applicant shall ensure that the existing natural ground level is maintained within the Eskom servitude area and where Eskom cables are affected. Should there be a need for the lifting of lines and / or replacement of existing structures / cables and application should be made via **Eskom Customer Services**.
- The vertical clearance required between the road surface and the 11kV / 22kV power-lines shall be at least 6.4m. (Where applicable.)
- Eskom Plant and Cables to be protected from proposed landscaping i.e. no big trees and large plants / scrubs (large roots.) to be planted in close proximity to Eskom services.
- Construction / Amendment of boundary wall/s / fences to be closely monitored with guidance from the CNC – where walls / fences are in close proximity of Eskom Plant.
- At all entrances and road crossings, corrosion-free sleeves must be installed at least 600 mm below undisturbed ground level to provide for existing and future installation of Eskom cables. (Where applicable.)
- Cross trenches by hand need to be done for each road crossing on both sides of the road before the services are installed, to ensure Eskom services do not get damaged during drilling operations. For installations where the service will be installed parallel to Eskom services, cross trenches need to be done by hand at regular intervals, which is to be determined by site conditions and the Eskom PPM cables representative.
- The contractor must inform and update Eskom PPM cables on a weekly basis of the on-site work being planned and performed.
- Equipment shall be regarded electrically live and therefore dangerous at all times.
- Eskom may stipulate any additional requirements to illuminate any possible exposure to Customers or Public to coming into contact or be exposed to any dangers of Eskom plant.
- Security must be on-site 24/7 when trenching and working in close proximity to the Eskom 132 kV cables
- Extra care must be taken when working in close proximity to the 132 kV cables. (Eskom's PPM cables can assist in identifying these cables on-site.)
- The contractor in charge of the construction or maintenance work on site must at all times be in possession of the Approved Wayleave letter of the affected Eskom services, as well as all plans related to the wayleave application. This should be available upon the request of any Eskom and Municipal official, during site visits. If no approval is presented, then the Eskom Official(s) can order that all work to be ceased until approval can be presented.

20.24 Horizontal Drilling

- All HDD work shall be carried out under the supervision of a competent person.
- All employees involved in HDD shall be trained.

- A risk assessment as well as a method statement for the HDD shall be compiled and submitted for approval by the Client.
- Contractor will submit specifications on directional boring equipment to be used to ensure that the equipment will be adequate to complete the project. Spares inventory shall be included
- The directional boring equipment shall consist of a directional boring rig of sufficient capacity to perform the bore and pullback the pipe, a boring fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system.
- All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.
- The directional boring machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head.
- The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing.
- The hydraulic power system shall be self-contained with sufficient pressure and volume to power boring operations.
- Hydraulic system shall be free of leaks.
- Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.
- The rig shall be grounded during boring and pull-back operations.
- Sufficient spares shall be kept on hand for any break-downs which can be reasonably anticipated.
- The Guidance System shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system.
- The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.
- The Engineer must be notified 48 hours in advance of starting work.
- The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made.
- The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.
- It shall be the responsibility of Engineer to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

20.25 Pipe jacking / tunnelling

- No person may enter a tunnel, which has a height dimension of **less than 800 millimetres**.
- Pipe Jacking shall be supervised and undertaken only by persons fully conversant with this work.
- Pipe Jacking to comply to SANS standards (SPEC 1200 LG-1983), Mine Health and Safety Act. 29 of 1996 and Mineral and Petroleum Resources Development Act (Act 28 of 2002).
- Adequate ventilation and lighting must be provided to employee working inside the tunnel at all times.
- Employees involved in drilling and operation of jackhammers must be provided with ear muffs and shock absorbing gloves
- The launch and reception pits should be properly secured from collapsing, and must be inspected daily by a competent person appointed in writing.
- The working area must be completely fenced off and the pits must be adequately barricaded.
- Where there is presence of groundwater or mud, steel toed gumboots must be provided.
- Employees shall be trained by a competent person on the safe use of the Hydraulic Power pack or winch used to push the pipes
- Hydraulic power packs and winches shall be pressure and load tested and records thereof retained
- Detailed method statements for each area shall be submitted to Johannesburg Water prior to the commencement of the work.

- A calibrated gas tester/ oxygen measuring meter shall at all times be placed at the working area, and employees will be trained on the use thereof
- An adequate emergency procedure must be submitted to Johannesburg Water prior to the commencement of the work.

20.26 **WATER ENVIRONMENTS**

- The contractor must ensure that where construction work is done over or in close proximity to water, provision is made for—
    - preventing persons from falling into water; and
    - the rescuing of persons in danger of drowning.
- The contractor must ensure that where a person is exposed to the risk of drowning by falling into the water, the person is provided with and wears a lifejacket.

21. Monthly reporting

- The Principal Contractor is required to provide Johannesburg Water SOC Ltd. with a monthly report in the format provided on the last working day of the month.
- The report will include the monthly man-hours, incidents, training, inductions, audits, etc

22. Project close out

- Upon completion of the project, the contractor is required to hand over a consolidated project file to the Client with all the working documents for retention.

Returnable Annexure A: Acknowledgement of SHE Specification & Annexures

CONTRACTOR:	

I, the undersigned, hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and the consequences of non-compliance. The Contractor furthermore reiterates its commitment to compliance of the requirements contained within the following provided documentation:

- Johannesburg Water SOC Ltd, Occupational Health and Safety Specification, Volume 2;
- Annexure 1: Baseline Risk Assessment
- Annexure 2: Medical Screening Policy

Signed at …… on this …….. Day of …… 20……...

CONTRACT MANAGER			
NAME	DESIGNATION	DATE	SIGNATURE
CONTRACT SUPERVISOR			
NAME	DESIGNATION	DATE	SIGNATURE
WITNESS (1)			
NAME	DESIGNATION	DATE	SIGNATURE
WITNESS (2)			
NAME	DESIGNATION	DATE	SIGNATURE

OHS CONTRACTORS' MANAGEMENT SYSTEM				
TENDER DOCUMENT SHE SPECS SIGN-OFF FORM				Johannesburg Water
REQUESTED BY	**Sijabuliso Tshuma**	**DATE**	**17/05/2024**	**JW 14358**

JW 14358: CONSTRUCTION OF WOODMEAD INLET BULK WATER PIPELINE

LIST OF SHE SYSTEM ATTACHED TO THE TENDER DOCUMENT

SHE SYSTEM ATTACHED	Y/N	VERSION	NO PAGES	REMARKS
Volume 2 SHE Specification & Acknowledgement Form	Y	V2 – 09/16	45	For info
Baseline Risk Assessment	Y	V01 – 05/15	18	For info
Medical Screening Policy	Y	V01 – 05/15	8	For info
Returnable Annexure A	Y	V02 - 02/20	1	Return with tender document