ATHI WATER WORKS DEVELOPMENT AGENCY(AWWDA)

MINISTRY OF WATER, SANITATION AND IRRIGATION (MWSI)

In partnership with

FRENCH DEVELOPMENT AGENCY

BIDDING DOCUMENTS

for

Procurement of

Construction of Eastern Nairobi Water and Sewerage Network Intensification Project

VOLUME II - TECHNICAL SPECIFICATIONS

IPC No : AWWDA/AFD/NWSP/W-01/2022

Project : CKE1135-NAIROBI WATER AND SANITATION PROJECT

Employer: ATHI WATER WORKS DEVELOPMENT AGENCY

Country: KENYA

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EMPOWERING THE NATION

PART 2 – Works Requirements

Section VII – Works Requirements

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TECHNICAL SPECIFICATIONS

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a) GENERAL REQUIREMENTS

1.1. Specifications Background

The specifications outlined hereunder have been adopted from the following BS EN, Standards, Kenyan Standards and other applicable Codes and Practice and Design Manuals:

- Ministry of Water and Irrigation – Practice Manual for Water Supply services in Kenya, October 2006.
- Practice Manual for Sewerage and Sanitation Services in Kenya (2008)
- Other Internationally acceptable standards;

The references are used in a complementary manner. Where requirements of two or more codes or standards are found to conflict, the more stringent of them is adopted for the purpose of this project.
Whenever reference is made to "The Engineer" (or "The Resident Engineer") or "The Engineer's Representative" in the specifications, it shall be construed to mean "The Project Manager" or "The Project Manager's Representative" respectively.

1.2. Schedule of Standards

The materials covered by this Specification are to be of a quality equal in all respects to the latest editions at the time of Biding of the following British Standards and other references or to any other widely accepted standard specification, which in the opinion of the Engineer, maintains an equal or better standard of quality: -

REFERENCE	TITLE
BS EN 197-1:2000	Portland cement composition, specifications and conformity criteria
BS 88	Cartridge fuses for voltage up to and including 1000 V a c and 1500 V d c
BS.89	Direct acting indicating electrical measuring instruments and their accessories.
BS 148: 1984(1992)	Specification for unused mineral Insulating oils for transformers and switchgear
BS 5486	Low voltage switchgear and controlgear assemblies
BS EN 60298: 1996	A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
BS. 7354: 1990	Code of practice for design of high-voltage open-terminal stations
BS 171	Power transformers
BS 7263	Precast concrete flags, kerbs, channels, edgings and quadrants
BS EN 124: 1994	Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control.
BS EN 10244/BS3601	Specification for steel pipes, joints and specials for water and sewage.
BS 5911	Precast concrete pipes, fittings and ancillary products.
BS 729: 1971 (1994)	Specification for hot dip galvanised coatings on iron and steel articles
BS 743: 1970	Specification for materials for damp-proof courses
BS 747: 1994	Specification for roofing felts

REFERENCE	TITLE
BS 812	Testing aggregates
BS 882: 1992	Specification for aggregates from natural sources for concrete
BS 952	Glass for glazing
BS 6925: 1988	Specification for mastic asphalt for building and civil engineering (limestone aggregate)
BS 6510: 1984	Specification for steel windows, sills, window boards and doors
BS 1125: 1987	Specification for WC flushing cisterns (including dual flush cisterns and flush pipes)
BS 1142: 1989	Specification for fibre building boards
BS 1186	Timber for and workmanship in joinery
BS EN 545: 1995	Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods.
BS EN 598: 1995	Ductile iron pipes, fittings, accessories and their joints for sewage applications. Requirements and test methods.
BS 5642	Sills and copings
BS 1243: 1978	Specification for metal ties for cavity wall construction
BS 1244	Metal sinks for domestic purposes
BS 1247	Manhole steps
BS 1254: 1981	Specification for WC seats(plastics)
*BS1377	Methods of test for soils for civil engineering purposes
BS EN 612: 1996	Eaves gutters and rainwater down-pipes of metal sheet. Definitions, classifications and requirements.
BS 6566	Plywood
BS 1521: 1972 (1994)	Specification for waterproof building papers
BS 1560	Circular flanges for pipes, valves and fittings (class designated)
BS 4987	Coated macadam for roads and other paved areas.
BS 1722	Fences
BS 1868: 1975 (1991)	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
*BS 1881	Testing concrete
*BS 6073	Precast concrete masonry units
BS EN 971	Paints and varnishes. Terms and definitions for coating materials
BS 7664: 1993	Specification for undercoat and finishing paints
BS.7668: 1994	Specification for weldable structural steels. Hot finished structural hollow sections in weather resistant steels.
BS EN 10029: 1991	Specification for tolerances and dimensions, shape and mass for hot rolled steel plates 3 mm thick or above
BS. EN 10113: 1993	Hot rolled products in weldable fine grain structural steels
BS 4449: 1988	Specification for carbon steel bars for the reinforcement of concrete
BS 4466: 1989	Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete
BS 4482: 1985	Specification for cold reduced steel wire for the reinforcement of concrete
BS 4483: 1985	Specification for steel fabric for the reinforcement of concrete

REFERENCE	TITLE
BS 4504	Circular flanges for pipes, valves and fittings (PN designated)
BS 4576	Unplasticized polyvinyl chloride (PVC-U) rainwater goods and accessories
BS EN 969: 1996	Specification for ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods.
BS 5075	Concrete admixtures
BS 5150: 1990	Specification for cast iron gate valves
BS 5153: 1974 (1991)	Specification for cast iron check valves for general purposes
BS 5155: 1984 (1991)	Specification for butterfly valves
BS 5163: 1986 (1991)	Specification for predominantly key-operated cast iron gate valves for waterworks purposes
BS 5328	Concrete
BS 5493: 1977	Code of practice for protective coating for iron and steel structures against corrosion
BS 5492: 1990	Code of practice for internal plastering
BS 6004: 1995	Specification for PVC-insulated cables (non-armoured) for electric power and lighting
*BS 8007	Code of practice for design of concrete structures for retaining aqueous liquids
BS 8110	Structural use of concrete
BS. 8206	Lighting for buildings
BS. 8204	Screeds, bases and in-situ floorings

1.3. Project Location and Area Characteristics

1.3.1. Location

The project is located in Nairobi City which is the capital center of the Republic of Kenya, located about 140Km south of the Equator and approximately 500Km west of the Indian Ocean City of Mombasa. It is one of the 3No. Cities in the country. It borders Kajiado County to the South, Kiambu County to the North & West and Machakos to the East. It occupies a total area of about 703.9Km2 between longitudes 360 45' East and latitudes 10 18' South. Nairobi County is one among the five counties (Kiambu, Kajiado, Machakos and Muranga) under the Nairobi Metropolitan region and considered as an important regional center for trade, commerce, integration and economic development.

The project is in Pressure Zone 10S which consists of the following sub-locations of the Nairobi County.

1. Mihango
2. Ruai
3. Ngundu

Mihango sub-location is in Embakasi East Sub County while Ruai and Ngundu are located in Kasarani Sub County. Towards South East, the zone borders Jomo Kenyatta International Airport. The average size of the area to be supplied is 125Km2.Zone 10S is located to the South East of Nairobi City. Nairobi is the capital and largest city of Kenya. The city and its surrounding area form the Nairobi County. The City is located at 1°17′S 36°49′E / 1.283°S 36.817°E / Lat -1.283; Long 36.817 and occupies an area of It is situated at an average of 1661metres above sea level.

1.3.2. Climate.

The rainfall pattern of the area is bimodal with wet seasons in March to May and mid-October to mid-December. The area is generally semi-arid and experiences hot and dry weather for most of the year, receiving very little and erratic precipitation. The average rainfall is about 785mm per annum. Mean temperatures range between12.5°C (minimum) to 25.5°C (maximum). Relative humidity ranges between 65% and 84%.

1.3.3. Topography.

The project area is mainly comprised of rolling plains that vary in elevation from 1610masl at the South-Eastern side, near airport to the low areas near Mbagathi River in Ngundu at 1461 masl. The South-Western Side of Kangundo Rd is on much higher ground.

1.3.4. Soils and Vegetation

The soils within the area have been developed on infill from volcanic ashes and are poorly drained, shallow to very deep, black cotton soil. This comprises moderately to strongly calcareous, slightly sodic clays. Kunkar nodules develop where the clays are leached. Much of the natural vegetation has disappeared, but where found consists of pure grasslands, sometimes with very scattered bushes. The area has some medium sized indigenous trees. There is a variety of wild animals in the area including gazelles, zebra, giraffe and a variety of birds.

1.3.5. Health Access

Kenyatta National Hospital is the major referral hospital in Nairobi and Kenya. There are more than 16 sub- County hospitals, 9 mission, 32 private, 15 nursing homes, 38 public health centers as well as 45 private health centres. The County has more than 30 public dispensaries, 84 private clinics and 22 public clinics. Kenyatta National Hospital has a total bed capacity of 1,800. Level 5 hospitals in the County have a bed capacity of 750. The doctor patient ratio stands at 1:7,816.

1.3.6. Education

The City of Nairobi is very vibrant on the education front. This is demonstrated by high concentration of tertiary and university level institutions with science and technology institutions being more than 237. There are more than 1,235 functional primary schools while the number of secondary schools is 319. Additionally, there are more than 1 million students in one form or another in Nairobi.

1.3.7. Existing Water Supply Infrastructure

The first recorded water source for Nairobi was commissioned in 1899, based on the Ngong River (Nairobi Dam) in the Athi catchment. This produced small quantities of poor quality water and was later abandoned.

During the period 1900 to 1906 the Kikuyu Springs located 18 km from the city were developed to produce approximately 4500 m3/day which was sufficient for Nairobi's needs until the late 1930's.

In 1938, the first phase of development of a source based on the Ruiru River- an intake weir and pipeline was completed. This source was further developed by commissioning a second pipeline in 1946, and a third pipeline then Ruiru Dam in 1949.

The next major source, Sasumua Dam was initially fed by Sasumua River, supplemented by water diverted from the head - waters of the Chania River. The Project included a water treatment plant works adjacent to the dam and a pipeline which deliver treated water to the terminal reservoir at Kabete in Nairobi. This project was completed in 1956. Subsequent developments have included raising the dam, diverting the Kiburu River into Sasumua and increasing the capacity of the treatment works, pipelines and terminal reservoirs.

When Sasumua yield was fully exploited, the next source of water which was developed is the Chania River, initially by pumping from the river at Ngethu, followed by a diversion dam, at Mwagu which transfers water to Ngethu treatment works by gravity via a three meter diameter tunnel and a 1400 mm pipeline. This project was completed in 1984. After completion of the Mwagu Diversion Dam, the associated tunnel and pipeline conveying raw water to Ngethu, the total available water to Nairobi was close to the demand. Then Thika Dam was developed and commissioned in 1994 to feed the Mwagu / Ngethu system.

The Northern Collector Phase 1 and Phase 2 were planned to be implemented in 2001 and 2006 respectively but the implementation of this project stalled, and was subsequently begun in 2015.

In the meantime, Nairobi is faced with chronic water shortage resulting to water rationing in most parts of the City.

The coverage in Eastern Nairobi is limited. This is attributed mainly to insufficient water supply. There is a DN300 running along Kangundo Rd up to Ruai town serving as the main trunk line. Nairobi City Water and Sewerage Co. has put effort to provide secondary and tertiary service lines in Ruai and Upper area of Mihango along Kangundo road.

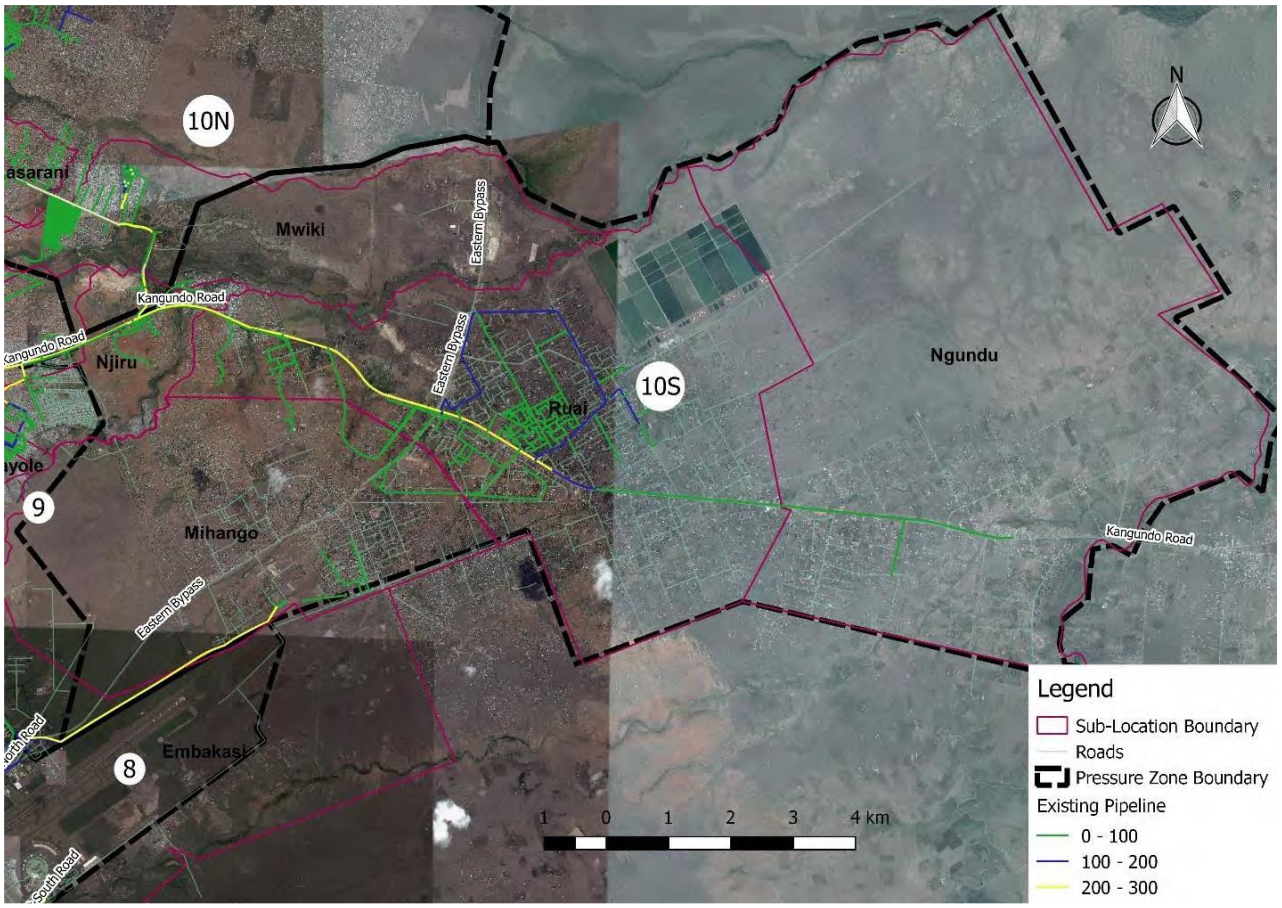


Figure 1.1 above also illustrates the existing coverage in pressure zone 10s

1.3.8. Existing Wastewater Infrastructure

The existing sewer network comprises a trunk sewer system that has a total length of about 162.7 km and covers an area of about 208 km2 which essentially covers only 40% of the city area served with water. The problems in the system are non-functional sewers due to washed away sections, accidental breakages or deliberate vandalism of manhole covers, blockages due to deliberate dumping of solid waste or accidental entry of stones and boulders into open manholes and also blockage of sewer lines by urban farmers to catch sewage for irrigation and overflowing of sewers due to insufficient capacity.

There are number of Sewage Treatment Plants within Nairobi, the main ones being the Dandora Estate STW, Kariobangi STW, Kahawa West STW and Karen STW.

The DESTW has a design capacity of 160,000m3/day and handles an average flow of 73,255m3/day. While the Kariobangi plant has a design capacity of 32,000m3/day and handles an average flow of 11,000m3/day, the plant is in the process of being rehabilitated and all its sewage is currently being diverted to the DESTW.

The sewage treatment plants are operating at very low efficiency, despite the fact that they receive flows below their design capacity. Other treatment plants have broken down with the sewage having to be diverted to other treatment plants. It has been suggested that this may be attributed to poor maintenance, high organic loading and influence of industrial discharges.

Sanitation facilities other than the waterborne system described above in use in Nairobi include Septic Tanks and Pit Latrines.

The main areas that are served by septic tanks in Nairobi are mostly those that are not covered by the sewerage network or sewers have just been built. This include Muthaiga, Lower Kabete, Karen, Githurai, Zimmerman, Kasarani, Garden Estate, Thome, Ridgeways, Runda, Ruaka, Utawala and Ruai. Pit Latrines are also in use in informal settlement areas.

1.3.9. Project Components

The water supply and sewer system proposed caters for the already built up areas and those that are in the process of being developed.

The water supply networks is a pressure system. Also, most areas where the sewer network has been proposed, the topography offers sufficient drainage of the Project area through gravity. In most cases, the sewers have been planned to follow the road reserves and recognizable storm water drainage riparian reserves.

1.3.10. Sewer Component

a) Laying of approximately 46km of sewer works ranging from DN 300 to DN 600 DWC pipes
b) Installation of approximately 1225 manholes
c) Establishing 1405 no of consumer connections

1.1.1. Water Component

The water distribution network construction will involve:

a) Laying of approximately 210km distribution network pipeline ranging from DN 800mm to DN 63mm in Embakasi, in the areas of Mihango, Utawala, Ruai, Njiru, Ngundu and Kamulu.
b) Establishing 1903 No of consumer water connections

1.2. Quality and Approvals

The materials and workmanship shall be the best of their respective kinds and to the approval of the Project Manager. The words “to the approval of the Project Manager” shall be deemed to be included in the description of all items relating to design, construction, installation and materials and workmanship for the due execution of the Works.

The Contractor shall submit all data, details and samples as necessary and as reasonably requested by the Project Manager of all materials that the Contractor proposes to use in the Works. Method statements which adequately demonstrate the Contractor’s proposed method of working, methods of maintaining safety and compliance with the programme shall be submitted for the Project Manager’s approval prior to the commencement of work on any area of the Site.

Where the Contractor is responsible for the preparation of Construction Documents to describe the permanent works such Construction Documents shall be approved prior to the procurement of any materials or commencement of any work to which the documents relate.

No materials, Plant or equipment shall be procured for the Contract and no work, permanent or temporary, shall commence without first obtaining the Project Manager’s approval.

All materials, Plant and equipment supplied shall be designed for operation under the above described conditions.

1.3. Construction Documents

Drawings and Documents which are to be submitted by the Contractor to describe the Permanent Works shall become Construction Documents upon their approval.

All drawings, technical specifications, bill of quantities, schedules, cost estimates; programme and other information to be submitted by the contractor shall be in English and shall be submitted for approval in triplicate. Following approval, the contractor shall supply a further five copies to the Project Manager. Construction Documents shall not be departed from without the approval of the Project Manager.

All drawings and documents submitted by the Contractor shall have been checked, signed and be ready for issue and shall bear:

- Title of the drawing or document;
- Scale;
- Date;
- Work item reference number complying with an approved numbering system;
- Name and references of the Contractor;
- Names of the employer and the Project Manager;
- Date of approval by the Contractor and the signature of the person responsible for approval.

Drawings and documents submitted for approval shall be delivered to the Project Manager’s office as designated by the Project Manager.

Unless otherwise specified the Contractor shall allow a minimum of 7 days, after the date of receipt by the Project Manager for approval of drawings and documents by the Project Manager.

1.4. Operation and Maintenance Manuals

The Contractor shall submit to the Project Manager for approval six copies of the Operation and Maintenance (O&M) Manuals as described in Clause 58 of the Contract Data.

The Contractor shall supply the final version of the O&M Manuals prior to the issue of the Taking-Over Certificate for either the whole of the Works or the respective Section or part of the Works. Each set shall be bound together in a stout plastic or other approved cover.

O&M Manuals shall be supplied written in English language, all parts and equipment listings shall be in English.

1.5. Level Datum

Before the commencement of construction work, the Contractor shall establish, in a position to the approval of the Project Manager, steel datum pegs which shall be securely concreted in. The level of these pegs shall be established and agreed with the Project Manager and all levels used in the construction of the Works shall be referred to these established datum points. The correctness of this datum shall be checked at regular intervals during the construction period as agreed with the Project Manager.

Where possible construction drawings and all levels used for construction shall be referred to the national height datum as defined by the Survey of Kenya. The Contractor shall be responsible for obtaining the location and values of the permanent bench marks. In cases where such bench marks do not exist, the site datum shall be agreed with the Project Manager.

1.6. Setting Out of the Works

The site layout drawings show indicative site layouts. Prior to commencing construction, the Project Manager will agree with the Contractor the basic information supplementary to that shown on the Drawings such as the position of manholes, chambers, centre-lines and base-lines sufficient for the Contractor to locate the Works.

The Contactor shall prepare detailed setting out drawings and data sheets as necessary and submit them to the Project Manager in triplicate for approval. Any modifications to the setting out drawings or data sheets required by the Project Manager shall be made by the Contractor and resubmitted for final approval. Should it be necessary during setting out or during construction for the approved setting out details to be amended, the Contractor shall amend the drawings or data sheets or make new ones for approval as required by the Project Manager.

For pipelines, the Contractor shall in the presence of the Project Manager set-out the pipeline alignments in accordance with the indicative alignments shown on the drawings taking into account physical features on the ground, any existing services, any requirements of relevant Authorities and any changes deemed necessary by the Project Manager, confirming the locations of all valves, air valves, washouts, hydrants and bends.

The Contractor shall prepare and submit to the Project Manager, at an approved scale, plans of the pipeline route and profiles of ground levels after any initial clearing of the wayleave or easement showing the proposed pipe invert levels and precise chainages for all valves and fittings for approval. Following approval, the Contractor shall submit to the Project Manager two copies of the agreed alignment and profiles.

1.7. Boundaries of Works

The Employer shall provide the Site upon which the Permanent Works are to be constructed. Where a drain or pipeline is to be within an existing road or track reservation or is otherwise located in land designated Public Domain the Site width will be restricted to the limit of the public land. The existing boundary fences and walls shall not be disturbed without prior approval of the Project Manager and, unless road diversions and closure notices are approved and posted, carriageways shall be left available for the safe passage of traffic.

The Contractor shall not enter upon or occupy with men, tools, equipment or materials any land other than the site without the written consent of the owner of such land.

On occupation of the Site or other land the Contractor shall provide such fencing, as required.

1.8. Public Utility Mains and Services

Where the Contract indicates the positions of existing services or apparatus the positions shown are believed to be correct but no warranty is given as to the accuracy or completeness of the information.

It shall be the responsibility of the Contractor to obtain all information available from the Public Utility Authorities regarding the position of existing mains and services and he shall copy this information to the Project Manager as soon as he obtains it.

The Contractor shall carry out excavation works in a manner which safeguards any existing services, including hand excavation as necessary and shall be responsible for the cost of any repair work necessitated by damage caused by him to any main or service and for any costs arising from the disruption.

The Contractor shall obtain all information and assistance from the Public Utility Authorities for the locating of the mains and services and shall agree with the Project Manager any trial excavation which may be necessary to confirm or establish these locations.

The Contractor shall be responsible for locating all existing services, whether known to the Public Utility Authorities or not, and shall conduct his own survey as necessary to accurately locate all services. All efforts to identify these existing services shall be carried out in advance of conducting excavation for the permanent works.

Any temporary or permanent diversion of mains and services shall be agreed with the appropriate Authority.

1.9. Safeguards to Existing Pipes, Cables, Structures

It shall be the Contractor's responsibility to safeguard by means of temporary or permanent supports or otherwise all existing sewers, pipes, cables, structures or other things which would be liable to suffer damage if such precautionary measures were not taken.

Safeguards shall be to the approval of the Project Manager and of the undertaker or owner concerned.

1.10. Record Drawings

At all sites and any locations where the Contractor executes work under the Contract, including locations where the Contractor undertakes repair or rehabilitation work, the Contractor shall record the location and nature of all water supply and wastewater works including their ancillaries and any associated services.

Where instructed by the Project Manager for the purpose of producing Record Drawings, the Contractor shall undertake such surveys and investigations to determine the location of existing services. Such surveys and investigations shall be additional to those surveys and investigations undertaken by the Contractor for the purpose of determining the location of services prior to excavation.

The Contractor shall where necessary utilize appropriate equipment and where instructed by the Project Manager excavate trial pits to confirm the location and determine the size and nature of the buried services.

For sites where the Contractor undertakes permanent works Record Drawings shall be submitted to the Project Manager, for approval, in the form of As Built Drawings. In the case of repairs and rehabilitation the Record Drawings shall be submitted for approval within a period of 21 days following execution of the work.

Record Drawings shall be prepared to an approved format, and scale in line with the construction drawing. The drawings shall be submitted in CD-ROM both as PDF and DWG.

1.11. Connections to Existing Pipes, Cables and Equipment

The Contractor shall be responsible for joining up and making connections between pipes and cables laid by him and existing pipes and cables. The Contractor shall submit to the Project Manager a drawing showing the details of the connection, and shall state the date on which the particular connection is required, and the work shall not proceed until the Project Manager's approval has been given.

The Contractor shall be responsible for ensuring the compatibility of new pipes and cables with existing pipework, cables, tubing and equipment.

1.12. Connections to Existing Pipes, Cables and Equipment

The Contractor shall be responsible for joining up and making connections between pipes laid by him and the existing pipes. The Contractor shall submit to the Project Manager a drawing showing the details of the connection, and shall state the date on which the particular connection is required, and the work shall not proceed until the Project Manager's approval has been given.

The Contractor shall be responsible for ensuring the compatibility of new pipes with existing pipework.

1.13. Lighting, Watching and Traffic Control

Where necessary for safety of the public or where required by the Project Manager, the Works shall be properly fenced and the relevant signage included. In addition, the Works shall be lighted from half an hour before sunset until half-an-hour after sunrise and at other times when visibility is poor. The position and number of the lamps shall be such that the extent and position of the Works are clearly defined. Each Site shall be provided with watchmen as required.

1.14. Contractor's Offices

The Contractor shall provide and maintain offices for the use of his representative and staff to which written instructions by the Project Manager can be delivered. Any instructions delivered to such offices shall be deemed to have been delivered to the Contractor.

Offices shall be located to give convenient access to the Works and shall be subject to the approval of the Project Manager. The Contractor shall be responsible for obtaining the land on which to establish any temporary site offices.

1.15. Project Manager's Office

The offices of the Project Manager shall comprise reception area, three offices, a meeting room, kitchen and one separate special WC. They shall be served with electric lighting power, potable water and networked broadband internet connection. The broadband connection shall be networked throughout the office to allow up to six computers to access the network. A wireless network is acceptable.

The Contractor shall make adequate provision for the drainage of rainwater, sink waste (grey water) and foul sewage. Fly screens shall be fitted on every opening window and steps shall be provided where the entrance is elevated above ground level. The Contractor shall arrange for the regular cleaning of the facilities and the removal of the solid waste. He shall maintain all equipment in working order throughout the duration of the contract and arrange for the supply of all consumables including mobile phone airtime vouchers, stationery, etc.

Each of the three offices, office 1, office 2 and office 3 shall have a minimum covered floor area of 20 m^2 ,12 m^2 and 12 m^2 respectively and each shall contain the following:

Office 2 and 3	Office 1
1 x double pedestal desk	2 x double pedestal desks
3 x chairs	6 x chairs
1 x 4 drawer lockable filing cabinet	2 x 4 drawer lockable filing cabinet
1 x 5 tier shelving unit to take A4 files	2 x 5 tier shelving unit to take A4 files
1 x plan table	1 x plan table

Note that an additional office, similar to Office 2/3, shall be provided for the resident sociologist/ outreach consultant who shall be undertaking field Community Outreach activities.

The meeting room shall have a minimum covered floor area of 20m^2 and shall contain the following:

- 1 x table (or tables of the same size) to accommodate 12 persons with 12 chairs
- 1 x wall mounted pin board, 2m x 1m
- 1 x wall mounted white melamine board, 2m x 1m
- 1 x AO size vertical plan chest
- 1 x A3/A4 colour printer/photocopier/scanner/fax
- 1 x standing desk

The kitchen shall be equipped with a sink, a 4 burner gas cooker, electric kettle and fridge together with appropriate work surfaces.

The separate WC shall be equipped with a low level WC suite with dual flush. Automatic air ventilation shall be provided where there is no opening window.

Other equipment to be supplied for the sole use of the Project Manager shall include:

Furniture:	**No**
Office paper punch	3 Nr
Whiteboard, 2.4m x 1.2m	1 Nr
Whiteboard, 1.2m x 1.2m	1 Nr
Office Tray (3 tier)	4 Nr
Office Stapling Machines	4 Nr
Steel File Cabinet with locks / 4 drawers ('Mecol' or equivalent approved)	3 Nr
'Casio' or similar small portable scientific electronic calculator	4 Nr
'Casio' or similar small portable electronic calculator	2 Nr
First Aid kit (for 10 persons) in Metal Box	5 Nr
Potable Fire Extinguisher (5 litres)	5 Nr
Small office scissors	3 Nr
Waste paper baskets	4 Nr
Electric kettle (capacity to make 12 cups of tea)	2 Nr
Coffee/Tea making facility including crockery for all supervisory staff 6 Nr. and 12 additional guests	1 Nr
Pedastal electric fan, size 400mm	4 Nr
'Samsung' or equivalent approved Refrigerator (0.2 cu.m. capacity)	2 Nr
Desktop: Inspiron 24 5000 Black All-In-One with Bipod Stand Windows 11 Office, English Intel® UHD Graphics with shared graphics memory 8GB, 8Gx1, DDR4, 2666MHz 1TB 7200 rpm 2.5" SATA Hard Drive Non-Touch Black	3 Nr

Laptop: HP ENVY Laptop 17-ch0011nr Windows 11 Office, English 11th Generation Intel® Core™ i7 processor Intel® Iris® Xᵉ Graphics 16 GB memory; 1 TB SSD storage 17.3" diagonal FHD touch display	6 Nr
Printer: HP Color LaserJet Enterprise M554dn Printer	2 Nr
Petty Cash Box with security lock	1 Nr
Wall Clock	3 Nr
Flashlights (battery powered)	3 Nr
Digital Camera as specified	2 Nr

The Contractor shall provide a local Secretary who is conversant with the use of above-mentioned furnitures for the duration of the Contract.

Stationery required per month as follows:

Stationery	**No.**
Photocopy paper A4	4 Reams
A3 paper	5 Ream
Biro pens blue/black	5 Doz.
Box files	4 Nr
Spring Files	2 Nr
Document Wallets	3 Nr
Cellotape (medium)	1 Nr
Masking tape (medium)	1 Nr
Staples	2 Pac.
Paper clips (various sizes)	2 Pac.
C-DR (Pack of 12)	1 Pac.
CD-RW (Pack of 12)	1 Pac.
Highlighters (set of all colours)	2 Sets
A6 hardcover notebooks	2 Nr
Soft Pencil Erasers (Staedtler or equivalent)	3 Nr
Envelopes (all sizes)	3 Doz.
Batteries for flashlights	3 Sets
Colour and Black ink cartridges for the A3 printer	1 Set
Black ink cartridge/ toner for the A3 printer	3 Nr

Supply of clean towels every day, soap, lavatory paper, disinfectant, cleaning materials, tea/ coffee, milk, drinking water, refreshments etc is to be provided and maintained throughout the Contract Period for all the offices. The List of Provisions and Consumables will be given by the Resident Engineer every month.

The cost of all the above services shall be included by the Contractor under item for maintenance and attendance for Resident Engineer's offices. Apart from the consumables, the rest of equipment will revert to the Employer at the end of the Contract.

The Contractor shall provide adequate space and facilities at a convenient location for meetings between the Project Manager and Contractor.

The Project Manager's office shall be in a well-lit, surfaced, fenced and secure compound with sufficient dedicated parking for 6 vehicles.

The compound shall be provided with 24-hour manned gate security to the approval of the Project Manager. All property shall be insured against theft of equipment and other materials from the offices.

The cost of all the above services shall be reimbursed to the contractor under Bill No. 1 – Preliminaries and General.

1.16. Vehicles for the Project Manager

The Contractor shall provide and maintain for the duration of the Contract vehicles for the use of the Project Manager. At the conclusion of the Contract the vehicles will be handed over to the Employer in a fully serviced and roadworthy condition, free from defects. Selection of vehicles shall be agreed with the Project Manager at the commencement of the contract and at minimum will be:

1. Double Cab Vehicle	
Engine Capacity:	2800cc
Number of cylinders:	DT5
Fuel type:	Diesel
Transmission:	Automatic/Manual
Fuel tank capacity:	80L
Front brakes:	Disc - Ventilated
Rear brakes:	Drum
Front suspension:	Coil Spring, double wishbone, hydraulic double acting shock absorber
Rear suspension:	Hydraulic Double Acting Shock Absorber, leaf spring
2.Sports Utility Vehicle (SUV)	
Engine Capacity:	3000cc
Engine Type:	V engine
Number of cylinders:	8
Fuel type:	Diesel
Transmission:	All time 4x4
Fuel tank capacity:	93L + Additional fuel tank of capacity 45L
Front brakes:	Ventilated discs
Rear brakes:	Ventilated discs
Front suspension:	Double triangle
Rear suspension:	Coil type

1.17. Drivers

The Contractor shall provide licensed drivers for the exclusive use of the Resident Engineer or his authorized representative. The drivers shall be available at all times during normal working hours and when specifically required by the Resident Engineer or his authorized representative, outside these hours.

The drivers shall have a minimum 10 years of clean driving record and a Certificate of Good Conduct from the Kenya Police. The drivers are to be employed and paid by the Contractor (including all overtime, NSSF, NHIF, etc.) but will report directly to the Resident Engineer for day to day instructions. The Resident Engineer will interview, test and approve the drivers prior to their deployment on the Works.

1.18. Contractor's Yards, Stores and Accommodation for Workmen

The Contractor shall be responsible for obtaining the land and for the provision of all temporary yards, stores, workshops, offices, mess rooms, shelters and for all services in connection therewith. The location of all such facilities shall be agreed beforehand with the Project Manager and shall be such as to avoid obstruction and nuisance to the public.

The Contractor shall construct secure storage compounds and storage building where he shall store at his own risk all equipment and Plant awaiting erection. The Contractor shall also provide secure covered storage for all samples submitted to the Project Manager for approval. Storage building shall be weatherproof and shall be of sufficient size to accommodate all items requiring covered storage.

The Contractor shall provide and maintain suitable and sufficient shelters and mess rooms for his workmen and supervisory staff as are customary and necessary. The Contractor shall provide sufficient closets or latrines to the satisfaction of the relevant authority. They shall be properly screened and maintained in a clean and sanitary state at all times. The Contractor shall be responsible for making all arrangements for the proper disposal of waste.

1.19. Water and Electricity Supplies

The Contractor shall make all arrangements for and provide adequate supply of potable water to each site as necessary for the execution and testing of the Works and for use by his workmen.

The Contractor shall make arrangements for and provide any electricity supply required for the execution of the Works, including the Tests on Completion.

1.20. Contractor's Staff and Workmen

The Contractor shall agree to employ Kenyan workers to the maximum extent possible. The Contractor shall provide a competent Site Agent to the approval of the Project Manager to be in charge of the work who shall not be changed except with the consent of the Project Manager.

The Contractor agrees that his workmen and employees shall be considered for all purposes in his direct pay and employment and under his supervision and control. He shall be directly and personally responsible for discharging all obligations, financial or other, which may be or becoming owing to any such workman or employee or to his successors, assignees or personal representatives. There shall be no contractual or legal relations of any kind whatsoever between the Employer and any such workman, employee or any person employed in the performance of the Contractor's obligations under this Contract.

The Project Manager may request and the Contractor agrees to accept the request for the immediate removal from the site of any employee or worker of the Contractor adjudged by the Project Manager to be incompetent, disorderly, and unreliable or of bad character. Such employee shall not again be employed on the Works.

1.21. Training of Employers Workmen

The Contractor shall make provision for the on-site training of up to 3 of the Employer's staff as directed.

1.22. Project Management

1.22.1. Project Control

The Contractor shall provide within his site organization a project management capability to advise and be directly responsible to the Site Agent. (Contractor's chief site representative). The duties of the section shall include the following:

a) Planning and programme preparation particularly in relation to the requirements of

the Employer and the public authorities, and the requirements to maintain water supply and wastewater disposal services where careful detailed arrangements have to be made and adhered to;

b) Planning the execution of the Works in a manner which minimizes disruption to the water supply systems and will permit the efficient and effective commissioning of the water supply systems and their respective components.

c) Continuous surveillance of progress and anticipation of factors likely to affect the timely performance of the Contract.

d) Making proposal for modification to forward planning and to the programme at an early stage in the light of factors resulting from (c) above.

e) Continuous appraisal of the Contractor's methods and routines particularly as to their effect on the community and property.

f) Forward planning for resource requirements taking due account of possible shortages and delays in the arrival on site of materials, equipment, plant and personnel and their mobilization for effective usage.

g) Acquisition and process of up-to-date information for progress meetings with the Project Manager. The preparation of monthly progress reports including an update of the detailed programme and cash flow forecast which shall include progress photographs as directed by the Project Manager.

The Contractor's project management staff shall be of adequate ability and experience. Programmes shall be based upon Critical Path Management (CPM) networks in precedence format and shall be prepared using a suitable PC-based project management software package approved by the Project Manager.

Reporting shall be in a manner compatible with the Employers project management procedures and shall use the Earned Value (EV) Technique and shall monitor the actual gross value of work completed against the predicted value.

1.22.2. Monthly Statements and Certificates

Monthly statements and certificates shall be submitted in an approved manner and format. In addition to the statements submitted in hard copy, the Contractor shall submit a soft copy using data base software as prescribed by the Project Manager. The statements and certificates shall detail the measured value of the work completed on each item of the Works in such detail that the Project Manager can identify location and measurement of each item. A location shall constitute a single structure such as a reservoir, pump station or section of a pipeline or a component of a system such as a pipeline valve.

Each item shall be uniquely identified in accordance with the numbering system as instructed by the Project Manager.

1.22.3. Progress Meetings

The Contractor shall provide a suitable venue, near the vicinity of the Site, and arrange progress review meetings to be chaired by the Project Manager at monthly intervals to coincide with submission of monthly progress submissions. The Contractor shall allow for attendance by the Project Manager and representatives of the Project Manager or Employer. The meetings shall be attended by the Contractor's senior representatives, Site Agent and other members of his senior staff as may be deemed necessary.

1.22.4. Equipment for the Employer

The Contractor shall hand over to the Employer on completion of the Works a complete set of tools and equipment together with spare parts and fittings as may be detailed in the BoQ to facilitate the maintenance and operation of the installed works.

1.22.5. Facilities for Survey and Inspection by the Project Manager

The Contractor shall make available technicians and such labour, materials and safety equipment as the Project Manager may require for inspections and survey work in connection with the Works. The Contractor shall provide all necessary test equipment, labour, staff and any other thing the Project Manager may reasonably require in order that he may safely, conveniently and quickly carry out such inspections as he deems necessary at any time during the execution of the Works and during the Defects Liability Period. The Project Manager, his representative and assistants, shall not inspect any area of the Works where they deem the safety provision to be inadequate and the Contractor shall undertake any work required by the Project Manager in order to make it safe.

The Contractor shall provide and handover the following or equivalent survey equipment to the Project Manager at the start of the project. These shall be new and in good condition for use at all times for the duration of the Works.

No.	Description	Quantity
1	South Galaxy G1c Base and Rover set, H5 Controller, External Radio, Tribrach and adaptor, 2 Aluminum tripods and plumbing pole.	1 Set
2	South Galaxy G1 plus (For tilt functionality) Base and Rover set, H5 Controller, External Radio, Tribrach and adaptor, 2 Aluminum tripods and plumbing pole.	1 Set
3	South N6 2" (2 second) Total station and accessories (Tripod, Plumbing pole , Prism and target set)	1 Set
4	DSZ2 Automatic level, X32 magnification and accessories (tripod and levelling staff	2 Sets
5	5 Metre Levelling staff	2 No.
6	30 Metre Steel tape	2 No.
7	3 Metre Steel tape	1 No.
8	3 Metre Ranging rods	21 No.
9	1 Metre Straight edge	1 No.
10	1.5kg Hammer	1 No.
11	4kg Hammer	1 No.

1.22.6. Inspections by the Project Manager during Defects Liability Period

The Project Manager will give the Contractor due notice of his intention to carry out any inspections during the Defects Liability Period and the Contractor shall thereupon arrange for a responsible representative to be present at the times and dates named by the Project Manager. This representative shall render all necessary assistance and shall record all matters and things to which his attention is directed by the Project Manager.

1.22.7. Protective Clothing and Safety Equipment

The Contractor shall provide for the Project Manager, his Representative and assistants adequate protective clothing and safety equipment necessary for the proper discharge of their duties on the Site.

The Contractor shall also provide any necessary protective clothing and safety equipment for the use of authorized visitors to the site including the Employer and his staff and representatives and those of any relevant authority who have reason to visit the Site.

1.22.8. Notice Boards

The Contractor shall provide and erect sign boards at the Sites where works are being executed, giving information to the public on the Project and the Employer and further details as will be prescribed by the Employer. The location of the sign boards at the sites will be indicated by the Project Manager. The Contractor shall maintain, alter, move or adapt the sign boards from time to time as may be instructed by the Project Manager. The display of any named Sub-contractors or any other information associated with the Works shall be to the approval of the Project Manager.

1.22.9. Language of Correspondence and Records

All communications from the Contractor to the Project Manager shall be in the English language. All books, timesheets, records, notes, drawings, documents, specifications and manufacturers' literature shall be in the English language. If any of the aforementioned is in another language a certified translation in English shall be submitted to the Project Manager.

1.22.10. Standards and Regulations

Each and every part of the Works shall be designed, constructed, manufactured, tested and installed in accordance with an internationally recognized standard, Code of Practice, or Regulation applicable to that part of the Works.

Such standards and codes shall include:

a) British Standard Specification last published;
b) International Electromechanical Commission, where available (IEC).
c) International Organization for Standardization (ISO).
d) European Standards (EN) Europäische Norm ;
e) American Water Works Association (AWWA) ;
f) Any other international recognized standard.

The Contractor shall provide and keep permanently on site copies of such standards as may be directed by the Project Manager and shall make them available to the Project Manager as required.

1.22.11. Equivalency of Standards and Codes

Wherever reference is made in the Contract, including Specifications, Drawings and Bill of Quantities, to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified will be accepted subject to the Project Manager's prior review and written consent. In the event the Project Manager determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the Contract.

1.22.12. Quality Control

The Contractor shall be responsible for his own quality control and shall provide sufficient competent personnel for supervising the Works, taking and preparing samples and for carrying out all necessary tests.

1.22.13. Units

The International System of (metric) Units as set out in ASTM E380 shall be used throughout the Contract except where otherwise provided.

1.22.14. Inspection and Testing during Manufacture

The performance of each item of Plant or Pipe shall be tested in accordance with the Specification to the requirements of the Project Manager.

Test certificates in triplicate shall be submitted by the Contractor to the Project Manager within 2 weeks of the date of the tests. Type tests are not acceptable. Test certificates shall be supplied for tests carried Plant shall not out on the actual Plant being supplied.

be dispatched from the manufacturer's works until it has passed the specified tests and approval been given by the Project Manager.

The Project Manager shall at his discretion witness tests of individual items of Plant at the manufacturer's facilities. The Project Manager shall be given three weeks' notice in writing before such tests are to take place.

The acceptance by the Project Manager of any item of Plant or equipment after testing at the manufacturer's facilities shall in no way relieve the Contractor of his responsibility for the correct performance.

b) EARTHWORKS, BACKFILLING AND RESTORATION

2.1. Conditions of Site

Before carrying out work on any Site, the Site shall be inspected by the Contractor in conjunction with the Project Manager to establish its general condition which shall be agreed and recorded in writing and by means of digital photography.

Details recorded shall include the location of all boundary and survey beacons, the condition of buildings, surface, terracing (if any), ditches, watercourses, roads, tracks, fences and other information relating to the Site and elsewhere which may be affected by the works.

In the case of way leaves for pipelines the boundaries of the way leave will be defined by the Employer and the contractor shall where directed provide, erect and maintain in position, from commencement to the final completion of the Works, in every section substantial timber stakes or similar approved markers not less than 1.5 m high indicating the position of the boundary at 100m or other such intervals as the Project Manager may direct. In the event of any boundary or survey mark established for the purpose of land title being disturbed or displaced the Contractor shall forthwith replace the beacon. Where necessary the Contactor shall employ the services of an approved licensed surveyor for the purpose of setting out boundaries.

2.2. Site Clearance and Topsoil Removal

Site clearance shall be carried out over the areas to be occupied by the Permanent Works before beginning excavation or filling or other work, and shall include the clearance of all trees, stumps, bushes and other vegetation and the removal of all boulders between 0.01 and 0.2m3 volumes. Boulders located within 1m of any pipe centreline shall be removed where directed by the Project Manager.

Before beginning clearance in any area the Contractor shall give seven days written notice of his intention to the Project Manager who will determine the extent and limits of such clearance.

Topsoil shall mean the surface layer of soil which by its humus content supports vegetation and is unsuitable, as a formation to roads and concrete structures or as a backfill or bedding material. The extent and depth of topsoil that needs removal shall be agreed with the Project Manager. Topsoil shall be set aside for re-use or disposed as directed by the Project Manager.

Trees to be removed shall be uprooted or cut down as near to the ground level as possible. Bushes, undergrowth, small trees stumps and tree roots shall, where directed by the Project Manager, be grubbed out. All holes left by the stumps or roots shall be backfilled with suitable material in a manner approved by the Project Manager.

The Project Manager may require that individual trees, shrubs and hedges are preserved; the Contractor shall take all necessary precautions to prevent their damage.

In the case of wayleaves for pipelines and the like, the Contractor shall preserve as far as practicable all grass and other vegetation outside the limits of trenches and permanent works and shall not necessarily destroy crops or any vegetation whose removal would not be essential to his operations.

2.3. Erosion

The Contractor shall take care at all times to prevent erosion on every site and elsewhere on land which may be affected by his operations and the Project Manager may impose such reasonable limitations and restrictions upon the method of clearance and upon the timing and season of the year when clearance is carried out as the circumstances warrant.

2.4. Ground Levels

Before commencement of any earthworks or demolition the sites shall be surveyed, as necessary, in conjunction with the Project Manager to establish existing ground levels. These agreed ground levels shall form the basis for the calculation of any subsequent excavation and filling.

2.5. Trial Holes

The Contractor shall excavate, refill and restore in advance of his programme such trial holes as he may require for determining the nature of the subsoil and the location of existing underground services and obstructions.

2.6. Excavation Generally

Excavations shall be made in open cutting unless tunnelling or heading is specified or approved by the Project Manager and shall be taken out as nearly as possible to exact dimensions and levels so that minimum of infilling will afterwards be necessary. The Contractor shall ensure the stability and safety of excavations and shall take all measures necessary to ensure that no collapse or subsidence occurs.

Except where described in the Contract or permitted under the Contract excavation shall not be battered. The sides of all excavations shall be kept true and shall where necessary be adequately supported by means of timber, steel or other type of struts, walling, poling boards, sheeting, bracing and the like.

Excavations shall be kept free from water and it shall be the Contractor's responsibility to construct and maintain temporary diversion and drainage works and to carry out pumping and to take all measures necessary to comply with this requirement.

In the event of soft or otherwise unsuitable ground being encountered at formation level or if the formation is damaged or allowed to deteriorate the Contractor shall forthwith inform the Project Manager, shall excavate to such extra depth and refill with compacted granular or other approved fill or C15 concrete (minimum compressor strength 15N/mm2) as the Project Manager may require. With respect to the side face of any excavation against which concrete or other work will be in contact the Project Manager may require that the net dimensions of the work be increased.

The Contractor shall be responsible for the disposal of Surplus excavated material off site, which shall be to a location approved by the Project Manager. No excavated material suitable for re- use shall be removed without the approval of the Project Manager.

The Contractor shall not deposit excavated materials on public or private land except where directed by the Project Manager or with the consent in writing of the relevant authority or of the owner or responsible representative of the owner of such land and only then in those places and under such conditions as the relevant authority, owner or responsible representative may prescribe.

2.7. Excavation in Excess

If any part of any excavation is in error excavated deeper and/or wider than is required, the extra depth and/or width shall be filled with Grade C15P concrete or compacted granular or other approved fill to the original formation level and/or dimensions as the Project Manager directs.

In pipe trenches where the pipe is not bedded on or surrounded with concrete, excess excavation shall be filled with compacted granular material. Excess excavation in rock trenches shall be filled with concrete (15N/mm2 compressive strength) up to 150mm below the pipe invert.

2.8. Mechanical Excavation

Mechanical excavation shall be employed only if the subsoil is suitable and only in such manner which will allow adequate support of the excavations. The Contractor shall ensure that there are no pipes, cables, mains or other services or property which may be disturbed or damaged by its use.

2.9. Excavation for Pipelaying

The width of trench excavation shall be the minimum required for efficient working after allowance has been made for any timbering and strutting, and shall not exceed the widths described in the Contract. At any one spread the maximum length of open trench shall not, without the prior approval of the Project Manager, exceed 100 metres.

Trenches in rock for pipes up to 100mm bore shall be excavated to provide a minimum clearance of 100 mm around the outside of the pipe and joints. For pipes exceeding 100mm bore the minimum clearance shall be increased to 150mm.

Where the trench is in rock or rocky ground the Contractor shall excavate the pipe trench to a depth of 150mm below the invert of the pipe and refill with compacted granular fill.

The materials for re-use excavated from trenches shall be stockpiled at the sides of the trench except where this would obstruct any road or footpath and prevent the passage of traffic or pedestrians. In such cases the Contractor shall excavate the trench in such lengths and stockpile the excavated materials at such places as the Project Manager may require.

Where excavation for pipe laying is carried out behind thrust blocks on existing pipelines the Contractor shall provide adequate support arrangements to transfer thrusts to the surrounding ground.

2.10. Headings

Excavation for pipes in heading shall be carried out to the approval of the Project Manager and to dimensions which will permit a proper inspection to be made. The heading shall be properly and securely timbered. The pipe shall be laid on a minimum thickness of 150mm of concrete. After the pipe has been laid, jointed and tested the heading shall be filled in short lengths not exceeding 1 metre with Grade C15P concrete or as directed. The heading shall be completely filled with concrete and hard filling shall then be rammed into the concrete at the crown of the heading.

Special precautions shall be taken to prevent a slump in the concrete and to ensure that no slips or falls of the heading or in the ground above or in the shafts can take place.

2.11. Excavation for Foundations of Structures

The Contractor shall give sufficient notice to the Project Manager to enable him to inspect and approve foundations in advance of placement of the permanent works. The Project Manager may withdraw his approval if work is not commenced within 48 hours or the formation is subsequently allowed to deteriorate.

If the Project Manager directs a bottom layer of excavation of not less than 75mm thickness shall be left undisturbed and subsequently taken out by hand immediately before concrete or other work is placed.

Formations which are to receive concrete blinding or a drainage layer shall be covered with such blinding or layer immediately the excavation has been completed, inspected and approved by the Project Manager.

Surfaces against which permanent works are to be placed shall be kept free of oil, water, mud or any material.

No concrete or other materials shall be placed until formations have been approved. Adequate notice shall be given to the Project Manager to enable him to examine the formation.

2.12. Rock Surfaces under Concrete Structures

Rock under concrete structures shall be prepared by picking, barring and wedging or other methods which will leave the rock in as sound a condition as may reasonably be expected according to the rock quality.

Rock surfaces shall be thoroughly cleaned by compressed air and water jet or such means as the Project Manager my direct before concrete is placed.

2.13. Concrete Placed on Capping Layer

Where instructed the rock excavation shall be taken down to a depth of 1.0m below the underside of the structure and the excavation backfilled with capping materials to the required formation level. Capping material shall be granular material. The material shall be compacted in 150mm layers to achieve a density of not less than 95% maximum dry density at optimum moisture content + 5% to 2% as determined by the BS heavy compaction tests to BS 1377.

2.14. Explosives

The removal of hard materials by use of explosives will only be permitted where specified in the Bills of Quantities subject to compliance by the Contractor in all respects with the Explosives Laws of Kenya.

In the Bill of Quantities hard material is classified as rock where blasting will be permitted subject to this clause.

The Contractor shall provide proper buildings or magazines in suitable positions for the storage of explosives in manner and quantities to be approved; he shall also be responsible for the prevention of any unauthorised issue or improper use of any explosives brought on the works and shall employ only licensed and responsible men to handle explosives for the purpose of the works.

The shots shall be properly loaded and tamped and where necessary, the Contractor shall use heavy mesh blasting nets. Blasting shall be restricted to such periods and such parts of the works as the Engineer may prescribe. If, in the opinion of the Engineer, blasting would be dangerous to persons or property or to any finished work or is being carried out in a reckless manner, he may prohibit it, and order the rock to be excavated by other means and payment will be made at the rate for rock for excavation where blasting is permitted. The use of explosives by the Contractor in large blasts, as in seams, drifts, pits, or large holes, is prohibited unless authorized in writing by the Engineer. In the event of wasting of rock through any such blasting, the Contractor shall if required by the Engineer, furnish an equivalent amount of approved materials for fill, 1 cubic metre of rock in-situ being taken to equal 1.5 cubic metre of material in embankment.

The Contractor shall at all times when engaged in blasting operations post sufficient warning flagmen to the full satisfaction of the Project Manager's Representative.

The Contractor shall also provide a special proper store for explosives in accordance with local regulations and shall provide experienced men with valid blasting licences, for handling explosives to the satisfaction of the Project Manager and the authorities concerned.

The Contractor shall at all times make full liaison with and inform well in advance and obtain such supervision and permission as is required from the Police and all Government Authorities, public bodies and private parties whosoever concerned or affected by blasting operations.

Blasting shall only be carried out on those sections of the Works for which permission in writing shall have been given by the Project Manager and the relevant authorities and shall be restricted to such hours and conditions as may be prescribed. Blasting within 10 metres of existing water mains will not be permitted.

Blasting shall be carried out so as not to weaken existing structures or the foundations or ground adjacent to the existing and proposed works. The Contractor shall take all necessary precautions to prevent loss, injury or accident to persons or property and shall be entirely liable for any accident or damage that may result from the use of explosives.

The Contractor shall submit to the Project Manager for his approval a method statement including details of the intended drilling patterns, depths of holes, the amounts of explosives at each location and the method or sequence of setting off that he proposes to use.

2.15. Excavated Materials Suitable for Re-use

In so far as they are suitable and comply with the Specification, materials arising from excavations shall be re-used in the Works.

During excavation, the Contractor shall ensure that all material suitable for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration.

The materials forming the surface and foundations of roads, road verges, tracks and footways shall when excavated, and if required for further use, be carefully separated. All hard materials shall be kept free from soil or other excavated materials.

During excavation of pipe trenches the Contractor shall ensure that all granular or other approved material suitable for filling around and over pipes shall be kept separate and re-used for this purpose.

Paving slabs, bricks and similar surfaces shall be carefully removed and stacked. Prior to the commencement of excavation, the number of badly broken and unsuitable paving slabs, bricks etc. on the line of the excavations shall be agreed with the Project Manager.

In verges and other grass surfaces the grass and top soil shall be stripped and separately stacked.

2.16. Backfilling of Excavations

Backfilling shall be thoroughly compacted in layers not exceeding 150mm compacted thickness and by means which will not damage the Works.

Backfilling of reinforced concrete structures shall be with suitable material approved by the Project Manager.

“Granular material” as backfill is defined as unconsolidated quarry dust, gravel, sand or similar in which the clay or silt content is not predominant. The use of angular crushed stone shall not be permitted.

2.17. Pipe Beddings

Unless otherwise specified granular material for beddings shall consist of aggregate to BS EN 12620 and shall conform to the following grading.

Pipe Nominal Diameter (mm)	Max Size (mm)	Grading (mm)
<50	sand	N/A
50	10	10 single-size
80	10	10 single-size
100	10	10 single-size
150	15	10 or 14 single-size or 14 to 5 graded
200 to500	20	10, 14 or 20 single-sized or 14 to 5 graded or 20 to 5 graded

>500	40	10,14 20 or single-size crushed rock or 14 to 5 graded or 20 to 5 graded or 40 to 5 graded

Granular bedding material where specified shall have a Compaction Fraction not greater than

0.3 as ascertained by the test method described below.

Aggregates for flexible pipes shall consist of sub-rounded or rounded material which will not cause damage to or penetrate the pipe material.

Sand bedding material shall consist of approved local sand which material shall have a Compaction Fraction ascertained by the test method described below of not greater than 0.3.

Class A bedding shall consist of Grade C15P concrete bed and surround.

Class A bedding shall comprise a 120 degrees' cradle of Grade C15P insitu un-reinforced concrete under the pipe with selected backfill material to a depth of 300mm above the crown of the pipe.

Class B bedding shall comprise a 180 degrees bed of single-size granular material in accordance with the above table, with selected backfill material to a depth of 300mm above the crown of the pipe.

Class S bedding shall comprise a complete surround of granular material in accordance with the above table to a depth of 150mm above the crown of the pipe.

Class D bedding shall comprise a hand-trimmed natural bottom to the trench with selected backfill material placed around and over the pipe to a depth of 300mm above the crown of the pipe.

Granular bedding and selected backfill material, placed around and to a thickness of 300mm above the crown of the pipes shall be placed simultaneously on both sides of the pipe in layers not exceeding 150mm thickness and compacted by the use of hand rammers taking particular care to compact the material under barrel of the pipe and around joints.

In trenches where there is a continuous accumulation of groundwater, the trench shall after obtaining the approval of the Project Manager, be over-excavated by 150mm and shall be backfilled using compacted granular material in accordance with the above table.

If the quantity of suitable material which can be obtained from the excavations is insufficient, the Contractor shall either screen the excavated material or transport suitable material from other excavated or borrow pits on the Site. In cases where insufficient material exists on the Site, the Contractor shall import suitable material after obtaining the written approval of the Project Manager.

2.18. Compaction Fraction Test

2.18.1. Apparatus required:

1. Open-ended cylinder 250 mm long and 150mm ± 5mm internal diameter (150mm diameter pipe is suitable);
2. Metal hammer with striking face 38 mm diameter and weighing 1 kg.
3. Ruler.

2.18.2. Method

Obtain a representative sample, more than sufficient to fill the cylinder (viz. about 10kg). It is important that the moisture content of the sample should not differ from that of the main body of material at the time of its use in the trench.

Place the cylinder on a firm flat surface and gently pour the sample material into it, loosely and without tamping. Strike off the top surface level with the top of the cylinder and remove all surplus material. Lift the cylinder up clear of its contents and place on a fresh area of flat surface. Place about one quarter of the material back in the cylinder and tamp vigorously until no further compaction can be obtained. Repeat with the second quarter, tamping as before, and so on for the third and fourth quarters, tamping the final surface as level as possible.

Measure down from the top of the cylinder to the surface of the compacted material. This distance in millimetres divided by the height of the cylinder (250mm) is the Compaction Fraction of the material under test.

To obtain a representative sample about 50kg of the proposed material should be heaped on a clear surface and divided with the spade down the middle into two halves. One of these should then be similarly divided, and so on until the required weight sample is left.

2.19. Selected Backfill Material

Backfill in contact with the pipes shall be selected material and shall not contain larges stones, rocks, tree roots or similar objects which through impact or by concentrating imposed loads might damage the pipes. The material shall be capable of being compacted without the use of heavy rammers and should be free of clay lumps or other material larger than 40mm or stones larger than the maximum particle size specified for pipe bedding.

2.20. Backfilling of Pipe Trenches

The trench above pipe bedding level (300mm above the crown of the pipe) shall be filled with the approved back fill material obtained from the trench excavations, free from clay limps, boulders and rock fragments larger than 150mm.

If the quantity of material which can be obtained from the pipe trench excavation is insufficient, the Contractor shall either screen the excavated material or transport suitable material from other excavations or borrow pits on the Site. In cases where insufficient material exists on the Site, the Contractor shall import suitable material after obtaining the written approval of the Project Manager.

The material shall be placed in layers not exceeding 150mm thickness and compacted by the use of rammers to achieve a density of not less than 95% maximum density at optimum moisture content +5% to -2% as determined by the BS Heavy Compaction Test to BS 1377.

For trenches in fields and open areas where agreed by the Project Manager the trench backfill shall be compacted to obtain a density of not less than 85% maximum dry density at optimum moisture content +5% to -2% as determined by the BS Heavy Compaction Test to BS 1377.

The density of the compacted fill shall be determined by the Contractor using the “sand replacement” method as directed by the Project Manager.

Before backfilling trenches the Contractor shall obtain approval from the Project Manager of the methods he proposes to use and shall demonstrate by means of tests that the specified compaction can be achieved. The method of compaction shall at all times be to the approval of the Project Manager.

Where ground water conditions are such that the bedding material would be likely to act as a carrier for ground water from higher of lower ground, the Project Manager may instruct flow barriers of suitable selected earth or concrete to be inserted in lieu of bedding material. Such barriers to be erected at reasonable intervals close to flexible joints in the pipe.

2.21. Making Good Subsidence after Backfilling

Backfilling, whether in foundations or in pipe trenches, shall be thoroughly compacted by ramming and any subsidence due to consolidation shall be made up with extra compacted material.

Should subsidence occur after any surface reinstatement has been completed the surface reinstatement shall first be removed, the hollows made up, and then the surface reinstatement re-laid.

Any subsidence that occurs adjacent to the Site of the Works which is attributable to the Contractor's activities shall be reinstated to the full satisfaction of the Project Manager.

2.22. Removal of Timbering from Excavations

Timbering shall be removed from the excavations before or during the process of backfilling except in so far as this removal of timber would be likely to cause damage to adjacent property, structures or structure foundations in which event the Contractor shall leave in the excavation such timbering as he considers necessary or as may be ordered by the Project Manager.

2.23. Reinstatement of Surfaces

All surfaces whether public or private that are affected by the Works shall be reinstated temporarily in the first instance and when the ground has consolidated fully the Contractor shall reinstate the surfaces permanently.

Temporary reinstatement and permanent reinstatement of all surfaces, affected by the operations of the Contractor shall be carried out and maintained to the satisfaction of the Project Manager and the responsible authority or owner.

Temporary reinstatement shall be carried out immediately the trenches are backfilled. Permanent reinstatement shall not be carried out until the ground has consolidated completely. The Contractor shall inform the Project Manager before carrying out this work. In the event of further settlement occurring after completion of the permanent reinstatement the Contractor shall forthwith make good the reinstatement to the approval of the Project Manager or responsible authority.

For the purpose of temporary and permanent reinstatement in bitumen and surfaced roads the surface width of trenches shall be increased by 150mm on each side of the trench for a depth of 75mm to provide a solid abutment for the surfacing material.

Reinstatement of surfaced roads shall be carried out to the approval of the relevant authority. The responsible authority shall have the right to carry out permanent reinstatement at the Contractor's expense.

Trenches in open ground shall be reinstated to the condition in which the ground was before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.

In verges and other grass surfaces and after the backfilling had been thoroughly consolidated the topsoil shall be re-laid rolled and planted with grass or other vegetation as directed by the Project Manager as may be necessary and watered until the grass has become well established. Should the planting fail it shall be replanted as required until satisfactory growth is obtained. If at any time any reinstatement deteriorates the Contractor shall restore it to a proper condition immediately.

Should the Contractor not remedy the defect to the Project Manager's satisfaction forthwith any remedial work considered necessary may be undertaken by the Employer and/or the responsible authority at the Contractor's expense.

All trees, shrubs and plants shall be carefully transplanted and shall be returned to their original location after the refilling of the excavations. Return of old or mature trees may be waived in cases where the age of the tree makes return impracticable, and approved tree seedlings shall be planted in their place. Topsoil shall be carefully set aside and replaced at the surface of the backfilling.

The trenches shall be refilled and rammed solid as specified in the Contract and shall not be topped up above the original surface level to allow settlement.

If any trench becomes dangerous the Project Manager may call upon the Contractor for its reinstatement at three hours' notice and failing this to have the work done by others at the Contractor's expense.

In the case of footpaths, the trench shall be refilled and rammed as specified to within 125mm of the surface. A foundation layer of 100mm compacted thickness of approved crushed limestone shall then be laid and compacted. The surface shall be cleaned and primed and the footpath surfacing shall be temporarily reinstated with 25mm compacted thickness of 14 mm nominal size dense

wearing course macadam laid and compacted so as to achieve a dense, smooth and even course surface using a roller of 750 to 3000kg mass. Any kerbs shall be reinstated to their original condition.

The trench surface shall be thus maintained until the end of the Period of Maintenance or permanent reinstatement is ordered by the Project Manager. Where permanent reinstatement is ordered by the Project Manager the temporary surface and part of the foundation shall be removed to 50mm depth to permit the construction of a tiled or paved surface to match the original surface. An approved tiled or paved surface shall then be laid and bedded on sand or mortar to an even finish.

2.24. Safety of Excavations in Roads

Where the surface of the road (other than that which lies immediately above the trench) is damaged either by the concentration of traffic caused by an open trench, by subsidence or other causes arising from the operations of the Contractor, he shall permanently reinstate the whole of the surface so damaged to its original condition.

The Contractor shall ensure that trenches and reinstatement are maintained in a safe condition and shall take immediate action to remedy any deterioration which renders the works unsafe. If in the opinion of the Project Manager any excavation or reinstatement is in a dangerous condition the Contractor shall immediately remedy the defect. Should the Contractor fail to carry out the reinstatement promptly, the work may be carried out by others at the Contractor's expense.

2.25. Temporary Reinstatement of Asphalted Roads

In all asphalted or bitumen sprayed roads the trenches shall be refilled and compacted to the underside of the original road surface. A sub-base layer shall then be laid consisting of approved free drainage granular material conforming to the following grading limits:

100% by weight passing 50mm sieve 75-95 by weight passing 25.4mm sieve 40-75 by weight passing 9.51mm sieve 30-60 by weight passing 4.75mm sieve 20-45 by weight passing 2.0mm sieve 15-30 by weight passing 425mm sieve 5-15 by weight passing 72mm sieve.

A base layer shall then be laid consisting of approved crushed limestone material conforming to the following grading limits.

100%	by weight	passing 50mm sieve
60% - 80%	by weight	passing 20mm sieve
25% - 40%	by weight	passing 5mm sieve

The materials shall have a plasticity index of not exceeding 6%. The materials forming the sub-base and foundation shall be laid in layers, brought to optimum moisture content and compacted to 95% of the maximum dry density as determined by Part 4 Clauses 3.3/3.4 BS 1377:1990.

Prior to application of the temporary reinstatement the surface of the road foundation shall be cleared of all dust, debris and other deleterious matter and shall then be primed with one application of prime coat MC-70 or similar approved. All joints with adjacent road surfacing shall be cut straight and vertical and primed.

The road surfacing shall be temporarily reinstated with 25mm finished thickness of asphaltic concrete. The asphaltic concrete shall be laid and compacted so as to achieve a dense smooth and even surface using a roller of not less than 12 tonne mass.

The surface shall be maintained until the end of the period of Maintenance or until instructions are given for the permanent reinstatement to be carried out. The surface shall not be topped up above the original surface level to allow for settlement.

2.26. Temporary Reinstatement of Unmade Roads

In all unmade roads the trenches shall be refilled and compacted as specified in the Contract to within 150mm of the surface.

The trench shall be surfaced with 150mm compacted thickness of base layer material as specified above.

The surface shall be maintained until the end of the Period of Maintenance and shall not be topped up above the level of the original surface to allow for settlement.

2.27. Permanent Reinstatement of Asphaltic Roads

Where instructions are given that permanent reinstatement is to be carried out then the temporary asphaltic concrete surface and part of the foundation layer shall be removed to a minimum depth of 200mm and the surface of the foundation shall be rolled, all dust and debris removed, joints cut straight and vertical.

The permanent reinstatement shall comprise crushed limestone material to a total compacted thickness of 150mm and the wearing course 50mm compacted thickness of 14 mm nominal size dense wearing course asphaltic concrete. The laying and finishing of the coated macadam shall be carried out so as to achieve a dense, smooth and even surface using a roller of not less than 12 tonnes mass.

2.28. Forming Banks and Filled Areas

The filling to be used in the embankments and filled areas shall be material selected from that arising from surplus excavation (unless otherwise defined in the Particular Specification), the material being placed according to its nature as shall be directed by the Project Manager. The fill shall be placed in layers not exceeding 150mm thick, each layer being thoroughly compacted by an approved roller to the satisfaction of the Project Manager.

2.29. Restoration of Borrow Areas, Spoil Tips and Quarries

Any spoil tips, quarries or other borrow area developed by the Contractor for the purpose of the Works shall be finished to safe and fair slopes to the approval of the Project Manager.

2.30. Top soiling and Grassing

Where required surfaces shall be soiled with fine sifted soil or silt not less than 100 mm compacted thickness which shall be raked and brought to a fine finish.

Surfaces required to be grassed shall be planted with approved local grass at a spacing of 200mm x 200mm. The grassed area shall be replanted if the first or subsequent operation is unfruitful or if for any reason the grass is destroyed. Grassed areas shall be watered and attended until the grass has become well established.

The soiling and planting of the grass in slopes shall be carried out immediately the slope is formed and the grass shall be kept weeded and cut until the work is accepted at the time of the Certificate of Completion.

The Contractor shall supply attendance during the Defects Liability Period to ensure that all planted grass is kept weeded and cut, and if necessary watered.

2.31. Free Draining Fill

Free draining fill for use as backing to wall shall consist of sound hard stone or broken rock or concrete derived from demolition of structures. The particles shall be roughly cube in form and shall be between 75mm and 25mm in size. All smaller particles, Dust, rubbish and organic matter shall be excluded.

2.32. Hardcore

Hardcore shall consist of sound hard stone or broken rock or concrete derived from excavations or demolition of structures and shall be graded from 150mm to 50mm in size, except that sufficient but not excessive blinding materials of smaller sizes may be permitted at the discretion of the Project Manager.

c) CONCRETE WORKS

3.1. General

The standard of materials and of workmanship shall not be inferior to the recommendations of the current:

a) British Standard Code of Practice BS 8110 – The Structural Use of Concrete

Or

b) British Standard Code of Practice BS 8007 – Design of concrete structures for Retaining Aqueous Liquids

c) Appropriate British Standards

d) Approved Kenyan Standards Or

e) Other equivalent and approved international standards

Whichever is applicable to the particular structures

The requirements outlined in the above documents must be read with those of this Section of the Specification and where any conflict exists between the recommendations of the above and of this Specification, the requirements of the Specification shall prevail. As and when required by the Project Manager the Contractor shall prepare and submit, before commencing the work, a time chart (additional to the general programme) detailing the various operations for concrete work.

No material shall be used in the Works until prior approval for its use has been given by the Project Manager; neither shall any change in the nature, quality, kind, type, source of supply or manufacture be made without the Project Manager's permission.

Names of manufacturers and test certificates for materials not supplied by the Employer shall be supplied as soon as possible to the Project Manager.

The cost of providing samples and the cost of carrying out tests required by Clause 306 (except as otherwise provided in the Conditions of Contract) together with the cost of supplying equipment for sampling and site testing indicated in columns 3 and 4 of Table 3.8 of this Section of the Specification shall be borne by the Contractor.

During the progress of the Works, consignment notes for materials not supplied by the Employer shall be supplied to the Project Manager giving details of each consignment.

The Contractor shall provide all samples required by the Project Manager as soon as possible after contract award. No deliveries in bulk shall be made until the samples are approved by the Project Manager. All condemned material shall be removed from the site within 24 hours.

A competent person approved by the Project Manager shall be employed by the Contractor whose duty will be to supervise all stages in the preparation and placing of the concrete. All cubes shall be made and site tests carried out under his direct supervision, in consultation with the Project Manager.

All materials which have been damaged, contaminated or have deteriorated or do not comply in any way with the requirements of these Preambles shall be rejected and shall be removed immediately from the site at the Contractor’s expense. No materials shall be stored or stacked on suspended floors without the Project Manager’s prior approval.

The use of the word "approved" in this Specification refers to the approval of the Project Manager or his delegates.

Cross-references between certain clauses of this Specification have been shown in brackets following the particular item.

3.2. Concrete

3.2.1. Requirements

The mix proportions shall be selected to ensure that the workability of the fresh concrete is suitable for the conditions of handling and placing, having regard to the structural element being constructed, the disposition of reinforcement, and taking full account of the environment to which it will be subjected.

The minimum cement contents and maximum water/cement ratios of designed mixes shall be as given in Table 3.1.

The maximum cement content in any mix shall not exceed 425 kg/m3 for normal structures and 500 kg/m3 for liquid retaining structures.

In all cases of mix proportioning, the added water shall be included with due allowance for the moisture contained in the aggregates and shall be the minimum consistent with the workability requirements.

Table 3.1 Minimum Cement Contents

Additional Requirements when Exposed to Sulphate Conditions (All Structural Concrete)

Concentration of Sulphates (expressed as SO3)		Minimum Cement Content (kg/m3) Maximum Aggregate Size				Maximum Water/ Cement Ratio
In soil (Total SO3)	In ground water Parts per 100,000	Type of Cement	40 mm	20 mm	10 mm	
□□0.2	□□30	No Special Precautions				-
0.2 - 0.5	30 - 120	OPC or CEM1,II Or IV per KS1725	300	330	370	0.50
		SRPC	250	280	320	0.55
0.5 - 1.0	120 - 250	OPC or CEMI, II Or IV per KS1725	Not permitted			-
		SRPC	300	330	370	0.50
1.0 - 2.0	250 - 500	OPC or CEMI, II or IV per KS1725	Not permitted			-
		SRPC	340	370	410	0.45
□□2.0	□□500	SRPC	Ditto but with protective coating			0.45

OPC - Ordinary Portland Cement
SRPC - Sulphate Resisting Portland Cement

3.2.2. Strength

The characteristic strength of concrete means that value of the 28-day cube strength below which 5% of all possible test results would be expected to fall.

The relationship between grade of the concrete and its characteristic strength shall be as given in BS 5328. The grade of concrete to be used in particular locations shall be as given in Table 3.2 unless noted otherwise on the drawings.

Table 3.2 Concrete Strength Requirements

Location	Maximum Coarse Aggregate Size (mm)	Grade of Concrete (BS 5328)
Blinding Concrete - General Structures - Liquid Retaining Structures	 20 or 40 20	 C15P
Blinding Concrete - Sulphate Condition	20	C20P
Substructure thickness less than 400 mm	20	C25D
Substructures, walls and slabs more than 400 mm	20 or 40	C25D
Superstructures, Normal Concrete	20	C25D
Liquid Retaining Structures	20	C30D
Fine Concrete	10	C25D
Precast Concrete	10 or 20	C30D

In the above table suffix P means a prescribed mix, D means a designed mix and A means a design mix complying with the requirements of BS 8007.

3.2.3. Mixes

a) Designed Mixes

Proportions shall be determined in accordance with the "Design of Normal Concrete Mixes" published by the United Kingdom Department of the Environment and the Building Research Establishment.

Or other approved methods, for the requirements set out in this Specification.

For the purpose of determining the design mean strength of the concrete a margin shall be added to the characteristic strength for the particular grade of concrete. This design margin shall be assessed on the degree of control reasonably to be expected in the manufacture of the concrete and shall neither be less than 5.0 N/mm2 nor less than 1.64 times the standard deviation. Until such time as the standard deviation has been assessed the margin shall be not less than 7.5 N/mm2.

Details of the designed mixes shall be forwarded immediately to the Project Manager for his approval.

b) Prescribed Mixes

Proportions for the several grades of concrete shall conform to the requirements of Tables 3.3 and 3.4.

c) Chloride Content

The total chloride content of the concrete mix shall comply with the requirements of BS 8500: Part 2: Section 5

3.2.4. Quality Control

The principal basis of control shall be by comparison of the results of the compression cube tests at 28 days, except for small quantities of concrete whose strength can be otherwise derived and which is permitted for use by the Project Manager. 40 sample cubes shall be made initially in eight samples each day for five days of concreting and thereafter one sample per 25 m3 of concrete but not less than one sample for each day's concreting.

Where materials are of an unfamiliar grading or type, compression cube tests shall be carried out at 7 days and adjustments made in advance of the main control methods outlined above.

Cube test results will be examined individually in 10 consecutive sets of four and the standard deviation and mean strength of each set calculated. The concrete mix proportions will only be acceptable if all of the following requirements are complied with: -

i. Not more than two results in 40 are less than the characteristic crushing strength.

ii. No value of the average for any set of four results is less than the characteristic strength plus one-half of the design margin.

iii. When 40 results have been obtained and the mean strength and standard deviation are calculated, the mean strength minus 1.64 times the standard deviation shall be greater than the characteristic strength.

Where the results do not conform to the above requirements the following action shall be taken: -

Adjustments to the mix shall be made to obtain the strength required.

In the case where any result is less than 80% of the characteristic strength the structural implications shall be considered and action taken as ordered by the Project Manager

For those Prescribed Mixes required to be tested, requirements (i) and (ii) only will be applicable.

3.2.5. Production

Aggregates and cement shall be proportioned by weigh-batching, and water shall be proportioned by volume. Subject to the prior approval of the Project Manager volume- batching of aggregates may be used for small sections of works, but volume batching of cement will in no case be accepted. The Contractor may, however, so proportion the mix that each batch shall use a whole bag or bags of cement, the weight of which is known precisely. Where permission has been given for volume batching of aggregates, all gauge boxes shall be accurate and due allowance shall be made for the bulking of the aggregates in assessing the correct volume to be used.

The aggregates and the cement shall be thoroughly mixed in a clean mechanical mixer for a period of time agreed with the Project Manager and the water added on the basis of the approved design.

The amount of water added shall conform to the requirements of Clause 3.2.1.

Batching mixing machines shall comply with the requirements of BS 1305. They shall be provided in such numbers and of such capacity as to ensure a continuous supply of freshly mixed concrete at all times during construction.

Target strength for trial mix = 1.3 x Characteristic Strength

Target strength for works = 1.2 x Characteristic Strength

Continuous mixing machines shall be used only with the written permission of the Project Manager.

Not less than 30 days prior to the installation of the Contractor's plant and equipment for processing, handling, transportation, storing and proportioning ingredients, and for mixing, transporting and placing concrete, the Contractor shall submit drawings for approval by the Project Manager, showing proposed general plant arrangements, together with a general description of the equipment proposed for use.

After completion of installation, the operation of the plant and equipment shall be subject to the approval of the Project Manager.

Where these Preambles, the Bills of Quantities or the Drawings require specific procedures to be followed, such requirements are not to be construed as prohibiting use by the Contractor of alternative procedures if it is approved by the Project Manager, prior to use of such alternatives.

Approval of plant and equipment or their operation, or of any construction procedure, shall not operate to waive or modify any provision or requirements contained in the Preambles governing the quality of the materials of the finished work.

Table 3.3 Prescribed Mixes - Mass of Dry Aggregate to be Used with 100 kg of Cement

Grade of concrete	Nominal maximum size of aggregate (mm)	40		20		14		10	
	Workability	Medium	High	Medium	High	Medium	High	Medium	High
	Range for standard sample (mm)	50-100	80-170	25-75	65-135	5-55	50-100	0-45	15-65
C7.5P C10P C15P C20P C25P C30P	Total aggregate	kg 1080 900 790 660 560 510	kg 920 800 690 600 510 460	kg 900 770 680 600 510 460	kg 780 690 580 530 460 400	kg NA NA NA 56 0 490 410	kg NA NA NA 47 0 410 360	kg NA NA NA 51 0 450 380	kg NA NA NA 42 0 370 320

N/A not applicable

Table 3.4 Prescribed Mixes - Percentage by Mass of Fine Aggregate to Total Aggregate

Grade of concrete	Nominal maximum size of aggregate (mm)	40		20		14		10	
	Workability	Medium	High	Medium	High	Medium	High	Medium	High
C7.5} C10P} C15P}		30-45		35-50		N/A		N/A	
C20P } } C25P } } C30P }	Grading Zone 1	35	40	40	45	45	50	50	55
	2	30	35	35	40	40	45	45	50
	3	30	30	30	35	35	40	40	45
	4								

N/A implies 'Not Applicable'

Notes on the use of Tables 3.3 and 3.4

NOTE 1. The proportions given in the tables will normally provide concrete of the strength in N/mm2 indicated by the grade except where poor control is allied with the use of poor materials.

NOTE 2. For grades C7.5P, C10P and C15P a range of fine-aggregate percentages is given; the lower percentage is applicable to finer materials such as zone 4 sand and the higher percentage to coarser materials such as zone 1 sand.

NOTE 3. For all grades, small adjustments in the percentage of fine aggregate may be required depending on the properties of the particular aggregates being used.

NOTE 4. For grades C20P, C25P and C30P, and where high workability is required, it is advisable to check that the percentage of fine aggregate stated will produce satisfactory concrete if the grading of the fine aggregate approaches the coarser limits of zone 1 or the finer limits of zone 4.

3.2.6. Cement

Cement shall, as a minimum, meet the requirements of CEMI-32.5, CEMII-32.5 or CEMIV-32.5 in accordance with Kenya Standard KS 1725 Part 1 (Composition, Specifications and conformity criteria for common cements) and Part 2 (conformity Evaluation). Concrete for power floated floors shall as a minimum meet the requirements of CEMI-42.5, CEMII-42.5 or CEMIV-42.5.

Approval to the use of cement manufactured to the above standards or any other approved standards shall be subject to the Contractor demonstrating that the resulting concrete shall meet the strength requirements as given in the drawings and the relevant sections of the Concrete Specifications.

Pulverised-fuel ash shall have a maximum colour index of 6 (Colour comparator disc reference No. 296570) when measured using the Lovibond Colour Comparator system as recommended in BS 3892: Part 1 Appendix H, Clause H8.

Cement shall be fresh when delivered to Site and the consignments shall be used in the order of their delivery. The Contractor shall mark the date of delivery on each consignment and each consignment shall be stored separately and in such manner as to be easily accessible and identifiable.

No cement in bags or other containers shall be used unless these and the manufacturer's seals are intact at the time of mixing.

If the cement is delivered in bags it shall be stored in a waterproof shed or building at a temperature of not less than 8oC and the bags shall be placed on dry boards above the floor to prevent deterioration or contamination from any cause.

Bulk cement may be used provided it is stored in an approved container.

The Contractor shall not use cement which has hardened into lumps, but subject to removal of the lumps by screening, the Project Manager may allow such cement to be used in non-structural concrete mixes.

Cement of different types shall be kept separate in storage and shall not be mixed together in the production of concrete.

3.2.7. Aggregates

The Contractor shall investigate the proposed aggregate sources in detail and shall submit a comprehensive report with technical information and data which shall include the following:

a) Location. Only Sources equipped with facilities adequate for the production of the materials as specified and in such quantities as shall be required for the prompt execution of the Contract shall be approved.

b) Petrology of sources and possible or likely variability during the Contract period.

c) Method of production

d) Schedule of available and proposed processed aggregates by size, including details of actual screen sizes to produce each aggregate.

e) Test data as applicable for each aggregate type and size based upon representative samples and tested in accordance with the appropriate British Standards.

f) A detailed statement of the aggregate proposed for use in each grade of concrete.

Samples of all aggregate, including fine aggregates and sand shall be submitted to the Project Manager for his approval. All samples shall be taken in accordance with BS 812 and shall weigh not less than the minimum weight indicated on Table 1 of that Standard.

The Contractor shall produce with each consignment or at intervals directed by the Project Manager a certificate signed by the Supplier, or other approved analyst, giving fully detailed chemical and physical properties of all aggregates together with a sieve analysis carried out in accordance with the appropriate British Standard.

Any changes in the particulars of the aggregates which occur during the course of the Contract must be notified to the Project Manager without delay.

The aggregates shall be stored on Site in separate stockpiles so arranged as to prevent the intermingling of the various aggregate sizes. The stockpiles shall be suitably protected to prevent contamination of the aggregates from the ground, rubbish or by leaves, dust or other windblown materials.

Aggregates shall conform to the requirements of "Acceptable Standards" of Table 3.8.

Building sand for mortar and similar uses and aggregates for concrete shall comply to BS 882 and shall be perfectly clean and free from all foreign matter and shall not consist of, nor contain argillaceous limestone or shells.

Where the nominal size specified exceeds 37.5 mm the grading shall be subject to the Project Manager's approval or in accordance with his directions.

Unless otherwise agreed with the Project Manager, single-sized aggregates shall be used in batching and mixing concrete.

The following impurities in both fine and coarse aggregates shall not exceed the limits stated in the following clauses.

The total chloride content of the concrete mix arising from the aggregate together with that from any admixtures and any other source, expressed as a percentage of chloride ion shall not in any circumstances exceed 0.1%.

Note: Marine aggregates and some inland aggregates contain chlorides. Both should be selected carefully and marine aggregates necessitate efficient washing to achieve the 0.1% chloride ion limit. Wherever possible, the total chloride content should be calculated from the mix proportions and the measured chloride content of each of the constituents.

Concrete made with some aggregates exhibit Alkali-Silica Reaction (ASR). This phenomenon is particularly detrimental in structures subject to wetting and their use will not be allowed in such structures.

Prior to acceptance of an aggregate as inert to alkali reaction the report of a qualified geologist, appointed by the Project Manager on the suitability or otherwise of materials shall be obtained following examination of all types of material that the proposed sources will yield during the course of the contract. The Project Manager may require that samples be taken from boreholes and if the contract extends over a long period then more than one report shall be obtained.

The Project Manager may order further tests to be carried out on the aggregates proposed by the Contractor for the structures in connection with this Contract before permission is given to use the aggregates proposed by the Contractor.

Where allowed by the Project Manager to use reactive or potentially reactive aggregates in certain structures the Contractor shall take all suitable measures to prevent deterioration of concrete due to alkali-silica reaction. Such measures shall include the use of cement with an acid soluble equivalent of sodium oxide content (Na2 O + O.658K2 O) of less than 0.6%. The reactive alkali content of the concrete mix shall in no circumstances exceed 3 kg/m³.

The Alkali-Silica Reaction (ASR) in hardened concrete is also affected by the water-cement ratio. Therefore, where ASR aggregates are used, with the permission of the Project Manager, the water-cement ratio shall be kept to a minimum (in the region of 0.4).

Aggregates required for use in the construction of concrete water retaining, water excluding and other similar structures shall have a low drying shrinkage and the water absorption shall not exceed 3%.

The absorption of the aggregates shall be measured in accordance with BS 812, Part 2.

Aggregates of rounded shape or otherwise capable of producing a concrete of good workability with the minimum addition of water shall be preferred.

Dust or flour resulting from crushing the aggregate shall not be allowed to contaminate the stockpiles. When, in the opinion of the Project Manager such contamination has taken place it shall be removed by an approved means or otherwise the aggregate shall be rejected.

For mass concrete, in order to improve the consistency of the mix, dust or flour resulting from crushing the aggregate, which may be subjected to test, be included in controlled quantities to supplement the fine aggregate.

Except where aggregates have been otherwise specified on the Drawings the grading of aggregates shall be as follows:

(i) Coarse Aggregate:

a) 10 mm max. size, graded, for all "fine" concrete.

b) 20 mm max. size, graded, for all reinforced concrete in beams and for walls and slabs not greater than 400 mm thick.

c) 0 mm max. size, graded, for all reinforced concrete walls and slabs in excess of 400 mm thick.

(ii) Fine Aggregate:

a) Where aggregates conforming to Zones 2 or 3 of BS 882 are available they shall be used.

b) For Prescribed Mixes, Zones 1, 2, or 3 aggregates only shall be used.

Fine and coarse aggregates shall be as defined by and be of the quality and nature required by BS 882. In addition, they shall be chemically inert to alkali reaction.

3.2.8. Water

The Contractor shall supply all water, make all arrangements and pay all charges in respect of such supply. Where water can be obtained from a public water supply it shall be used.

Where water cannot be obtained from a public supply it shall be tested in accordance with BS 3148 and if necessary shall be treated to assure compliance therewith.

Water for washing and curing shall be such that it will impair neither the strength of the finished concrete nor its appearance.

3.2.9. Admixtures

General

The quantity and method of using admixture's shall be in accordance with the manufacturer's recommendations and in all cases shall be subject to the approval of the Project Manager. Unless otherwise specified or approved by the Project Manager, an admixture shall comply with one of the following :-

- BS 1014 (Pigments for Portland cement and Portland cement products). BS 5075 (Concrete admixtures except chloride based admixtures).
- In all cases the Contractor shall provide the following information for the Project Manager's approval: -

a) the quantity to be used, in kilograms per kilogram of cement and in kilograms per cubic metre of concrete;

b) the detrimental effects caused by adding a greater or lesser quantity in kilograms per cubic metre of concrete;

c) he chemical name (s) of the main active ingredients;

d) whether by the Project Manager, the Contractor shall demonstrate the action of an admixture by means of trial mixes.

Calcium chloride. The use of calcium chloride in any form is prohibited.

3.2.10. Control of Alkali-Silica Reaction

The risk of cracking and expansion due to alkali-silica reaction shall be minimised by compliance with the specification and guidance notes set out in Technical Report No. 30 of the Concrete Society, Riverside House, 4 Meadows Business Park Station Approach, Blackwater, Camberley, Surrey, GU17 9AB Fax: +44 (0) 1276 607141, Website: www.concrete.org.uk.

3.2.11. Reinforcement

i. **Steel**

Reinforcement shall be:

a) Plain round mild steel or High Yield steel bars conforming to BS 4449.

b) Cold worked steel bars conforming to BS 4449: 1988.

c) Fabric reinforcement made of cold drawn high tensile bars conforming to BS 4483.

The Contractor shall obtain from his supplier's certificates of the mechanical and physical properties of the reinforcement and shall submit them to the Project Manager for approval, except where reinforcement has been supplied by the Employer. The frequency of sampling and the method of quality control shall be in accordance with Table 4 and Clause 20 respectively of these British Standards. All high yield and cold worked bars (except in welded fabric reinforcement) shall be deformed bars complying with Classification Type T2 for bond strength in accordance with BS 4449.

Where galvanised reinforcement is specified, galvanising shall comply with the requirements of BS 729, Part 1.

ii. Storage

Reinforcement shall be stored on Site under cover and supported clear of the ground and in such manner as to make identification easy. Supports shall be such that distortion of the steel is avoided and contamination and corrosion prevented.

iii. Bending and Fixing

The Contractor shall provide on Site facilities for cutting and bending reinforcement whether he is ordering his reinforcement bent or not and shall ensure that a token amount of straight bar is available on Site for bending as and when directed by the Project Manager.

Reinforcement shall be wire brushed and cleaned at the Contractor's expense, before and/or after it is placed in position, if required by the Project Manager.

The bars shall be cold bent in strict accordance with the drawings and the Contractor shall be responsible for the accuracy of the bending. Bending dimensions shall be worked to the tolerances indicated in BS 4466 and BS 8110 table 3.28. Bars in which any errors in bending are beyond the limits of the foregoing tolerances shall be replaced at the Contractor's cost by correctly bent new bars, or, may be straightened and rebent cold subject to the Project Manager's prior approval. Any discrepancy or inaccuracy found in the drawings shall be notified to the Project Manager immediately.

After bending, reinforcement shall be securely bundled and labelled with weather-proof tags or shall be marked with other approved signs by which it can readily be identified.

Before assembling or fixing the reinforcement the dimensions to which it has been bent shall be checked by the Contractor against the drawings.

The reinforcement shall be fixed in strict accordance with the drawings as regards cover, spacing and

position, and suitable precautions shall be taken by the Contractor to prevent the displacement of reinforcement during the placing and compaction of concrete.

During concreting a competent steel fixer must be in attendance to adjust and correct the positions of any reinforcement which may be displaced. The vibrators are not to come into contact with the reinforcement.

Where required to support and retain the reinforcement in its correct position the Contractor shall provide templates, stools or other supports at his own cost. He shall allow for cutting to correct length all corner lacer bars included in the bar schedules as standard lengths.

Precast concrete support blocks for reinforcement shall be manufactured from Grade C30D "fine" concrete to ensure the correct cover thickness. They shall be well cured before use and carefully stored on Site to avoid contamination. Plastic and metal supports, chairs, etc. may be used and shall be subject to the Project Manager's prior approval.

In the case of mild steel, a lap of not less than 40 diameters of the smaller bar shall be provided at the junction of two bars for which the lap is not specifically detailed on the Drawings and, in the case of High Yield steel, a lap of not less than 50 diameters.

All intersections of bars in walls and slabs and all connections between binders or links and main bars in columns or beams shall be tied with soft iron wire ties or with fixing clips which shall not be allowed to make contact with the formwork or to project materially into the specified cover.

Unless permitted by the Project Manager, welding of bar reinforcement at intersections or for the joining of bars is prohibited. Where permission is granted, welding shall be carried out in accordance with the recommendations of the Institute of Welding for the welding of reinforcing bars for reinforced concrete construction.

When fixed reinforcement is to be left exposed for more than eight weeks, it shall be thoroughly cleaned and painted with neat cement grout.

Where galvanised reinforcement is used any damage suffered by galvanising shall be made good by the application of an approved galvanising formulation, before concrete placing is commenced.

No concreting shall be commenced until the Project Manager has inspected the reinforcement in position and until his approval has been obtained and the Contractor shall give adequate notice of his intention to concrete.

iv. Couplers

Couplers for reinforcement shall be either Standard Swaged Splices or Type II Alpha Couplers manufactured by CCL Systems, Unit 4, Park 2000 Millennium Way, Westland Road, Leeds, LS11 5AL, Telephone: +44 (0) 113270 1221, Fax: +44 (0) 113 277 8977, email: sales@cclstressing.com or similar approved. Where bars of different diameters are to be joined a CCL Reducer Sleeve or similar shall be used.

Couplers shall be suitable for the type and size of reinforcing bars and shall be capable of developing 115% of the characteristic strength of the smaller of the reinforcing bars being joined in both tension and compression. Couplers shall be installed in accordance with the manufacturer's recommendations. Square twisted reinforcing bars shall not be used with couplers.

3.2.12. Formwork

i. Requirements

The term "formwork" shall be taken to include centering, formwork, strutting, bracing and the like.

When called upon to do so by the Project Manager the Contractor shall submit his formwork proposals for checking and approval by the Project Manager in advance of the concreting.

Formwork shall be of such accuracy, strength and rigidity as to carry the weight and pressure from the concrete to be placed on or against it, together with all constructional, wind or other loads likely to be imparted to it, without producing deformation of the finished concrete in excess of the tolerances outlined in Table 3.5.

All formwork shall be sufficiently tight, without plugging, to prevent loss of grout during the vibration of the concrete. When required by the Project Manager, joints between formwork facing boards shall be sealed with foam rubber, sealing strips or other approved material. A foam rubber or polyurethane strip shall be provided around the tops of all walls and columns before affixing the forms for the next lift.

Faces of formwork shall be clean, free from projecting nails, adhering grout and other imperfections or defects which would prevent the specified surface finish from being attained. They shall be treated with approved mould oil before positioning. Great care shall be exercised to prevent reinforcement or steelwork from being contaminated by the oil during erection of the formwork.

Formwork, which as a result of prolonged use or general deterioration does not, in the opinion of the Project Manager, conform to the particular requirements set out in this clause, shall not be used.

Through-bolts or ties will not be permitted in liquid-retaining structures. The Contractor shall use only such bolts or ties as are capable of being removed in whole or in part so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement.

Beam soffits shall be erected with an upward camber of 5 mm for each 3 metres of span. Top formwork shall be counterweighted or otherwise anchored against flotation.

Boxes for forming holes shall be constructed so as to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air, and shall be capable of being sealed, subsequently to prevent the loss of grout. The use of polystyrene blocks for the forming of holes, sinkings, etc. will not be allowed except by express permission of the Project Manager.

On all external edges risers of the concrete 20 mm chamfers shall be formed.

Openings for inspection of the inside of beam, wall, column and similar formwork and for cleaning-out purposes shall be formed so that they can conveniently be closed before the placing of concrete.

All props shall be supported on adequate sole plates and shall not bear directly on or against concrete. They shall be capable of being released gently and without shock from the supported formwork. No appliance for supporting the formwork shall be built into the permanent structure without the Project Manager's prior approval. Props for upper level support shall be placed directly over those at lower levels, and the lowermost props shall bear upon work sufficiently mature to carry the load.

Formwork shall be such as to allow for its removal without damaging the concrete, and in the case of suspended floors, for the removal of the beam sides and slab soffits without disturbing the beam-bottom boards and their props.

Before concreting, the areas which are intended to receive the concrete shall be cleaned by jetting with compressed air, and all water and extraneous material removed.

Where timber is used for formwork it shall be properly cured, free from warp, straight, clean and free from loose knots.

Where metal forms are used for formwork they shall be of the type strengthened by intermediate ribs or cross bracing.

Moving formwork may be used where in the opinion of the Project Manager it is appropriate.

ii. Sawn Formwork

Sawn formwork shall produce an ordinary standard of finish consistent with normal good practice for use where the face of the finished concrete will not be exposed. The face in contact with the concrete shall consist of sawn timber boards, sheet metal or other approved material.

iii. Wrought Formwork

Wrought formwork for use on exposed faces and water retaining faces shall produce a high standard of finish consistent with the best practice. The face in contact with the concrete shall consist of wrought and thicknesses boards tongued and grooved of not less than 30 mm finished thickness, framed plywood or metal panels or other approved material. Joints between boards and/or panels shall be arranged in a uniform pattern.

iv. Special Wrought Formwork

Special wrought formwork shall provide the highest standard of finish where the face of the finished concrete is to form a particular feature. The face in contact with the concrete shall consist of large smooth sheets, unless otherwise specified, arranged in an approved uniform pattern, with joints coinciding with possible architectural features, sills, window heads, or changes in direction or surface. Accurate alignment of all joints shall be maintained. Wrought boarding and standard steel panels shall not be used unless specially faced.

v. Tolerances

Unless otherwise indicated on the drawings, the tolerances of the finished concrete with respect to the dimensions shown on the drawings shall not exceed the limits set out in Table 3.5.

Table 3.5 Tolerances of Dimensions for Finished Concrete

Items	Tolerances (mm)
Overall dimensions and Levels	±5
Column sizes	±5
) Beam sizes	
Vertical lines out of plumb	5 mm ± 15 mm in every 15 m height

Except that in the case of Sawn Formwork the dimensions of the finished concrete shall be not less than those shown on the drawings.

3.2.13. Striking and Removal of Formwork

The recommendations set out in Table 3.6 are given as a minimum requirement for striking formwork:-

Table 3.6 Striking of Formwork

Item	Sulphate Resisting and Ordinary Portland Cement CEM I to KS 1725 Normal Weather (16^{O}C and above) Days	Rapid Hardening Cement Normal Weather 16^{O}C and above) Days	Portland Pozzolana Cement or CEM IV to KS 1725
Beam Sides, Walls, Columns	1	1	1
Slabs (props left under)	4	3	5
Beam Soffits (props left under)	7	5	9
Removal of props to slabs	8	5	10
Removal of props to beams	16	8	18.5
Shafts and Tunnels	1	1	1.5

The removal of props to slabs and beams shall, if directed by the Project Manager, be subject to satisfactory results of the relevant 7-day cube crushing tests.

The above striking times are for normal conditions and before deciding on the actual time for each case, the Contractor shall consider and extend the period as tabled if: -

a) the span of the structural member under consideration exceeds 6 metres for beams and 3 metres for slabs. An additional period of one day for each 500 mm of additional span shall then be allowed;

b) the dead load of the structural member under consideration forms a large proportion of the total design load;

c) constructional loads coming on to the structural member under consideration are being placed soon after the concreting operations and these loads form a large proportion of the total design load;

d) the setting of the concrete has been retarded for any reasons;

e) the temperature falls below 8^{O}C. An additional period of half a day shall be added

for each day on which the temperature falls below 8^{o}C. For temperatures falling below 3^{o}C the additional period to be added shall be one day for each day on which the temperature falls below 3^{o}C;

f) any combination of the above points and other considerations which would call for such a precaution to be taken.

g) the span concerned is part of a continuous spanning system and the adjacent two spans have not been cured sufficiently.

Information regarding paragraph (b) above will be supplied by the Project Manager; any other design information relevant to the above shall be obtained by the Contractor from the Project Manager.

3.3. Concreting

3.3.1. Requirements

The finished concrete shall be dense, durable, impervious to the ingress of water, free from cracks and honeycombing, and resistant to wear and mild chemical attack. Special concretes will be the subject of their own particular sections of Special Concrete.

3.3.2. Transporting

Concrete shall be transported to the place of final deposit by approved means.

Barrows, spades and other equipment used in the process of transporting concrete shall be thoroughly cleaned before each day's work or after a long interruption and they shall be free from hardened concrete.

Concrete shall be transported as soon as possible after mixing, by methods which will prevent the segregation, loss or contamination of the ingredients.

Proper bridging arrangements for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

Where approval is obtained for concrete to be conveyed by chutes, these shall have a slope (not exceeding 1 vertical to 2 horizontal) such as to ensure a continuous flow of concrete. Additional water shall not be introduced to assist the flow. If deposition is to be intermittent the chute shall be arranged to discharge into a storage hopper. In no case will a clear fall of more than 1 m be permitted at the discharge end of the chute.

Where approval is obtained for pumping the concrete, the pump manufacturer's recommendations shall be followed. The pumps used shall be of adequate capacity and power to ensure delivery of a continuous supply. The Contractor shall provide adequate alternative arrangements for transporting the concrete in case of a breakdown of the pumping equipment.

Wherever transport of concrete is interrupted for any length of time (periods of over half an hour shall be treated as such) the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out and cleaned. These shall also be flushed out immediately prior to resumption of concreting and shall be kept free from hardened concrete. All washwater used shall be discharged outside the formwork and clear of any freshly placed concrete.

3.3.3. Placing and Compaction

No concrete shall be placed until the Contractor has obtained approval to do so from the Project Manager. When the Contractor intends to place concrete he shall inform the Project Manager in sufficient time to enable him to inspect the reinforcement, formwork and surface on which the concrete is to be placed and the Contractor shall provide all facilities for such inspection.

This approval shall be sought by presenting two copies of the completed “Structural Concrete Approval Form” (SCAF) to the Project Manager’s Representative at least 24 hours before intending to concrete. Concrete shall be placed within 30 minutes of mixing, to uniform level, in layers not exceeding 500 mm deep in such manner as to avoid segregation, and each layer shall be compacted by means of approved vibrators to form a dense material free from honeycombing and other blemishes. Compaction by hand may be used only with the prior approval of the Project Manager.

At least one internal vibrator shall be operated for every four cubic metres of concrete placed per hour and at least one spare vibrator for every three shall be maintained on Site in case of breakdown during concreting operations.

Vibration time, the effective radius and other vibration characteristics shall be in accordance with the vibrator manufacturer's recommendations.

If internal vibrators are used, they shall be withdrawn immediately water or a thin film of mortar begins to appear on the surface of the concrete. Withdrawal shall be carried out slowly to avoid cavitation.

Internal vibrators shall not be inserted between layers of reinforcement less than one and one half times the diameter of the vibrators apart. Contact between vibrators and reinforcement and vibrators and formwork shall be avoided.

Vibrators shall not be used to move concrete from place to place in the formwork.

Where two distinct batches of concrete, placed at different periods of time and forming part of the same concreting operation are required to be formed monolithically with each other, the more mature concrete shall be penetrated by the vibrator to a sufficient depth to effect plastic movement between the two batches. Where the concrete does not respond to the action of the vibrator, it shall be deemed to have set, and no further disturbance will be permitted. Unless otherwise instructed by the Project Manager the condition shall be treated as for a "stoppage of work" and the marrying up of the two concretes shall be effected only when both concretes have properly set.

If external vibrators are used, the formwork shall be strong enough to withstand the forces of vibration. Temporary or permanent stoppages of work shall be made only against stop ends.

Unless otherwise specified, before placing new concrete against concrete which has already hardened, the face of the older concrete shall be prepared by the removal of any laitance and loose aggregate, and shall be cleaned by a jet of compressed air.

When displacers are permitted to be used they shall be so placed that no displacer is within 300 mm of any finished face or within 500 mm of any other displacer. On completion of any lift, displacers shall be so arranged that they project for half their height above the surface.

STRUCTURAL CONCRETE APPROVAL FORM (SCAF)
(To be filled in duplicate before any concrete pour)

Contract Details

Job _____ Job No _____

Contractor _____ Site Engineer _____

Section and Concrete Details

Section / Block _____

Level _____ Member _____

Date / Time of Request _____ Date / Time of Pour _____

Concrete Class _____ Mix: Design / Nominal (delete one) Batching: Site / Ready Mix (delete one) Check List

Description of Check	Checked	Remarks
Reinforcement Fixing		
Chairs / Links, etc.		
Reinforcement Cover		
Shutters / Stop ends		
Shutter Props		
Tie Bolts		
Plumbness / Slope		
Dimensions		
Line and Level		
Preparation hacking of joints		
Water Stops		
Moulds for Cubes		
Materials for Curing		
Any other checks (specify)		

Approval

Approved ☐ Not Approved ☐

Date: _____ Signature: _____

Note: Approval by the Project Manager or his Representative does not relieve the Contractor of any of his contractual obligations.

3.3.4. Concreting in Deep Lifts

(i) Limitations

Any height exceeding 2.5 m from which concrete is poured into formwork to form sections of wall will be considered within the terms of this Clause.

Concrete in columns may be placed to a height of 4.0 m with careful placing and vibration and satisfactory results. Where the height of the column exceeds 4.0 m suitable openings must be left in the shutters so that the maximum lift is not exceeded.

Deep lift construction will not be permitted where the reinforcing bars are to be placed closer than 100 mm to one another in any direction or, where the clear width at the point of admitting the concrete between one layer of reinforcement and another (or in the case of singly reinforced walls between reinforcement and formwork) is less than 200 mm.

The method shall only be used where trial sections revealed that, in the Project Manager's opinion it can be satisfactorily employed, in which case the requirements of this Specification shall apply except where they are in conflict with the requirements of this particular clause, when the latter shall prevail.

(ii) Concrete

In order to prevent segregation of aggregates, concrete mixes shall be designed for increased cohesion, or, where suitable, on a gap-graded basis. The use of approved admixtures may be made to achieve this end (Clause 3.2.9).

At the same time, the mix shall be such as to limit the amount of bleeding in the concrete, and where in the opinion of the Project Manager the quantity of free water rising to the surface is excessive, the mix shall be corrected before further concreting is undertaken.

In order to offset any increase in the water-cement ratio at the upper levels, the Project Manager may require the concrete mix to be modified for the upper depositions.

A slump of 80 mm shall not be exceeded.

(iii) Reinforcement

In order that reinforcement is not distorted or displaced during construction as a result of it being used for gaining access in or out of the formwork, all intersections of vertical and horizontal steel shall be properly fastened.

All obstructions caused by spacer blocks or chairs shall be eliminated so as to permit an unobstructed passage for the concrete to the bottom of the formwork. The Contractor may use sliding timber spacers instead of fixed concrete or plastic spacer blocks to position the reinforcement.

(iv) Formwork

In view of the high pressures to be expected from this form of construction extra attention shall be paid to the strength and stability of the formwork, to the prevention of loss of grout, and to the prevention of displacement of adjacent panels.

The use of through-bolts and other accessories which might interfere with the free passage of concrete between and around the reinforcement shall be reduced to a minimum by the use of properly designed formwork.

(v) Concreting

Particular attention shall be paid to the concreting of the initial sections at the bottom of the formwork to prevent segregation caused by rebound from the hard surface of the kicker, base and/or lower sections. The initial depositions shall therefore be made by using trunking methods, or by placing the concrete through openings formed in the sides of the formwork. Such openings shall not be higher from the hard surface than 2.5m.

In order to reduce differential settlement, and consequently, cracking between two sections of concrete placed at different intervals of time, concreting between one section and another shall be carried out on a gap-construction basis (Clause 3.3.10). The gap shall subsequently be concreted in distinct lifts each not exceeding 2.5m in height. For the same reason, when concreting two adjacent sections placed at the same time but of different heights (e.g. where boxing out is included), the difference in height shall not exceed 15% of the height of the deeper section.

Concreting from the upper level of the formwork shall be carried out in such manner as to ensure that concrete is admitted centrally between the faces of the formwork. For this purpose, the Contractor shall make use of trunking or shall use funnel-shaped hoppers extending for a distance of not less than 1.5 m into the formwork. A sufficient number of such hoppers shall be provided, and/or they shall be capable of movement along the length of the formwork, to enable the concrete to be placed in contiguous heaps at the base of the pour. Such heaps shall not exceed 460 mm in height.

Where excessive bleeding is in evidence, the excess water shall be removed before placing further concrete.

(vi) Compaction

Compaction shall be carried out where possible by manual operation of poker vibrators within the formwork. Where this is not possible poker vibrators shall be suspended in sufficient numbers to ensure uniform compaction along the length of wall receiving the concrete, without the need for their withdrawal and re-insertion. The means of suspension shall be such that the vibrators may be progressively and systematically lifted as the concreting proceeds to ensure that every section of placed concrete is married into adjacent and underlying sections.

The use of vibrators to reposition deposited concrete is prohibited. Surface vibrators attached to the formwork may be used only to supplement the main means of compaction.

3.3.5. Continuous Concreting

Where the Contractor desires to use continuous concreting method in large sections (rafts and walls), he shall submit a written request to the Project Manager for approval. In the request he shall attach details which shall include but not be limited to the following :-

- Total amount of concrete to be placed in the shift.
- Stock of approved concrete materials on site.
- Capacity of the batching plant.
- Number and type of truck mixers to be deployed for the exercise and movement logistics.
- Number of skilled and other manpower to be deployed for the exercise in shifts.
- Number and capacity of plant to be used in placing concrete (pumps, vibrators, buckets, etc).
- Method(s) of monitoring and dealing with the heat of hydration.
- Details of protection against rain and floodwaters and how to cope with it.

The Project Manager shall consider the above details and other parameters (e.g. weather, satisfactory records of cube test results, availability of adequate working sections where reinforcement placement and the necessary formwork have been approved etc), before making his decision. The Project

Manager may order that additional concrete cube moulds be made available as well as arrangements be made for cube crushing with an approved laboratory to cope with the increased demand.

The Project Manager may order that the concreting works be stopped immediately if in his opinion the quality of the works is threatened for whatever reason.

3.3.6. Hot Weather Concreting (for temperatures above 20 Degrees Centigrade)

Concreting shall not be permitted if its temperature at placing is in excess of $35^{O}C$. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Project Manager: -

(i) All aggregate stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun;

(ii) Coarse aggregate shall be cooled by constant watering where possible;

(iii) Mixing water shall be cooled by the addition of ice to the storage tanks where necessary;

(iv) Rapid-hardening cement shall not be used;

(v) Where the above precautions are inadequate concreting shall be carried out during the cooler parts of the day or during the night as may be directed by the Project Manager.

When the air temperature is above 20oC loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the mix . In order to maintain the water/cement ratio within permissible limits an approved water-reducing agent shall be included in the mix .

The maximum water/cement ratios indicated in Clause 3.2.1 may be increased with the Project Manager's permission by 0.05 (or 2.5 litres/50 kg of cement) during mixing, but on no account shall water be added to concrete directly or indirectly once it has left the mixer.

In order to reduce premature drying of the concrete during transporting and placing, all chutes, formwork and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun. Any water so used shall be removed by jetting with compressed air before placing the concrete in close contact.

As soon as possible after concreting, the formwork shall be stripped (Clause 3.2.13) and the surface of the concrete shall be treated in accordance with Clause 33.11.

Where drying winds are encountered, wind shields shall be positioned as directed by the Project Manager to protect exposed surfaces of the curing concrete.

3.3.7. Wet Weather Concreting

Concreting during periods of constant rain shall not be permitted unless aggregate stockpiles, mixers and transporting equipment, and the areas to be concreted are adequately covered.

During showery weather, the Contractor shall ensure that work can be concluded at short notice by the provision of stop ends. On no account shall work be terminated before each section, between one stop end and another, is complete. Adequate covering shall be provided to protect newly placed concrete from the rain.

3.3.8. Holes, Cavities and Fixings

The Contractor shall be responsible for the co-ordination of all requirements of his Sub-contractors as regards provision of holes, chases, cavities and fixings and shall, if required by the Project Manager, prepare drawings giving details of his and his Sub-contractor's requirements and shall send copies of such drawings to the Project Manager prior to construction.

Holes, etc. shall be accurately marked and boxed-out for before concreting operations commence and, without the Project Manager's prior approval, no such holes, etc. shall be formed after the concrete has set.

Where bars, if placed to specified spacing would foul holes of size less than 250 mm x 250 mm the full length of the bar shall be moved to one side and in the case of holes exceeding 250 mm x 250 mm the bars shall be cut on site and lapped with additional equivalent bars, or as otherwise indicated on the drawings.

Wherever possible, the Contractor shall build in all pipework, ironwork, etc. which passes through walls and floors, and the pipework, ironwork, etc. shall first be thoroughly cleaned and freed from any deleterious matter, and every care shall be taken to ensure that it is thoroughly encased in concrete.

Unless otherwise instructed by the Project Manager all electrical conduits to be positioned within the reinforced concrete shall be fixed inside the steel cages of beams and between the top and bottom steel layers in slabs and similar members.

The proposed position of all conduits 25 mm and over in diameter which are to be enclosed in the concrete shall be shown accurately on a plan to be submitted to the Project Manager, whose approval shall be obtained before any such conduit is placed.

Bolts, hooks and other fixings shall be embedded in concrete, or holes shall be drilled and fitted with threaded expanding anchors to receive the bolts. The Contractor shall ensure that bolts, hooks, etc. are accurately positioned. Holding down bolts for machinery shall be set by means of a template.

Where brick or stonework is to form a facing to the concrete or where the end of a brick or stone wall butts against a concrete face, galvanised metal ties of approved manufacture to BS 1243 shall be incorporated. The distance between ties shall be gauged with due regard for the bonding of the walls, and at intervals required by the Project Manager.

3.3.9. Protection and Curing

Newly placed concrete shall be protected by approved means from rain, drying winds, sun and contact with substances which can adversely affect it.

No traffic or constructional loads shall be permitted on newly placed concrete until it has hardened sufficiently to take such traffic or load, and only then with the approval of the Project Manager.

Concrete shall at no time be subjected to loading (including its own mass) including compressive stress until it has reached 0.40 of its specified 28-day strength.

Any concrete surfaces, risers and treads of stairways which might be damaged during the construction of the Works shall be adequately protected.

All structural concrete shall be cured using methods approved by the Project Manager.

The method of curing shall prevent loss of moisture from the concrete. Immediately after compaction and for 7 days thereafter concrete shall be protected against harmful effects of weather, including rain, rapid temperature changes and from drying out.

The curing time shall be the number of days given in Table 3.7 unless the average temperature of the concrete during the required number of days falls below 10oC in which case the period of curing shall be extended until the maturity of the concrete reaches the value given in the table.

Table 3.7 Normal Curing Methods

Minimum period of protection for different types of cement

Conditions under which concrete is maturing	Number of days (where the average temperatures of the concrete exceeds 10°C during the whole of the period)				
	Type IV	Type I or Type V	Type III	Type IV	Type I or Type V
1. Hot weather or drying winds	7	4	2	3500	2000
2. Conditions not covered by 1.	4	2	1	2000	1000
	Type IV Cement	-	Low Heat Portland Cement/Portland - Pozzolana		
	Type I	-	Ordinary Portland Cement		
	Type V	-	Sulphate-resisting Portland Cement		
	Type III	-	Rapid-hardening Portland Cement Hot		
	weather	-	Temperature over 16oC		

Curing shall be carried out using either of the following basic methods, or any other method agreed with the Project Manager. Methods involving the use of dampened hessian coverings shall not be used. The method adopted for any particular situation shall be agreed with the Project Manager.

A. Membrane Applied by Spray

Liquid membrane compounds shall be applied to moist concrete surfaces as follows: -

(i) Unformed Surfaces

The compound shall be applied immediately after the free water has left the surface.

(ii) Formed Surfaces

The compound shall be applied immediately after removing the forms. If there is appreciable drying, the surface shall be mist sprayed with water to produce a uniformly damp appearance before the compound is applied.

The compound shall be applied in one or two separate applications to produce complete and uniform coverage of the surface. If the compound is applied in two increments, the second application shall follow the first within 30 minutes. The method and rate of application shall be in accordance with the compound manufacturer's instructions.

If rain falls on the newly coated surface before the film has dried sufficiently to resist damage, or if the film is damaged in any other manner, a new coat of compound shall be applied to the affected area equal in curing value to that originally applied.

Compound applied to construction joint surfaces, or to other surfaces to which concrete is to be bonded, shall be removed prior to placing the fresh concrete.

Depending on the surface to which it is to be applied the compound shall conform to the following requirements of AASHTO M148.

(i) Exposed and vertical concrete surfaces - Type I-D (clear compound with fugitive dye).

(ii) Unexposed top surfaces of foundations and superstructures - Type 2 (white pigmented).

B. Polythene Sheeting

The concrete surfaces shall be covered with white polythene sheeting as follows:-

(i) Unformed Surfaces

The sheeting shall be laid over the surface as soon as possible without marring the surface, and not until initial stiffening has taken place if a brushed or tamped finish is required.

(ii) Formed Surfaces

The surfaces shall be covered immediately after the removal of the forms.

The sheeting may be in contact with the concrete or made into portable shelters on light weight frames. In both cases, the sheeting shall be jointed and sealed against the concrete surfaces to prevent wind blowing between the sheeting and the concrete.

The white polythene sheet shall conform with the requirements of AASHTO M171. On no account shall clear or any other colour of sheeting be used.

C. Other Curing Methods

These shall be agreed with the Project Manager. Methods involving the use of damped hessian coverings shall not be used, unless at least 2 layers of continuous hessian are used and they are kept continuously wet and protected from winds which cause accelerated drying.

Where the thickness of concrete placed exceeds 1.5 m, the Contractor shall submit for the Project Manager's approval proposals to ensure that, during the curing period:-

a) the rate of rise of temperature in the concrete does not exceed $15^{o}C$ per hour for the first 3 hours;

b) thereafter the rate of rise and fall of temperature in the concrete does not exceed $35^{o}C$ per hour;

c) the maximum temperature in the concrete does not exceed $70^{o}C$; and

d) the maximum difference in temperature between the core and the surface of the concrete does not exceed $20^{o}C$.

The proposals shall include consideration of: -

a) concrete mix design;
b) temperature of mix at time of placing;
c) method of curing.

Where required by the Project Manager, the Contractor shall carry out temperature measurements in the concrete. The method and procedure of temperature measurement shall be agreed with the Project Manager.

3.3.10. Joints

(i) Construction Joints

The position of construction joints, when not shown on the Drawings or otherwise required by this Specification, shall be decided on site having regard to the plant and labour made available by the Contractor for the manufacture, placing and compaction of the concrete as well as its curing, the climatic conditions prevailing at the time of concreting, the nature and size of the formwork, and the conditions of operation of the work. Waterstop shall be provided to all construction joints on water

retaining or excluding structures. The Contractor shall submit his proposals to the Project Manager for his approval at least fourteen days before commencing the work.

Construction joint surfaces shall be treated by the "wash-off" method explained below, except where it cannot be practically effected.

When expanded metal lathing is used for the formation of construction joints a rebate will not be required to be formed. The expanded metal lathing shall be left in the work and shall not extend closer to the finished surface of the concrete than 25 mm. It shall be securely fixed to the reinforcement.

The following particular requirements shall also be observed: -

* Slabs supported on the ground

In order to ensure control in the placing of concrete the Contractor shall provide control boards to form panels not larger than 15 m2 in area. These shall be lifted as the concreting proceeds except where they are of expanded metal in which case they may be left in position as part of the permanent works, provided that they shall not extend closer to the finished surface of the concrete than 25 mm. In the event of a breakdown in the supply of concrete the Contractor shall ensure that an alternative supply of concrete is made available (to finish the work against the control boards acting as stop ends). The joint so formed shall then be treated as a construction joint. Where Ready-mixed concrete is permitted the control boards shall be positioned so as to enclose a volume of concrete equal to that delivered by each truck.

Construction joints and control joints shall be formed normal to the surface of the retained concrete.

* Suspended Beams and Slabs

T-beams shall be formed to their full depth integrally with the adjacent slab and without horizontal joints.

* Columns

Where kickers are indicated on the drawings these shall be cast together with the slab or beam below. On no account shall kickers be cast as a separate operation. Alternatively, the Contractor may adopt “kickerless construction” methods providing he can satisfy the Project Manager that his system is reliable and does not compromise workmanship.

* Walls

Horizontal construction joints in walls shall be formed along straight lines coinciding with the full height of the formwork. The height of the formwork thus controlling the height of the pour shall be determined with reference to the availability of concrete, the size and amount of reinforcement and the means of compaction available.

Unless otherwise indicated on the drawings or otherwise permitted by the Project Manager for the construction of circular tanks, concreting shall be carried out continuously for the full circumference without vertical joints. Where permission is granted for the use of vertical joints the Project Manager may order, at no extra cost to the Employer, the inclusion of an approved type of water stop.

In the case of rectangular tanks, vertical joints shall not be positioned closer to any corner than one metre. They shall be formed with properly rebated stop ends or, where conditions permit, by the use of expanded metal lathing. Unreinforced manholes shall be constructed without vertical joints.

(ii) The "Wash-off Method" of preparing Construction Joints

As soon as possible after concreting, and while the surface is still green, the surface of the concrete forming the joint shall be freed of loose aggregate and sprayed with a fine spray of water to prevent

the formation of laitance. Subsequently all excess water shall be removed by a jet of compressed air and the surface left clean to receive further concrete.

Where expanded metal lathing is used for construction joints, this method of surface preparation shall be used in every case.

(iii) Movement Joints

These shall include contraction and expansion joints and shall be as indicated on the drawings.

Contraction joints will be either full contraction joints or partial contraction joints. Where partial contraction joints are specified a period of at least five days shall elapse between the concreting of the section on each side of the joint.

Where the drawings indicate a contraction gap to be formed in any panel (this gap will not exceed one metre), concreting on either side of the gap shall be carried out so as to form partial contraction joints at each side of the gap. Prior to the concreting of the gap section, the joint surfaces shall be cleaned but otherwise left untreated. The concreting of the gap section shall not be carried out until a period of at least five days has elapsed after completion of the adjacent sections.

Alternate panel construction (other than contraction gap construction outlined above) will be permitted only with the approval of the Project Manager, or in those cases where either the reinforcement is not continuous through the joint or where the panels are separated by expansion or contraction joints.

Unless otherwise specified or permitted by the Project Manager all waterstop shall consist of rubber or PVC. Jointing of waterstop shall be by vulcanising, except where PVC is specified or permitted in which case joints shall be by fusing or welding. Materials shall be obtained from an approved manufacturer whose recommendations as to jointing shall be fully complied with.

(iv) Waterstop and Jointing Materials

Waterstop and jointing materials shall be obtained from an approved manufacturer.

All waterstop and jointing materials which are not required for immediate use shall be stored at all times in a cool damp place.

Waterstop shall be manufactured of rubber or PVC (polyvinylchloride) as shown on the drawings, and shall be of the type and size shown on the drawings. Site joints shall be made strictly in accordance with the manufacturer's instructions and all intersections and junctions shall be obtained prefabricated from the approved manufacturer.

Joint filler shall be manufactured of natural bonded cork or other approved material which remains serviceable when wet. Joint filler shall be cut and trimmed accurately to suit the joint profile and shall be maintained accurately in position by means of an approved adhesive. The compressibility of the filler shall be such that it can be compressed to 50% thickness with a pressure of not less than 0.07 N/m square and no greater than 0.4 N/mm square. After 50% compression, the material should recover to at least 70% original thickness within 30 minutes. On no account shall fibreboard or similar be used as filler.

Joint sealing compounds shall be approved polysulphide based compounds suitable for sealing joints in horizontal and vertical/sloping concrete surfaces as appropriate. Sealing compounds shall be applied strictly in accordance with the manufacturer's instructions and shall completely fill the joint recess. Surface primers shall be from the same manufacturer as the sealants themselves. Joint sealing compounds shall be entirely suitable for contact with potable water where these are used in water retaining structures.

Waterstop shall be located and maintained accurately in position and details of the proposed method of fixing shall be submitted to the Project Manager for approval. On no account shall waterstop be secured by nails or by any other means involving puncture of or damage to the waterstop material unless purpose made nailing flanges are incorporated in the design of the waterstop.

(v) Slip Membrane

The slip membrane shall be "slipstrip" as supplied by Serviced Limited, Ajax Avenue, Slough, Berkshire, UK or similar approved material. The slip membrane shall be not less than 1.5 mm thick and shall be a plastic preformed strip with low coefficient of friction specifically manufactured for use as a separating membrane in sliding joints between concrete surfaces. Each sliding joint shall comprise two layers of the membrane unless otherwise shown on the drawings.

The concrete surface to which the slip membrane is to be fixed shall be finished with a steel float to provide a smooth true surface free from dust and loose particles.

(vi) Expandafoam

Expandafoam shall be as supplied by Expandite Limited or similar approved material. Expandafoam is a closed cell flexible polyethylene joint filler used where a readily compressible low load transfer joint filler is required. Expandafoam shall be fixed in position using a suitable adhesive.

3.3.11. Finishes - General

All exposed faces of concrete unless otherwise specified shall be hard, smooth and free from honeycombing, air and water holes and other blemishes.

All projecting imperfections shall be rubbed down with carborundum stone or by other approved means and grit and dust therefrom shall be thoroughly washed off with clean water.

Surface Finishes

a) Wood float finishes shall be formed by smooth floating the accurately levelled and screeded surface. Care shall be taken to ensure that the concrete is worked no more than is necessary to produce a uniform surface free from screed marks.

b) Steel trowel finishes shall be formed while the concrete is still wet by means of a steel trowel applied to an accurately levelled and screeded surface.

c) Granolithic finishes shall conform to the recommendations laid down in "Specification for Granolithic floor toppings laid in-situ concrete", as published by the UK Cement and Concrete Association with special reference to monolithic construction.

d) Screeded finishes shall be formed by levelling and screeding the concrete to produce a uniform, plain or ridged surface as specified; surface hardners shall be applied strictly in accordance with the manufacturer's recommendations.

e) Bush-hammered or pattern-worked finishes.

When exposed aggregate is to be the surface texture, the Contractor shall ensure that a uniform distribution of the coarse aggregate takes place at the face. The formwork shall be removed as soon as possible from the face to be treated; the surface shall be thoroughly wetted and wire brushed, and bush-hammered or pattern-worked as and when instructed. Surface retarders shall be used only when permitted by the Project Manager.

Bush-hammering or pattern-working shall not be relied upon to obscure any defects in the concrete face which arise from formwork imperfections.

Making Good

On no account shall any faulty honeycombed or otherwise defective concrete be repaired or patched until the Project Manager has made an inspection and issued instructions for the repair.

Honeycombed or damaged surfaces of concrete, which in the opinion of the Project Manager, are not such as to warrant the cutting out and replacement of the concrete, shall be made good as soon as possible after removal of the formwork as follows:-

1:1.5 Portland Cement and sand mixture shall be worked into the pores over the whole surface with a fine carborundum float in such a manner that no more material is left on the concrete face than is necessary to fill the pores completely so that a uniformly smooth and dense surface of uniform colour is finally presented.

Removal and Replacement of Unsatisfactory Concrete

The Contractor shall on the Project Manager's instructions to do so cut out and replace any concrete in any part of the structure if in the Project Manager's opinion:-

a) the concrete does not conform to the Specification, or

b) deleterious materials or materials which are likely to produce harmful effects have been included in the concrete, or

c) the honeycombed or damaged surfaces are too extensive, or

d) the finished concrete sizes are not in accordance with the drawings within permissible tolerances, or

e) the setting-out is incorrect, or

f) the steel cover has not been maintained, or

g) the protection, including curing, of the concrete during the construction was inadequate, resulting in damage, or

h) the work of making good or other remedial measures the Project Manager may indicate are not carried out to his satisfaction, or

i) undue deformation of or damage to the works has taken place due to inadequate formwork, or to premature traffic or to excessive loading, or

j) any combination of the above points has taken place resulting in unsatisfactory work.

3.3.12. Testing

i. Sampling and Testing

The Contractor shall provide on the Site equipment, staff and labour for carrying out the sampling and testing outlined in columns 3 and 4 of Table 3.8, and he shall carry out any or all of these tests at such times and with such frequency as may be requested by the Project Manager.

All equipment shall be calibrated and checked from time to time by an approved agency, as the Project Manager may require.

The Contractor shall provide all samples required by the Project Manager. Those samples to be tested in an offsite laboratory shall be carefully forwarded by the Contractor to an approved laboratory. Results of laboratory and site tests shall be kept on site and copies of all test reports shall be forwarded in duplicate to the Project Manager.

Each cube shall be marked with a distinguishing number (numbers to run consecutively) and the date, and a record shall be kept on Site giving the following particulars:

a) Cube No.

b) Date and time made

c) Temperature and weather conditions

d) Location in work

e) 7-day Test
Date :
Strength

f) 28-day Test
Date :
Strength

Cubes shall be forwarded, carriage paid, to an approved Testing laboratory in time to be tested two at 7 days and two at 28 days. No cube shall be dispatched within 3 days of casting.

Authentic copies of all Work Test results shall be forwarded to the Project Manager directly from the testing laboratory and one shall be retained on the site. The test certificates shall indicate all properties as required by BS 1881.

The Contractor must allow in his rates for concrete test cubes for all expenses in connection with the preparation and conveyance to the Testing Laboratory and testing of test cubes and no claim in respect of his failure to do so will be entertained.

Any batch of concrete which fails to achieve the required characteristic strength shall be removed and made good in accordance with this Specification. The Contractor shall carry out all such work at his own cost.

Frequency of tests and the number of samples required will be governed by the results of the previous tests, the quality of the materials revealed during the tests, and the uniformity of that quality (see Table 3.8). Should it become evident that the quality of concrete is deteriorating the Project Manager may require additional samples to be taken and test cubes to be made and tested to determine the cause.

ii. Loading Tests

The Project Manager may direct that a loading test be made on the works or any part thereof if he deems such test to be necessary for one or more of the following reasons:-

a) failure of "Site Cubes" to attain the strength requirements of Clause 3.2.2.

b) premature removal of formwork;

c) overloading of structure during construction;

d) improper compaction and/or curing of concrete;

e) any other circumstances attributable to alleged negligence on the part of the Contractor, which, in the opinion of the Project Manager, may result in a structure being of less than the required strength;

If the loading test is ordered to be made solely or in part for reasons (a) to (d) the test shall be made at the Contractor's own cost.

If the loading test is ordered to be made for reason (e), the Contractor shall be reimbursed for the cost of the test if the result is satisfactory. No extensions to the Contract Duration shall be granted for delays and disruption resulting from these tests.

Loading test shall be carried out in accordance with the requirements of BS 8110 – 2 Section 9.

If the results of the test are not satisfactory, the Project Manager will direct that the part of the work concerned be taken down or removed and reconstructed to comply with the Specification, or that such other remedial measures as he may think fit be taken to make the work acceptable and the Contractor shall carry out such work at his own cost.

Table 3.8 Sampling, Testing and Acceptance Standards

Materials	Test	Site Sampling	Testing	Accepted Standards	Remarks
1	2	3	4	5	6
Cement	Ordinary Portland Rapid Hardening Sulphate Resisting		 BS 4550	BS 12 BS 12 BS 4027 KS1725	Manufacturer's Test Certificate
Aggregates	Description and Classification		BS 812 Sec 2	BS 882	
	Particle Size	BS 812 Sec 1	BS 812 Sec 3	BS 882	Mix design requirements
	Particle Shape	BS 812 Sec 1	Visual and BS 812 Sec 3		Mix design requirements
	Specific Gravity	BS 812 Sec 1	BS 812 Sec 3		Mix design requirements
	Density	BS 812 Sec 1	BS 812 Sec 3		Mix design requirements
	Voids	BS 812 Sec 1	BS 812 Sec 4		
	Absorption	BS 812 Sec 1	BS 812 Sec 4	BS 8007 Cl 6.2.2	See Freeze-thaw Test in this table
	Organic Impurities	BS 812 Sec 5			
	Moisture Content	BS 812 Sec 5			For adjustment of added water for concrete
	Mechanical Properties	BS 812 Sec 6	BS 882		Ten per cent fines value
Water	Suitability	BS 3148	BS 3148	BS 3148	Not required for potable water
Concrete	Compacting Factor	BS 1881 Pt 101	BS 1881 Pt 103		Workability Test
	Slump		BS 1881 Pt 102		
	Crushing		BS 1881	BS 5328, BS 8110	Cube test
	Water Absorption		BS 1881 Pt 122	BS 7263	
	Freeze-thaw	BS 1881	BS 812 Sec. 1		Durability test for aggregate not complying with moisture absorption requirements of

Materials	Test	Site Sampling	Testing	Accepted Standards	Remarks
1	2	3	4	5	6
	Electrolytic Efflorescence				As required for salt-containing aggregate or saline water
	Cores	BS 1881 Pt 6 BS 1881 Pt 120	BS 1881 Pt 6 BS 1881 Pt 120	BS 1881 Pt 120 with ref to concrete strengths this Specification	
Admixers	Compatibility with cement	As required by Laboratory			Tests to be carried out by independent Laboratory as required

The Project Manager may also instruct the Contractor before a loading test takes place to take out cylindrical core specimens from the structures concerned and have them tested. The cutting equipment and the method of doing the work shall be to the Project Manager's approval. The specimens shall be dealt with in accordance with BS 1881. Prior to testing, the specimens shall be available for examination by the Project Manager. If the cores are ordered to be taken solely or in part for reasons (a) and (d) above, the work involved and the testing shall be made at the Contractor's own cost. If the cores are to be taken for reasons (b), (c) and (e) above, the Contractor will be reimbursed the cost if the loading test described in the previous paragraphs proves satisfactory.

3.4. Special Concrete

i. No-fines Concrete

No-fines concrete for use in subsoil drainage shall consist of a 1:8 cement/aggregate mix by volume. Aggregate shall be 20 mm to 10 mm graded with no more than 5% passing the 10 mm sieve. Only sufficient water shall be added to ensure complete coating of the aggregate. One half of this water shall be placed into the mixer first, after which the aggregate and cement shall be admitted. After partial mixing the balance of the water shall be added until a consistency of mix is achieved.

Preliminary tests shall be carried out on the site to prove the suitability of the finished concrete, and adjustments made to the proportions and or grading as may be required by the Project Manager.

ii. Air-Entrained Concrete

Concrete for roads and those structures where specified, shall include an approved air-entraining agent capable of producing a 5% air-entrainment with a tolerance of 0.5%.

The mix shall be purposely designed, having regard for the nature of grading of the aggregates and air-entraining agent being used.

Preference shall be given to the use of air-entraining agents which can be administered in fixed calibrated amounts through a dependable mechanical dispenser or sachet, and which are added to the mixing water.

Frequent air meter tests shall be carried out and the consistency of the air-entrainment maintained to the above tolerances by adjustments in the mix, as may be necessary.

iii. Concrete in Benching

Concreting for benching in manholes, pumping stations and works structures shall consist of Grade C25P concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required and, while still green, shall be finished with not less than 50 mm of Grade C25P concrete to a steel trowelled finish and to the contours indicated on the drawings.

iv. Ready Mixed Concrete

Unless otherwise stated the relevant clauses of BS 5328 shall apply.

Ready mixed concrete shall only be used with the prior approval of the Project Manager. The Contractor shall not be relieved of his obligation to provide concrete to the standard laid down in this Specification by virtue of any approval given for the use of concrete supplied by others, and the Project Manager reserves the right to withdraw his approval at any time consequent on any deterioration in the quality of the Concrete, or unsatisfactory delivery or any other reason he considers detrimental to the Works.

Ready mixed concrete manufactured off the site shall be transported in a revolving drum and shall be continuously agitated until it is used in the work unless otherwise approved. The time interval between adding water to the drum and placing shall not exceed 90 minutes.

v. Granolithic Concrete

Refer to Clause 3.3.11.

3.5. Pneumatically Applied Mortar (Gunite)

(i) Requirements

The pneumatic application of mortar shall be carried out only by Contractors experienced in this type of work and who are in possession of proper Plant and equipment. Nozzlemen employed on the works shall be skilled operators.

The finished product shall be dense, of even texture and colour, and to the requirements of strength, tolerance and finish set out in this Specification.

(ii) Strength

After curing, the mortar shall be capable of producing cored samples with a 28-day characteristic strength of not less than 27.5N/mm2.

(iii) Materials

Sand, cement and water shall comply with the requirements of Clause 3.2.7 of this Specification except that the sand shall conform to the grading of Zone 2 of BS 882.

(iv) Proportions

The proportions to be used in the mix shall be determined with reference to the requirements outlined in sub-clause 307(i) and the mix shall be not weaker than one part of cement to four parts of sand by volume, having regard to the adjustments for bulking of the sand.

(v) Operation

Air and water pressures shall be such as to permit the proper application of the mortar, and shall be determined with reference to hose lengths and nozzle diameter.

Mortar rebound, recovered, cleaned and uncontaminated with extraneous matter, may be re-used but not for water-retaining structures. It shall be regarded as an equivalent volume of sand which shall not exceed 20 per cent of the total sand requirement. Rebound which has lodged in the formwork or between reinforcement shall be removed by compressed air.

Reinforcement shall be completely embedded in the mortar by the proper direction of the nozzle and the mortar shall be applied as a steady and uninterrupted flow from the nozzle.

Mortar application shall be discontinued at any section of the work where sagging of the mortar is in evidence.

(vi) Joints

These shall be formed by sloping the surface to a thin edge. Before applying new mortar, the surface shall be thoroughly wetted. Laitance shall be removed by the initial discharge of fresh mortar.

(vii) Tolerances

The thickness of applied mortar shall be not less than the dimensions shown on the Drawings nor greater than 10 mm over those dimensions, unless otherwise indicated on the Drawings or otherwise permitted.

(viii) Protection and Curing

Shall be carried out in accordance with the requirements of Clause 3.3.9.

(ix) Finishes

Unless otherwise specified all surfaces shall be brought to a granular textured finish by means of a wooden float.

(x) Cold Weather Work

No application of mortar shall be made against frozen surfaces nor when the air temperature is below 5°C.

(xi) Making Good

Any defective work shall be cut out immediately and made good with fresh mortar pneumatically applied.

3.6. Cement Grouts

Cement grout shall be mixed in the relevant proportions indicated in the following table using the minimum quantity of water to ensure the necessary fluidity and to render it capable of penetrating the work.

Class	Nominal Mix by Mass	
	Cement	Sand
G1	1	-
G2	1	3
G3	1	10

Cement grout shall be used within one hour of mixing, except where containing a retardant admixture.

3.7. Pumped Concrete

Where pumping of concrete is permitted to be used no relaxation of the requirements of this Specification will be permitted. Particular attention shall be paid to the proper grading of aggregates to prevent bleeding and/or segregation during the pumping operations. The inclusion of water-reducing additives or other materials, including fly ash, to improve the flow characteristics of the concrete will only be permitted where it can be shown that they do not adversely affect the concrete either in the plastic phase or in the finished work.

3.8. Precast Concrete Units

3.8.1. Requirements

Unless otherwise agreed in writing by the Project Manager, all precast concrete units shall be manufactured on site and shall be true to dimension and shape, with true arises and with perfectly smooth exposed faces free from surface blemishes, air holes, crazing and other defects, whether developed before or after building-in. They shall comply with the appropriate BS. (Note: Coping blocks and similarly exposed units are particularly susceptible to crazing when the concrete is manufactured using high water/cement ratios)

The maximum size of coarse aggregate in precast concrete shall not exceed 20 mm except for thicknesses less than 75 mm where it shall not exceed 10 mm.

The compacting of precast concrete shall conform with requirements given elsewhere in this Specification except for thin slabs where use of immersion type vibrators is not practicable. The concrete in these slabs may be consolidated on a vibrating table or by any other methods approved by the Project Manager.

Steam curing of precast concrete will be permitted. The procedure for steam curing shall be subject to the approval of the Project Manager.

The precast work shall be made under cover and shall remain under the same for seven days. During this period and for a further seven days the concrete shall be shielded by sacking or other approved materials kept constantly wet. It shall then be stacked in the open for at least a further seven days to season before being set in position. Where steam curing is used these times may be reduced subject to the approval of the Project Manager.

Precast concrete units shall be constructed in individual forms. The method of handling the precast concrete units after casting, during curing and during transport and erection shall be subject to the approval of the Project Manager, providing that such approval shall not relieve the Contractor of responsibility for damage to precast concrete units resulting from careless handling.

Repair of damage to the precast concrete units, except for minor abrasions of the edges which will not impair the installation and/or appearance of the units, will not be permitted and the damaged units shall be replaced by the Contractor at his own expense.

Except where precast work is described as “fair face” or as having “exposed aggregate” or terrazzo finish the moulds shall be made of suitable strong sawn timber true in form to the shapes required. Unless otherwise described, faces are to be left rough from the sawn moulds.

Where precast work is described as “fair face” the moulds are to be made of metal or are to have metal or plywood linings or are to be other approved moulds which will produce a smooth dense fair face to the finished concrete suitable to receive a painted finish direct and free from all shutter marks, holes, pittances, etc. Where precast work is to have an “exposed aggregate” or terrazzo finish the moulds shall be constructed to the requirements given for moulds for “finished fair” work.

The method of achieving the exposed aggregate finish shall be “aggregate transfer” or other approved method.

3.8.2. Kerbs

Precast concrete kerb shall conform to BS 7263: Part 1: 1990, except that coarse aggregate shall conform to BS 882: 1983. Fine aggregate shall consist of sand resulting from the natural disintegration of rock.

Approved air-entraining agents may be permitted to be used providing that approved adjustments are made to the mix with regard to water and fine aggregate proportions. In such cases the moisture absorption limits set out in BS 340 may be neglected subject to the concrete satisfying the freeze thaw test laid down under the heading "Weir Blocks and Sills".

3.8.3. Paving Slabs

Paving slabs shall conform to BS 368 and shall be 50 mm thick unless otherwise specified.

3.8.4. Other Blocks

Blocks used for building work and filter bed walls shall conform to BS 6073: Part 1: 1981.

3.8.5. Wall Units

L-shaped wall units shall conform to the requirements of BS 8110. Where it is not intended to use coping blocks for the protection of the upper exposed surface of the units, the uppermost 150 mm, for the full width of the unit, shall be formed with concrete composed of aggregate complying with BS 882: 1992. Such concrete shall be formed integrally with the main body of the concrete.

3.8.6. Other Items

Manhole ring units, tapers, cover slabs, segments and concrete pipes are referred to under their particular heading.

3.9. Concrete Works Site Books and Standards

3.9.1. Instructions to be Recorded

The Contractor shall provide and keep permanently on the Site a numbered triplicate book wherein the Contractor shall record all instructions relating to concrete work issued by the Project Manager. One copy of every entry therein shall be sent to the Project Manager on the same day as the entry is made.

3.9.2. Site Diary

The Contractor shall provide and keep permanently on the Site a continuous entry diary wherein the Contractor shall record details of formwork, construction, placing of reinforcement, concreting and curing operations, striking of formwork, making good and daily temperature and weather conditions. This diary shall always be available for inspection by the Project Manager.

3.9.3. Copies of Standards and Codes

The Contractor shall provide and keep permanently on the Site copies of Standard Codes of Practice Notes and Specifications as may be required by the Project Manager.

3.10. Water Retaining Structures - Special Clauses

Note: In the event of any differences between the "Special Clauses" and the previous Specification under Section 2.3 the provisions of these "Special Clauses" shall have precedence.

3.11. Making Good

The cement mortar used in filling recesses in the concrete formed by bobbins in connection with formwork shall contain an approved expanding admixture.

3.12. Construction Joints in Water Retaining Structures

In water retaining structures PVC waterstops not less than 130 mm wide manufactured by an approved manufacturer shall be built into all construction joints in external walls and construction joints in roofs of potable water retaining structures. Construction joints shall be formed at positions agreed by the Project Manager.

The cost of forming construction joints shall be included by the Contractor in his general concrete rates.

3.13. Watertightness of Structures

The Contractor shall be solely responsible for the watertightness of structures and any remedial measures necessary.

3.13.1. Hydrophilic Rubber Sealer

Hydrophilic rubber sealer shall be co-extruded from chloroprene and hydrophilic rubbers into a cellular strip approximately 25 mm x 7 mm thick which expands as it absorbs water. The strip shall incorporate an expansion delay coating to prevent activation during setting of the surrounding concrete.

Hydrophilic rubber sealer shall be applied to the perimeter of all pipes to be built into concrete structures, to existing concrete walls and slabs at or below water levels which have been demolished and require extension, and to other locations as indicated on the Drawings.

The strip sealer shall be bonded to the pipe diameter or on to the face of demolished structures on to which new concrete is to be placed so as to be at least 100 mm from the wall surface. Where dowel bars are incorporated in bonding new concrete to old, the sealer shall be placed above the dowel bars on the "wet" side of the structure. Bonding shall be accomplished using proprietary neoprene or epoxy adhesives to ensure the sealer is not disturbed during placement of the concrete.

The sealing strip shall be from an approved supplier and application shall be strictly in accordance with the manufacturer's recommendations.

3.13.2. Waterproof Membranes for Concrete Roofs and Gutters

Concrete roofs and gutters shall be waterproofed by the provision of a membrane to be laid on top of the slab. The membrane shall be a cold applied preformed waterproof laminated layer comprising a HDPE carrier film with a solar reflective surface and a self-adhesive rubber bitumen compound complying with the requirements of BS 8102. The membrane shall exhibit a tear resistance of at least 250 N/mm when tested in accordance with ASTM D1004. Adhesion to primed concrete to itself shall exceed 1.75 N/mm when tested in accordance with ASTM D100, and a puncture resistance of 290 N 65 mm when tested in accordance with ASTM E154. Membranes shall exhibit a water resistance of not more than 0.14% after

24 hours when tested in accordance with ASTM D574. The contractor shall submit proposals for waterproof membranes for approval, together with manufacturer’s catalogues and technical literature.

Waterproof membranes shall be installed entirely in accordance with the manufacturer's instructions. Membranes shall be continued up the internal face of the parapet wall and finished centrally under the coping. Adjacent strips of membrane shall be overlapped to provide a waterproof joint. The provision of a waterproof membrane on the roof slab shall not relieve the Contractor of his responsibilities to produce a waterproof roof slab which shall have successfully passed a watertightness test before the membrane is installed.

d) PIPELINES AND PIPEWORK

4.1. General

4.1.1. Equivalency of Goods, Materials and Plant

Wherever reference is made in the Contract, including Specifications, Drawings and Bill of Quantities, to specified manufacturers or suppliers for the supply of goods, materials and plant for the Works, goods, materials and plant from alternative manufacturers and suppliers will be permitted, unless otherwise expressly stated in the Contract, providing these other goods, materials and plant are substantially equal or of a higher quality than those of the specified manufacturer or supplier and are approved in writing by the Project Manager. Differences between the specified goods, materials or plant and the proposed alternative shall be described in writing by the Contractor and submitted to the Project Manager, together with such manufacturer's or supplier's technical literature and samples as the Project Manager may reasonably require. At least 28 days prior to the date when the Contractor desires the Project Manager's consent. In the event the Project Manager determines that such proposed alternative goods, materials or plant do not ensure substantially equal or higher quality, the Contractor shall obtain the goods, materials or plant from the manufacturer of supplier specified in the Contract.

4.1.2. Materials

Any material which will come into contact with potable water or water to be used for potable supply shall comply with the standards and regulations on the use of materials for potable water supply. AWWA, BS EN, DIN, national standards adopted for use in Kenya or any other international accepted standards.

4.1.3. Approval

As soon as possible after commencement of the Contract, the Contractor shall submit to the Project Manager for his approval a list of his proposed suppliers, sources of materials and proposed standards. No materials, plant or equipment shall be procured for the Contract without first obtaining the Project Manager's approval. Samples of materials shall be submitted to the Project Manager for approval as required by the Project Manager. Materials subsequently supplied shall conform to the quality of the samples which have been approved by the Project Manager. No standards, method of manufacture or specification shall be changed without the approval of the Project Manager. Where possible, plant shall be supplied to the same standards or to compatible standards.

The Contractor shall provide secure storage for all samples submitted to the Project Manager.

4.1.4. Dimensions

Plant and materials shall be supplied to the general arrangements and dimension, or to suit the dimensions, shown on the Drawings or otherwise indicated in the Contract. Where no such dimensions are shown the Contractor shall be responsible for sizing the Plant. Any redesign, extra design, additional construction or any other costs resulting from the use of Plant to other arrangements or to other dimensions shall be the responsibility of the Contractor.

4.1.5. Packaging and Protections

All items shall be adequately crated or packaged to withstand damage and prevent deterioration due to shipping, handling and storage. The methods of protection and shipping shall be to the approval of the Project Manager.

4.1.6. Marking

All Plant shall be marked in accordance with Clause 5 of BS EN 545 and Clause 37 of BS 5163. Before shipping, all items shall be clearly marked. Crates or packages shall be marked on two sides with indelible paint with the name of the project, the Employer and the Contract number shall bear marks indicating the contents.

4.1.7. Receipt, Storage, Handling and Transportation

Plant, equipment and materials shall be stored in such a manner as to preserve its quality and condition to the standards required by the Contract. The Project Manager shall refuse to accept or shall reject any materials of Plant that in his opinion is defective or otherwise fails to comply with the standards required by the Contract. All such defective items shall be removed from the Site as directed by the Project Manager. Repairs shall be carried out in accordance with procedures approved by the Project Manager and shall be completed to the Project Manager's satisfaction.

4.1.8. Manufacturer's Certificates

The Contractor shall furnish the Project Manager with a manufacturer's certificate conforming compliance to the specification in respect of all items of Plant, equipment and materials. The original and one copy of the manufacturer's certificate shall be delivered to the Project Manager not later than 14 days prior to the intended date of delivery of the item to Site.

4.1.9. Proprietary Materials

Proprietary materials shall be supplied in suitable containers and in appropriate batch sizes for the work to be undertaken. The containers shall be marked with the following information:

i. Storage instructions
ii. The manufacturer's name
iii. Shelf life and dates of manufacture
iv. Material identification
v. Batch reference number
vi. Net weight
vii. Any warnings or precautions concerning the contents and their safe use.

The Contractor shall supply with each consignment of proprietary material delivered to the Site, certificates furnished by the manufacturer or his agent stating:

i. The manufacturer's name and address
ii. The agent's name and address where applicable
iii. Material identification
iv. Batch reference numbers, size of each batch and the number of containers in the consignment
v. Date of manufacture.

4.1.10. Rejected Materials

Should any item of plant, materials or manufactured articles be in the judgment of the Project Manager, unsound or of inferior quality or in any way unsuited for the purpose in which it is proposed to employ them, such items, materials or manufactured articles shall not be used upon the Works but shall be branded, if in the opinion of the Project Manager this is necessary, and shall forthwith be removed from the Site.

4.1.11. Samples and Storage of Materials

Where required by the Project Manager the Contractor shall submit to the Project Manager for approval samples of pipes, fittings and materials prior to procurement. The Contractor shall only store pipe, fittings and other material at places approved by the Project Manager and shall at all times provide adequate supervision and watchmen to prevent theft or damage. Any loss or damage incurred will be the Contractor's responsibility.

Pipes shall not be stacked higher than recommended by the manufacturer. The area on which the pipes are to be stacked shall be free draining, the grass or other vegetation shall be kept cut and suitable timber

cradles shall be provided on which the pipes shall be laid. End stops to all stacks shall be provided.

Fittings and valves shall not be stacked more than one tier high and they shall be supported off the ground by suitable timbers.

Air valves, rubber joint rings, gaskets, bolts and similar fittings and materials shall be kept in approved locked premises and such fittings and materials shall not be distributed to the trench side until immediately prior to laying, fitting, jointing or assemble thereof. All rubber joint rings and gaskets must be stored in a cool damp location and all fittings and materials shall at all times be stored in the shade under cover and protected from the weather to the satisfaction of the Project Manager.

4.1.12. Flanges

Flanges shall be faced and drilled to conform to the dimensions specified in BS 4504. Flanges shall be compatible with the pressure rating of the adjacent pipework or as stated on the drawings. Bolts, nuts and washers (two washers per bolt) shall be to BS EN 1092-3; 2003. No bolt shall project less than two full threads beyond its nut after tightening. In no circumstances shall the shortening of excessively long bolts by cutting be allowed.

Gaskets shall comply with replaced by BS EN 1514 (1997) and replaced by BS EN 681-2 (200) and BS 681-1 (1996) Type W. Flanges shall be painted with two coats of epoxy resin paint. Puddle flanges shall be fitted to all pipework passing through water-retaining structures and manholes greater than 2.5m deep.

4.1.13. Mechanical Couplings

Bolted sleeve couplings: Couplings shall consist of two end flanges made from special hot rolled tee sections and a middle sleeve. The flanges shall be tightened together by galvanised bolts to compress a pair of rubber gaskets located between each flange and the sleeve. These joints provide for expansion

and joint deflection (up to 3º) and are covered under AWWA C219, BS EN 10224, and UNI 6363. They shall be coated with fusion bonded epoxy to AWWA C213. They may be harnessed for end thrust. Joint pressures range for upto 40 bar as may be specified. Rubber rings used shall be of the ethylene propylene rubber (EPDM) or other material approved by the Project Manager.

4.1.14. Materials for the Assembly of Flexible Joints

Lubricant shall be of a kind not conducive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water, taste, colour, or any effect known to be injurious to health.

4.2. Ductile Iron Pipes

4.2.1. General

Ductile iron pipes and fittings for water supply shall comply with BS EN 545 (1995). Pipes and fittings shall have spigot and socket joints unless otherwise specified. Pipes shall be class K9. Spigot and socket flexible joints shall be of the push-fit type with gaskets of ethylene propylene rubber (EPDM). The Contractor shall supply straight pipes suitable for cutting on site and these shall be clearly marked.

4.2.2. Corrosion Protection

Ductile iron pipes shall be socket and spigot pipes, manufactured by a centrifugal process in accordance with Standards: ISO 2531-2009 and EN 545-2010. The pipes shall be internally lined with a blast furnace cement, suitable for potable water, resisting to sulphates, applied by centrifugation, in accordance with ISO 4179:2005 and EN 545-2010. The cement mortar will be in accordance to EN 197-1. The water used for the cement mortar must be in compliance with the relevant standards related to the quality of water for human consumption.

Pipes will be externally manufactured with metallic zinc coating in accordance with ISO 8179-2004 and EN 545-2010. The thickness of the metallic zinc will not be less than 200gr/m². The zinc paint will not be accepted (except on small areas in case of touch up)

4.3. Galvanised Steel Pipes

Galvanised steel pipes shall be manufactured to BS 1387.

4.4. Steel Pipes

4.4.1. General

Steel pipes shall be manufactured to BS EN 10224, AWWA C200 or DIN 1626/DIN 2460 and shall be suitable for the pressure ratings required by the Contract. Fittings shall conform dimensionally to BS EN 10244, AWWA 208-59 or AWWA M11. Unless otherwise specified or necessary to meet the requirements of the Contract steel pipes shall be manufactured as follows:

a) DN300 mm and below shall be manufactured to minimum of Grade L235 or API 5L Grade B
b) DN350 mm and above shall be manufactured to a minimum of Grade L275 or API 5L Grade X42. The pipes and fittings of diameter 800mm or less shall be supplied with push-fit spigot and socket type joints with integral gasket of EPDM rubber or similar to BS EN 10224 or BS CP

2010. Pipes greater than 800mm shall be supplied with ends cut square suitable for use with flexible couplings and the external weld ground back sufficiently.

4.4.2. Corrosion Protection

Steel pipes and fittings shall be protected externally at the manufacturer's works with fusion bonded epoxy resin in accordance with AWWA C213. Pipes greater than 600mm and all fittings shall also be lined internally with fusion bonded epoxy to AWWA C213. Pipes 600mm or less shall be lined with cement mortar to AWWA C205 or BS EN 10298. All lining and coating materials shall be approved for contact with potable water by an internationally recognized standards.

Where required by the Bills of Quantities, the Supplier shall also price for the provision of an alternative 3LPE coating to DIN 30670 or AWWA C215 of a triple wrap system of fusion bonded or sprayed epoxy primer, an intermediate polymer adhesive layer and an extruded high density polyethylene coating in general conformance with ISO/DIS 21809-1 Class B as appropriate.

4.5. Glass Reinforced Plastic (GRP) Pipes and Fittings

Glass reinforced plastic (GRP) pipes and fittings for pressure water supply shall be high stiffness and shall comply with the relevant provision of BS EN 1796. The minimum pipe stiffness shall be 5,000 N/m2.

Pipes and fittings shall be marked in accordance with BS EN 1796.

Pipes shall only be cut by techniques which can be shown not to impair the pipes pressure regression performance. Where any pipe is cut the exposed fibres at the cut pipe end shall be resealed to prevent potential long term degradation. Methods of cutting and resealing exposed fibres shall be submitted to the Project Manager for Approval. Elastomeric sealing rings and foils shall comply with BS EN 681.

On delivery to site and immediately prior to installation each pipe shall be visually inspected both externally, and where possible, internally for damage such as star cracking of the gel coat layer. Where any damage extends through the pipe wall the pipe shall be rejected or the damaged section cut out and replaced in accordance with repair methods approved by the Project Manager. If in the Project Manager's opinion the pipe is not suitable of repair it shall be rejected and removed from site.

All pipes and fittings must be tested and be in compliance with the following standards:

Standard	**Description**
ASTM D 3681:	Chemical resistance of "Fiberglass" (Fiber Reinforced Thermosetting - Resin) pipe in deflected condition (Strain corrosion performance).
BS 5480: 1990 (Appendix L):	British standard specification for fiberglass reinforced plastics (FRP) pipes, joints and fittings for use for water supply or sewerage - method for determination of long term specific ring stiffness and creep factor under ring deflection.
ASTM D 4161:	Standard specification for "Fiberglass" (Fiber Reinforced Thermosetting - Resin) pipe joint using flexible elastomeric seals.
ASTM D 1599	Short time Hydraulic failure pressure of pipes, fittings and prefabricated spools
BS 5480:1990 (Appendix J):	British standard specification for Fiberglass reinforced plastics (FRP) pipes, joints and fittings for use for water supply or sewerage - method for determination of Impact Resistance
ASTM D 2992:	Standard practice for obtaining hydrostatic or pressure design

	basis for “Fiberglass” (Fiber Reinforced Thermosetting - Resin) pipe and fittings. (Hydrostatic Design Basic (HDB)).
ASTM D 5365:	Standard Test Method for Long-Term Ring-Bending Strain of “Fiberglass” Pipe

4.6. Concrete Pipes, Bends and Junctions

Concrete pipes, bends and junctions for use in sewers shall be made with sulphate-resisting cement. Pipes, bends and junctions shall conform to the requirements of BS 5911 for the particular class of pipe required to be used. The internal dimensions shall be true and regular and the internal surface smooth and free from surface blemish. The actual diameter of the pipe shall be not less than the nominal diameter. All joints shall be of the gasket type with flexible spigot and socket approved by the Project Manager. Gaskets shall be elastomeric complying with BS EN 681.

The main pipe and branches of all junctions shall be of the same strength classification and shall have the same internal dimensions as the pipes with which they are to be used.

The pipes, bends and junctions delivered to the Site shall be certified by the pipe manufacturer to have complied with BS 5911, or other approved standard and one copy of the certificate shall be delivered to the Project Manager before the goods are unloaded.

Unless otherwise specified pipes are required to be of Extra Strength; they may, unless otherwise specifically called for, be reinforced either with cast-in steel or by an external wrapping of fibre glass and resin, applied by an approved manufacturer.

The Contractor shall provide all facilities for and shall carry out jointly with the Project Manager (if so required) a full visual inspection of all pipes, bends and junctions for manufacturer’s defects and other faults or damage. Before any pipe, bend or junction is laid it shall again be carefully examined and sounded with a wooden mallet. Any pipe found to be cracked or otherwise defective shall not be used on the Works.

Concrete pipes shall be internally coated with a 100 percent solids coal tar epoxy lining 70 percent minimum epoxy content. Coat thickness 300 micron minimum.

4.7. Double Walled Corrugated Pipes

Structured Wall Piping Systems in Polypropylene (Pp) And Polyethylene (Pe) ISO 21138/3 – DWC

Double wall corrugated pipes must be manufactured using two layers or either PP or PE that are bonded in the extrusion process. The pipe will have a corrugated outer skin, forming ribs and bonded to the internal skin of the pipe leaving a smooth inner surface. This inner surface will be free of cracks, deformities and will ensure smooth flow properties throughout the pipeline. The pipe shall be socketed on one side, and have a spigot on the other. The internal colour shall be a light reflective colour to reflect light to ease camera inspection. An elastomeric rubber water sealing ring will be place on the spigot side to create a strong seal between the spigot and socket. The pipe must have a coextruded line on the pipe of a different colour for easy identification of the fluid within the pipe.

The pipe must also be produced with a reinforced air channel for added rigidity

Manufacturing Process.

The pipe must be manufactured in a horizontal corrugator with water cooled mold blocks that keeps the ovality to a minimum, and contraction consistent. The pipes shall use suitable PP or PE to acquire the required stiffness and deflection characteristics describe below. The pipe will have inline socketing, with the required socket diameter to create a water tight seal with the help of an elastomeric ring.

Corrugated Construction: The pipe will have a plain smooth inside surface, with an annular ribbed external surface. As shown in the diagram below:

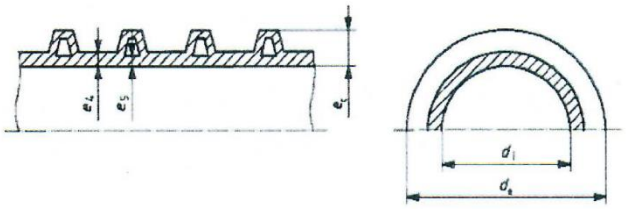


Figure 1— corrugation diagram

4.7.1. Materials

PP(Polypropylene) material characteristics described in table below:

Characteristic	Requirements	Test Parameters		Test method
Resistance to internal pressure, 140 h [a' b]	No failure during the test period	End Caps Test temperature Orientation Number of test pieces Circumferential stress Conditioning period Type of test Test period	Type A or B 80 ^{O}C free 3 4,2 MPa In accordance with ISO 1167-1 Water-in-water 140 h	ISO 1167-1 ISO 1167-2
Resistance to internal pressure 1000 h [a,b]	No failure during the test period	End Caps Test Temperature Orientation Number of test pieces Circumference stress Conditioning period Type of test Test period	Type A or B 95 ^{O}C Free 3 2,5 Mpa In accordance with ISO 1167-1 Water in water 1000 h	ISO 1167-1 ISO 1167-2
Melt mass-flow rate	≤1.5g/10 min	Temperature	230 ^{o} c	ISO 1133:2005
		Loading mass	2.16 kg	Condition M
Thermal stability, OIT [c]	≥ 8 min	Temperature	200^{0} c	ISO 11357-6
a. For extrusion compounds this test shall be carried out in the form of a solid-wall pipe made from the relevant extrusion material.				
b. For injection-moulding compounds this test shall be carried out in the form of an injection-moulded, or extruded sample in solid-wall pipe form made from the relevant material.				
c. This requirement is only valid for pipes and fittings intended to be jointed in the				

field by fusing or welding.

PP material of MRS 1700Mpa is advisable, and should have a minimum carbon content (for outer layer) of 2% to achieve UV resistant characteristics

PE (Polyethylene) material characteristics described in table below:

Characteristic	Requirements	Test Parameters		Test method
Resistance to internal pressure 165 h [a,b]	No failure during the test period	End caps Test Temperature Orientation Number of test pieces Circumferential stress Conditioning period Type of test Test period	Type A and B 80 ^{O}C Free 3 4.0 MPa In accordance with ISO 1167-1 Water – in – water 165 h	ISO 1167-1 ISO 1167-2
Resistance to internal pressure 1000 h [a,b]	No failure during the test period	End caps Test Temperature Orientation Number of test pieces Circumferential stress Conditioning period Type of test Test period	Type A and B 80 ^{O}C Free 3 2.8 MPa In accordance with ISO 1167-1 Water – in – water 1000 h	ISO 1167-1 ISO 1167-2
Melt mass-flow rate	≤1.6g/10 min	Temperature Loading mass	190 ^{o} c 5 kg	ISO 1133:2005 Condition M
Thermal stability, OIT [c]	≥ 20 min	Temperature	200 ^{o} c	ISO 11357-6
Reference density	≥930 kg/m^3	In accordance with ISO 1183-1		ISO 1183-1
[a.] This test shall be carried out in the form of a solid-wall pipe made from the relevant extrusion material.				
[b.] For injection-mouolding compounds this test shall be carried out in the form of an injection-moulded, or extruded sample in solid-wall pipe form made from the relevant material.				
[c.] This requirement is only valid for pipes and fittings intended to be jointed in the field by fusing or welding.				

PE material of MRS 1000Mpa is advisable, and should have a minimum carbon content (for outer layer) of 2% to achieve UV resistant characteristics

Typical spigot and socket

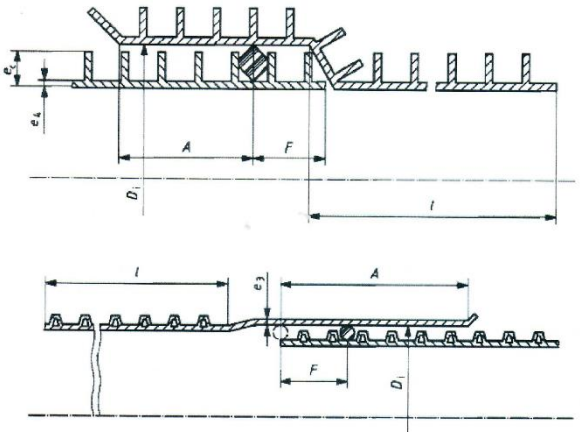


Figure 2 — examples of sealing ring joints

Above are typical examples of elastomeric sealing ring joints, with the sealing ring located on the spigot.

Below is a table showing the following: Nominal sizes, minimum internal diameters, thickness of inside layers and socket length. These must be strictly adhered to or exceeded under the ISO 21138 standard for structured wall pipes.

The indications for e4, e5 and A(min) can be seen on figure 1 above as a reference diagram.

	Minimum wall thickness		
Internal Diameter (mm)	**e4 (min) (mm)**	**e5 (min) (mm)**	**A (min) (mm)**
100	1.00	1.00	32.00
150	1.30	1.00	43.00
200	1.50	1.10	54.00
250	1.80	1.50	59.00
300	2.00	1.70	64.00
400	2.50	2.30	74.00
500	3.00	3.00	85.00
600	3.50	3.50	96.00
800	4.50	4.50	110.00
1000	5.00	5.00	140.00
1200	5.00	5.00	162.00

The minimum inner skin thickness (e4) is the minimum requirement for survivability for hard sewage mediums, and integrity for the lifespan of the pipe.

In addition to the minimum required wall thickness of sockets and spigots, their ring stiffness, when determined in accordance with ISO 9969, shall conform to the following equation:

$$\delta_{so} + S_{sp} \geq SN_{pipe}$$

For the test, it is permitted to use cut-off straight spigot and socket parts even if they do not conform to the length requirement specified in ISO 9969.

4.7.2. Mechanical characteristics

When tested in methods specified in the table below, using the indicated parameters, the pipe shall have the mechanical characteristics conforming to the requirements given in the table below.

The pipes shall be designated in one of the following nominal ring stiffness classes (SN):

DN≤500: SN4, SN8 or SN16 DN > 500: SN2, SN4, SN8 or SN16

Characteristic	Requirements	Test parameters		Test method
Ring strength	≥ relevance SN	In accordance with ISO 9969		ISO 9969
Impact strength	TIR ≤ 10%	Test temperature	$(0\pm1)^0$C	ISO 3127
		Conditioning medium	Water or air	
		Type of striker	d90	
		Mass of striker for [a]		
		Dm,max ≤ 100	0.5 kg	
		100 < $d_{im,max}$ ≤125	0.8 kg	
		125 < $d_{im,max}$ ≤160	1.0 kg	
		160 < $d_{im,max}$ ≤200	1.6 kg	
		200 < $d_{im,max}$ ≤250	2.0 kg	
		250 < $d_{im,max}$ ≤315	2.5 kg	
		315 < $d_{im,max}$	3.2 kg	
		Fall height of striker for [a]		
		$D_{em,min}$ ≤ 100	1600 mm	
		$D_{em,min}$ > 110	2000 mm	
Ring flexibility	In accordance with 9.1.2 at 30% of dem	Deflection	30%	EN 1446
		Length of test piece	Shall incorporate at least 5 ribs/spirals b	
		Position of test piece	Mould split line, when applicable, at 0^o. 45^o and 90^o from the	

			upper plate	
Creep ratio	PVC-U ≤ 2.5 AT 2 years extrapolation	In accordance with ISO 9967		ISO 9967
	PP and PE ≤ 4 at 2 years extrapolation			
Tensile strength of seam [b]	In accordance with 9.1.3	Rate of movement	15 mm/min	EN 1979
[a.] Refer to the specialized $d_{em,min}$				
[b.] Only applicable to spirally formed pipes				

4.7.3. Ring Flexibility

When tested in accordance with the test methods described in the previous table, and visually inspected without magnification

- There shall be no decrease of the measured force
- There shall be no cracking in any part of the wall structure
- There shall be no wall delamination except possible delamination between the outside and inside wall of double layer pipes
- There shall be no other types of rupture in the test piece
- Permanent buckling in any part of the structure of the pipe wall including depressions and craters shall not occur in any direction

4.7.4. Tensile strength

When tested in accordance with the test methods highlighted above, the minimum require tensile strength of the seam shall conform to the table below:

Nominal Size Nd/ID or ND/OD	Minimum tensile force N
ND ≤ 375	380
400 ≤ ND ≤560	510
600 ≤ ND ≤710	760
ND ≥800	1020

The pipe should have an allowable deflection of up to 30% without any signs of cracks, or ovality during the process.

4.7.5. Performance requirements

When tested in accordance with the test methods below, the joints and system shall have the characteristics conforming to the requirements given in the table below

Characteristic	Requirements	Test parameters		Test method
Tightness of elastomeric ring seal joint		Temperature Spigot deflection Socket deflection	(23 ± 2) ° C 10% 5%	EN 1277:2003 Condition B
	No leakage	Water pressure	5 k Pa (0.05	

			bar)	
	No leakage	Water pressure	50 k Pa (0.5 bar)	
	≤ - 27 kPa (-0,27 bar)	Air pressure	-30 k Pa (-0.3 bar)	
Tightness of combined elastomeric seal joint		Temperature Joint deflection for $d_e \leq 315$ mm 315 mm ≤ $d_e \leq$ 630mm 630< d_e	(23 ± 2) ^{o} C 2^0 1.5^0 1^0	EN 1277:2003 Condition C
	No leakage	Water pressure		
	No leakage	Water pressure		
	≤-27 kPa (-0.27bars)	Air pressure		
Resistance to combined temperature cycling and external loading [b]	[a]	For dim ≤ 160mm in accordance EN 1437:2002 Method A		EN 1437:2002 method A, hot and cold water
		For dim > 160mm in accordance with EN 1437:2002 Method B		EN 1437:2002 method B, hot and cold water
Long-term performance of TPE seals	Tube pressure -100 years extrapolated: ≥ 150 kPa (1.5 bars)	Test temperature	(23±2)^{o} c	EN14741
Watertightness [C]	No leakages	Water pressure duration	50 kPa (0.5bar) 1 min	EN 1053
Tensiles test welded or fused joints	No break in the joints	Minimum tensile force	In accordance with Table 15	EN 1979 [d]

a. The following requirements apply:
- ✓ vertical deformation: 9 %
- ✓ deviation from surface evenness in bottom: ,..: 3 mm
- ✓ radius of bottom.;,... 80 % of original
- ✓ opening of weld line: s 20 % of wall thickness
- ✓ tightness at 35 kPa (0.35 bar)/15 min. no leakage allowed

b. Only for components in accordance with this part of ISO 21138 with DN/OD,<.-, 335 and DN/ID s 300.

c. Only for fabricated fittings made from more than one piece. A sealing ring retaining component is not considered as a piece

d. This test is applicable for all pipe and fitting constructions when jointed by fusion or welding. The test pieces shall be cut longitudinally in the fusion area. The length of the test piece shall include the joint plus a length at each end sufficient to ensure a proper grip in the tensile testing machine.

4.8. HDPE Pipes and Fittings – Water and Sewers

4.8.1. General

All Polyethylene pipes shall comply with the relevant provisions of BS EN 12201, Parts 1 to 5. The pipes shall be clearly and indelibly marked to show the name of the manufacturer, diameter, pressure class, manufacturing standard and date of manufacture. All HDPE pipework shall be PE100.

ISO21307 –2011 for butt fusion jointing procedures for PE pipes and fittings used in the construction of gas and water distribution systems shall apply.

4.8.2. Compound Material

The material from which the pipes are made shall be in accordance with ISO 4427-1. All pipes shall be manufactured using pre-compounded carbon black, bimodal, high density polyethylene MRS 10.0 material (PE100). The use of natural PE100 with a Carbon black master batch is strictly not allowed.

Carbon black should be well dispersed to give outstanding UV resistance, and should have a minimum carbon content of 2%. Pipes should be manufactured from certified PE100+ material with batch certification available with pipe delivery.

4.8.3. Identification compound

The compound used for identification stripes shall be manufactured from a PE polymer manufactured from the same type of base polymer as used in the compound for pipe production.

4.8.4. General appearance

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects such as would prevent conformity of the pipe to ISO 4427. The pipe ends shall be cut cleanly and square to the axis of the pipe.

4.8.5. Color

The pipes shall be black with coloured identification stripes.

4.8.6. Dimensions

The dimensions of the pipe shall be measured in accordance with ISO 3126. Manufacturing shall be to ISO 4427 Standard, as per the approved dimensions chart.

Pipes should be manufactured in machinery capable of ultrasonic wall thickness detection with production reports provided with delivery of pipes.

The lengths shall be supplied to minimize the number of joints to be done in the field, and the size that is allowed to be legally transported on Kenyan roads by the traffic department.

4.8.7. Markings

All pipes shall be permanently and legibly marked in such a way that the marking does not initiate cracks or other types of failure and such that normal storage, weathering, handling, installation and use does not affect the legibility of the marking.

The colour of the printed information shall differ from the basic colour of the product. The marking shall be such that it is legible without magnification. The frequency of marking shall not be less than once per metre. Markings should be made using a hot embossed foil stamp printing.

Each pipe shall a minimum of 3 equispaced blue longitudinal stripes indicating medium of fluid transported in the pipes. A summary of marking requirements are given in the table below.

Minimum required marking

Aspect	Marking
Standard Number	ISO 4427
Manufacturer's identification	Name or symbol
Dimensions (*d*n × *e*n)	e.g. 125X11.4
SDR series (for DN > 32)	e.g. SDR 11
Material and designation	PE 100
Pressure rating in bar	e.g. PN 16
Production period (date or code)	e.g. 0204[a]
Country of Production	Kenya

Aspect	Marking
Coils shall be sequentially marked with the metreage, indicating the length remaining on the coil.	
[a] - In clear figures or in code providing traceability to the production period within year month and, if the manufacturer is producing at different sites, the production site.	

4.8.8. Jointing of Pipes

Unless otherwise specified or approved by the Project Manager, Polyethylene pipes shall be electro fusion welded. Joints between polyethylene pipes supplied from different manufactures or not manufactured from the same grade of polymer shall only be jointed by electro fusion or by push fit mechanical couplings. Mechanical couplers and compression type fittings shall incorporate a serrated internal liner to support the pipe against compression loads exerted by the fitting and to prevent pullout under axial load.

Butt or socket fusion joint techniques shall only be applied between pipes supplied from single source and manufactured from the same grade of base polymer. Fusion welding of polyethylene pipes shall only be undertaken by skilled operatives using appropriate specialized tooling. Pipes to be jointed shall be free from contamination and care shall be used to protect fusion jointing operations from wind and against the effects of inclement weather. Mechanical jigs or other approved methods shall be used to ensure correct alignment of the pipe when making butt fusion joints. Details of fusion welding procedures including details of tools, operatives, materials and method statements shall be submitted to the Project Manager for approval prior to any jointing.

Steel and iron pipe fittings shall comply with the relevant provision of BS EN 545 (1995) replaced by BS EN 10224 but also current.

4.9. Gate Valves

4.9.1. General

Valves for normal duty on water pipelines with pressure ratings up to PN25 shall be key operated cast iron flanged gate valves for waterworks purposes generally complying with the requirements of BS 5163 (Type B). All Gate Valves shall be supplied with a 10-year manufacturer's warranty.

Cast iron gate valves for pressure ratings to PN14 shall be cast iron flanged valves complying with BS 5150 replaced by BS EN 1171 (both BS 5150 and BS 5151) or cast iron parallel slide valves complying with BS 5151.

Butterfly valves for pressure ratings of up to PN16 shall be double flanged wafer type butterfly valves complying with BS 5155.

Unless otherwise specified valves for use on steel pipes shall be flanged, where butt-weld ends are specified valves shall comply with BS EN 1984, or BS EN 13709.

4.9.2. Wedge Gate Valves for Manual Operation

Valves up to and including DN 300 shall be of the resilient seal type and valves larger than DN 300 shall have metal seals. Valves greater than DN 300mm shall have ductile iron wedges.

Spindles shall be of the non-rising type and screwed so as to close the valves when rotated in the clockwise direction. The direction of closing shall be clearly cast on the valve cap or hand wheel as appropriate. The valves shall be constructed of the following materials:

body	-	cast iron;
spindle	-	forged bronze or stainless steel;
metal faces and seal	-	Gunmetal.

The valves shall be suitable for the unbalanced head as specified or indicated in the schedules.

Suitable gearing and anti-friction devices such as ball bearing thrust collars shall be provided as necessary to enable opening and closing by manual operation at the pressure stated, using an effort no greater than 26kg on the tee key or hand wheel supplied. Hand wheels shall not exceed 500mm diameter. A bypass with gate valve forming an integral part of the valve shall be provided where recommended by the valve manufacturer for the pressures specified.

Gearing on valves of DN 300 and less shall be enclosed in a sealed gearbox suitable for buried installation and operated with a tee key. Except where shown in the Drawings, all valves exceeding DN 300 shall be provided with bevel gearing. Valves to be used for washouts and isolating air valves shall have screwed seats.

Extension spindles shall be galvanized or stainless steel adequately supported with cast iron brackets, and of sufficient diameter to prevent any whiplash effect through twisting when being used to operate the valves. The spindles shall be capped for key operation. Valve caps shall be fitted with hexagonal set screws.

Valves shall be coated with an approved epoxy complying with DIN 30674. Keys for valve operation shall be of sufficient length so that the valves can be operated by a man standing, but shall not exceed 1.2m in length, and shall have a detachable cross bar.

4.10. Butterfly Valves

4.10.1. General

Butterfly valves shall conform to BS EN 593. All Butterfly Valves shall be supplied with a 10 year manufacturer's warranty.

4.10.2. Construction

Butterfly valves shall have a high grade cast iron body to BS EN 1561 designed to the specified working and test pressures. The pressure rating valve shall be cast in the valve body. The disc shall be of high grade cast iron to BS EN 1561 or nodular cast iron to BS 2789 to the defined working and test pressures. It shall have a convex shape designed to achieve low head loss characteristics. The valve shafts shall be of stainless steel operating in self-lubricating bushes in the body.

The valve seat shall be of gunmetal to BS 1400. The sealing ring shall be a renewable Ethylene Propylene Diene Monomer (EPDM) rubber attached to the disc edge by a sectional bronze retaining ring to form a resilient and durable seal.

The valves shall be fitted with hand wheel actuators not exceeding 500mm diameter incorporating gearing to allow opening and closing by manual operation at the pressure stated using an effort no greater than 36kg on the hand wheel supplied.

In all cases the gearing shall be designed to close the valve, from fully open to fully close in a period of not less than ten minutes with this effort. Actuators shall be designed so as to close the valves when the hand wheel is turned in a clockwise direction; the direction of closing shall be clearly cast on the hand wheel. Position indicators shall be fitted to all actuators.

Where required valves shall be electrically actuated with a manual override. Remote actuation shall be provided with a visual indication of valve open, valve closed and percentage opening together with fault indication.

4.10.3. Valve Performance

A performance curve, relating percentage valve travel, open area and discharge coefficient shall be submitted to the Project Manager. The head loss coefficient with valve fully open shall be defined.

4.10.4. Testing

All valves shall be tested in accordance with BS EN 593 and pressure and material test certificates shall be submitted to the Project Manager for approval.

4.11. Air Valves

Specification for Combination air valve / Triple function air valve DN 50mm

The air valve shall be in accordance with BS EN1074.4 for drinking water.

The Air Valve shall be Combination type OR triple function type for drinking water systems. The chamber body shall be made of Ductile Iron with threaded inlet or flanged DN50. The coating on the Ductile Iron body shall be Fusion Bonded Epoxy at least 250 microns. On the discharge outlet there will be a screen to avoid bugs and dirt to enter the air valve.

Float shall be made of injected composite material. Automatic and Kinetic functions shall be supported by one float. Min. area of the automatic orifice will be 10mm^2. The automatic function shall be operated by rolling seal mechanism to assure self-cleaning.

The working pressure range of the air valve will be 0.2 – 16 bars. The air valve shall seal at min. pressure 0.2 Bar. The main chamber shall have a plug or a choc to drain and release the trapped pressure.

The float shall be closed only by water, to assure that the air valve shall not premature close,

The manufacture shall provide the air flow charts [in & out] for the air valve and will have to recommend for working zone on those charts with each air valve type and size, upon filling and draining the network.

The location and sizing of the air valves shall be backed by an optimization air valves software.

The manufacture of the air valve shall be approved by ISO9001, ISO14001, ISO18001 and shall provide Certificate of Conformity, Certificates of Test and 3.1 certificates (for materials used) for each air valve.

4.12. Non-Return Valves

4.12.1. Swing Check Valves

Non-return valves shall be suitable for waterworks purposes and shall be manufactured to comply with the general requirements of BS EN 12334. They shall be double flanged type, non-slamming and recoilless on flow reversal.

Valves of DN 700 and larger shall be of the multi-disc type or tilting disc type. The valves shall have a high grade cast iron body and cover to BS EN 1561 Grade 220/260 with gun metal nickel bronze alloy door seating. The hinge pin shall be of stainless steel carried on non-corrodible bearings.

4.12.2. Nozzle Check Valves

Nozzle check valves shall be slam free closing with a streamlined cross section as manufactured by Mannesmann Demag or similar.

4.13. Flow Control Valves

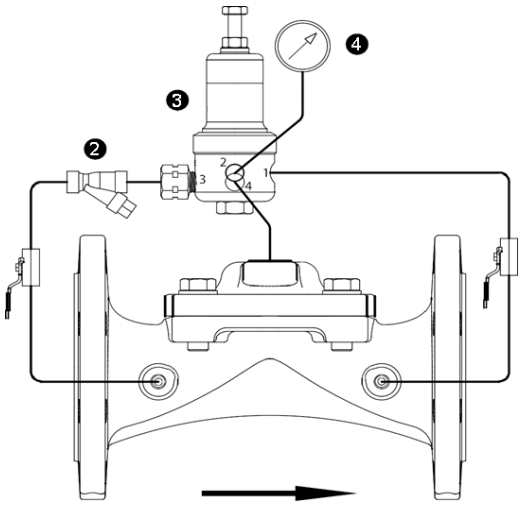
Flow controls unless otherwise specified shall be butterfly valves. They shall be installed complete with a headstock and position indicator showing the degree of opening.

4.14. Pressure Reducing Valves

Pressure reducing valves shall automatically reduce a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate or varying inlet pressure. The control valve shall be a hydraulically operated, pilot controlled, weir type, in-line serviceable valve. The main in-line hydraulic control valve shall have only two moving parts, the resilient diaphragm, and the spring. The diaphragm shall be the only sealing component of the control valve.

The valve shall be a hydraulically operated pilot controlled diaphragm type, globe or angle valve.

The main valve shall have a single removable seat and a resilient disc.



1. Ball Valve
2. Y - Strainer
3. P-26 R pressure reducing pilot valve
4. Pressure Gauge

Valve Technical Specifications

Pressure Rating PN16

Self-actuated, WEIR type diaphragm actuated, hydraulic control valve

Material	Body & Bonnet	Ductile Iron / Stainless Steel SAE 316
	Diaphragm	Natural Rubber / EPDM
	Spring	Stainless Steel SAE 302
	Spring Seat	Acetal / Stainless Steel SAE 316
	Bolts	Steel, Zinc Cobalt Coated / Stainless Steel SAE 316
	Piping & Tubing	Stainless Steel SAE 316 / Reinforced Nylon
	Coating	Fusion bonded epoxy coating according to the standard DIN 30677-2
Pressure Rating		Maximum working pressure - 16 bar Minimum working pressure - 0.4 bar (depending on type of diaphragm)
Water Temp. Range		5° to 60°C

Pilot Specifications

Rating: PN16

Spring loaded 2W hydraulic control pilot valve

Material	Body	Brass – Nickel Plated / Stainless Steel 316
	Internal Parts	Elastomers: EPDM / NBR Metal: Stainless Steel SAE 316 / Brass
	Spring	Stainless Steel SAE 302
Pressure Rating		Maximum working pressure - 16 barMinimum working pressure - 0.4 bar
Water Temp. Range		5° to 60°C

4.15. Ball Float Valves

Ball float valves which are to be installed within reservoirs shall be the delayed action type to eliminate inflow at small valve openings. They shall be fitted with a stilling chamber, auxiliary float valve and inlet bell-mouth with regulating valve. The main valve shall be fitted with a long actuating lever to provide a long float travel for slow valve closure.

Valves shall be of the right angle pattern type with flanged inlet and have a resilient synthetic rubber disc which forms a drop tight seal against a removable seat insert. Valves shall be free of cavitation and vibration under the specified working conditions. Flanged tapers shall be provided on the inlets as necessary to suit the size of valves proposed.

Valves shall be capable of withstanding the maximum static pressure and of passing the maximum flow rate shown. Orifice plates shall be provided as necessary to absorb excess working pressure at the initial flow rates indicated.

The pressure rating of the valve shall be cast into the body of the valve.

4.16. Constant Flow Valves

Constant flow valves shall maintain a constant rate of flow regardless of fluctuations in upstream pressure.

Valves shall be hydraulically operated, diaphragm actuated globe pattern. They shall have a resilient synthetic rubber disc which forms a drop tight seal against a removable seat insert. The diaphragm assembly and valve stem shall be fully guided at both ends by bearings in the valve cover and valve seat. The diaphragm shall consist of nylon fabric bonded with synthetic rubber. Packing glands and stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls.

The pilot control shall be direct acting diaphragm valve designed to close when the actuating differential increases beyond the spring setting. The actuating differential pressure shall be produced by a thin edged orifice plate installed in an orifices flange downstream of the valve.

Any necessary repairs to the valve shall be accomplished without removing the valve from the main.

Valves shall be sized to pass the maximum continuous flow stated on the drawings at the working pressure given. The pressure rating of the valve shall be cast into the body of the valve.

4.17. Surface Boxes and Chamber Covers

Surface boxes and chamber covers shall be made of synthetic material.

Surface boxes over gate valves shall be hinged and chained and shall be heavy duty with 150 x 150mm nominal clear opening. This applies to surface boxes for hydrant chambers.

Covers to air valve and other chambers shall be to the dimensions and loading requirements shown on the Drawings or as stated in the Bill of Quantities.

Covers shall be made of composite material complying to BS EN 124-5:2015 — Gully tops and manhole tops made of composite material. Lifting keys shall be provided for each type surface box or cover supplied. One set of keys shall be provided for every ten surface boxes or covers subject to a minimum of ten sets of keys or the actual number of covers if less than ten.

4.18. Manhole Safety Chains

Mild steel chain shall be 8 mm nominal size Grade M (4) non-calibrated chain, Type 1, complying with BS withdrawn. After manufacture, mild steel safety chains shall be hot dip galvanized in accordance with BS EN 124.

4.19. Manhole and Chamber Access Covers

The manhole and chamber access covers shall be made of composite material and shall comply with BS to BS EN 124-5:2015 and be obtained from an approved manufacturer and shall be to the internal minimum clear opening as detailed in the Contract.

All manhole and chamber access covers shall be Heavy Duty pattern unless otherwise specified. The frame and lid shall have key holes formed with sealed pockets underneath to prevent ingress of sand, grit and surface water and shall be of an approved non-rocking pattern. The covers and frames shall have accurate seating faces to prevent rocking and the ingress of sand or water, and it shall be tight fitting to resist overflow conditions or unauthorized removal. The seating faces shall be coated with graphite grease before installation of the cover.

A supply of keys for use with every type of manhole cover and surface box shall be handed over by the Contractor at the completion of the Contract on the basis of one set of keys for each 50 covers or part thereof.

Manhole and chamber cover frames shall be set in cement mortar and haunched with concrete and shall be set to the camber or fall of the finished road surface. It shall be the Contractor's responsibility to establish the finished road surface levels from the appropriate authority and to fix the covers accordingly.

4.20. Manhole Step Irons

Manhole step irons shall be manufactured using virgin polypropylene copolymer plastic and reinforced with structural carbon steel. The steps shall be bright coloured to ensure high visibility and shall have no sharp edges. The steps shall be corrosion resistant and shall be manufactured in accordance with BS EN 13101,

e) PIPELINE CONSTRUCTION

5.1. General

The requirement of this section shall apply to the construction of potable and raw water pipelines and pipework.

Within this section 'Plant' refers to pipe fittings, valves, surface boxes and chamber covers, and other such materials required for pipelines, mains and pipework at reservoirs and elevated tanks.

All Plant shall be suitable for waterworks purposes for the conveyance of potable water in the climatic conditions prevailing in Kenya and in particular at the location of the Works.

The Project Manager shall provide details of each pipeline diameter, pressure rating, hydraulic characteristics and the approximate alignment. The Contractor shall, in consultation with the Project Manager set out the proposed pipeline alignments, making any changes that the Project Manager may deem necessary, confirming also the exact locations of all manholes, valves, air valves, washouts, hydrants, and the like.

5.2. Topographic Surveys

Topographic surveys along pipeline routes shall be either: -

- Plan and profile surveys, or
- Line and level traverse surveys, as instructed by the Project Manager.

Plan and profile surveys shall cover a strip of 10.0m wide centrally on the proposed centre line of the pipeline. The survey shall be carried out in accordance with the specification detailed in Clause 1.8.

Line and level surveys shall comprise a traverse line along the centre line of the pipeline as established by the Project Manager.

5.3. Handling and Transport of Pipes and Fittings

The loading, transporting, unloading and handling of pipes and fittings shall be carried out such that no damage is caused. All in accordance with the recommendations of the manufacturer and to the approval of the Project Manager. The use of lifting hooks is not permitted. Pillows shall be provided between lashing (ropes, wires or chains) and the pipes. All cradles and lashings shall be of such widths as to prevent damage to the coating of the pipe, or distortion of the pipes.

Valves and fittings shall be transported in timber packing and where possible in the manufacturer's original packaging.

Protective cover and other protective materials provided by the manufacturer shall not be permanently removed until immediately prior to installation.

In the event of any damage being caused to a pipe, the Project Manager shall determine whether damaged piece shall be replaced or repaired. Repair to coating only shall be allowed and shall be as directed by the Project Manager.

In all instances when along trench sides, ferrous pipes shall be supported within 1 metre of either end on sand filled bags such that no part of the wall of the pipe touches the ground, and in the case of pipes over 6 metres long with additional central sand bags.

When pipes are being loaded into vehicles care shall be taken to avoid their coming into contact with any

sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length and not allowed to project unsecured over the tailboard of the lorry.

Pipes may not be offloaded from lorries by rolling them, suitable carnage shall be used. Pipes shall not be rolled or dragged along the ground.

5.4. Stringing and Examination of Pipes Prior to Laying

All DI and Steel Pipes and their coatings and linings shall be carefully inspected on Site prior to laying.

Inspection of the pipe will be made by the Project Manager after delivery and again immediately prior to laying. Any pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the site.

All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the Project Manager. Handling and laying of pipe and fittings shall be in accordance with the Manufacturer's written instructions and as specified herein.

All cement mortar linings shall be visually inspected for defects such as cracking or spalling and crack widths shall be measured to confirm that width is such that natural re-sealing will occur once put into service; otherwise cracks as well as any spalling shall be made good before laying in accordance with the manufacturer's written instructions.

All epoxy linings and all coatings shall be subjected to holiday detection tests, in accordance with NACE RP 0490 or other acceptable methods. The voltage of the holiday detector being selected appropriate for the material and its thickness. Factory test certificates shall be submitted upon delivery of the pipes to site. Defective areas will be made good in accordance with the manufacturer's written guidelines.

All pipe and fittings shall be thoroughly cleaned before laying, and shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Pipe shall not be laid unless the trench is free of water and in a satisfactory condition. Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA C600 while AWWA C200 will apply for steel pipes except as otherwise provided herein. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense.

When laying is not in progress, including any work break exceeding 30 minutes, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the Manufacturer. End caps shall not be removed until such time as the pipe is to be inspected and laid.

Where the pipeline crosses roads, tracks or any other access or where directed by the Project Manager, the Contractor shall place the pipes so that access to the public is not in any way prohibited.

Shortly before laying or fixing any valve, pipe or fitting, the Contractor shall examine each valve, pipe and fitting to ascertain that there is no damage or defect. The Contractor shall give the Project Manager not less than 48 hours' notice of his intention to undertake such examination. The Contractor shall not lay such pipes and fittings until he has received approval from the Project Manager.

Linings shall be inspected prior to laying and any defect made good.

5.5. Laying Pipes

Immediately before any pipe is lowered into the trench the plug shall be removed from the end of the last pipe laid and the new pipe shall be carefully lowered into the trench.

Each pipe and fitting shall be laid true to alignment curve and gradient in accordance with the Drawings or as directed by the Project Manager. The minimum gradient shall not be flatter than 1 in 500.

Pipes shall be boned to gradient and sight rails shall be provided for this purpose at intervals not exceeding 50m and at all changes in grade. No dips or summits shall be permitted other than as shown on the Drawings.

5.6. Embedment and Compaction

All ductile iron and steel pipes shall be embedded using a sand or coarse grained soil with less than 12% fines, which if necessary shall be imported if excavated material is found to be unsuitable:

In areas prone to water logging or where specifically called for on the Drawings or in the Bills of Quantities a single size or graded gravel shall be used as a special lower bedding, with grading as indicated below.

Nominal Pipe Diameter (mm)	**Grading for Special Lower Bedding [to ASTM Sieve Sizes]**	
	Single size Gravel	**Graded gravels**
< 200	10 or 14 single-size gravel	14 to 5 graded
200 to 500	10, 14 or 20 single-size gravel	14 to 5 graded or 20 to 5 graded
> 500	10, 14, 20 single-size crushed rock, or gravel	14 to 5 graded or 20 to 5 graded

The suitability of as-dug trench material as an embedment material and where imported, the source shall be approved by the Project Manager. Any delays as a result of not seeking this approval in good time shall be entirely to the Contractor's account

All layers of the embedment shall be thoroughly compacted, and shall not exceed 150 mm and be raised evenly on both sides of the pipe as it is placed. A minimum compaction of 90% MPD shall be achieved at all times, this being confirmed by sampling and testing at intervals on different levels of embedment at intervals of not more than 50 m with testing in accordance with BS 1377 or ISO 22476 using the "sand replacement" method.

Should any results fail to achieve this absolute minimum level, then the pipes, embedment material and layer shall be removed for an equal distance on either side of the failed test, the total distance being equal to the length between adjacent sampling locations, and re-laid appropriately but with compacted layer thickness halved. In addition the distance between sampling and testing shall also be halved until in the opinion of the Project Manager's Representative a sufficient number of consecutive passes allows both individual layer thickness and the distance between sampling and testing to be returned to the previous thickness and spacing.

All backfill soil above the embedment shall be free from clay lumps, boulders and rock fragments greater than 50 mm and as far as practicable, given the nature of the soil, 90 % MPD shall be attained. However, this requirement may be relaxed to 85% MPD by the Project Manager's Representative if he considers the circumstance warrant it.

5.7. Pipes Laid in Trench

Pipes and fittings laid in trench shall have at least the minimum cover stated in the Drawings.

Long radius curves in buried pipelines shall be negotiated by deflections taken up in the joints of one or more pipes. The deflection at joints shall not exceed 75% of the manufacturer's maximum specified limits. Designs have been based upon the use of 6m long pipes. If the Contractor provides longer pipes sufficient short lengths shall be provided to enable the proposed pipe curvature without additional bends or deep excavation.

Pipes shall not be dragged along the trench bottom. Pipes laid in trenches shall be laid and firmly bedded on an even and uniform bed. Where pipes are not laid on a granular bed, the bottom of the trench shall be smooth and free from stones or other projections.

Joint holes shall be excavated below the trench bottom and shall be as small as possible and shall be filled in and compacted after the pipes are laid and before the refilling of the trench is commenced.

5.8. Trenchless/ Micro Tunnelling Methods

The use of trenchless technology will be in accordance with the specifications provided by the respective road authorities of Kenya. All required documentation such as method statements, drawings, stakeholder consultations, required safety measures and any other requirements for the proposed works will seek approval from the respective road authorities prior to commencement.

5.9. Pipe Bedding and Surround

For polyethylene, uPVC and GRP pipelines, Class S bedding (Granular Bed and Surround) shall be used where the cover is equal to or greater than 1.0m. Where there is less than 1m cover, Class A concrete surround shall be used. In between the Project Manager shall decide upon the bedding type dependent upon the assessed risk of damage to the pipe.

5.10. Pipes Laid Above Ground

Pipelines to be laid above ground shall be constructed of flanged ductile iron or steel pipes with mechanical type expansion joints. Supports shall be provided at a maximum spacing of one pipe length and adjacent to the flanged joints.

The expansion joints shall compensate for a variation of ambient temperature between zero and 40º C on the adjoining pipeline. Anchorages shall be provided immediately uphill of each expansion joint and at each change in vertical and horizontal alignment. The ground/rock surface under the pipeline shall be re- graded as necessary to allow a satisfactory vertical alignment of the pipeline.

The Contractor may propose, as an alternative to the use of mechanical expansion joints, either of the following methods for accommodating thermal expansion:

1) A zigzag pipeline alignment whereby the thermal movement is accommodated by deflection of the bends.
2) A rigid form of construction with the thermal movement being constrained within the pipe walls by the use of substantial anchor blocks.

Joints shall be made in compliance with the manufacturer's instructions as approved by the Project Manager. Care shall be taken to ensure the absolute cleanliness of the pipe ends and joint components. Only the recommended approved lubricants shall be used.

Jointing shall only be carried out by experienced personnel under close supervision by the Contractor.

The Contractor shall ensure that no dirty water or other extraneous matter is allowed to enter the pipes during or after laying. In the event of dirty water or extraneous matter entering the pipes the Contractor shall immediately carry out cleaning and disinfection as directed by the Project Manager.

Except when necessary for jointing, the end of the last pipe laid shall be kept plugged to the satisfaction of the Project Manager to prevent the ingress of dust, dirt, rocks and other debris.

The Contractor shall be liable for any damage caused to the Employer's Plant and apparatus or other equipment as a result of foreign matter of any kind not having been cleared out of pipelines before Taking-Over.

Pipe trenches shall not be backfilled until approved by the Project Manager. Once approved trenches shall be backfilled without delay to at least the minimum extent required for pressure testing.

5.11. Cutting of Pipes

The edges of the cut pipes shall be clean, true and square. Ductile iron pipes shall only be cut with an approved mechanical pipe cutter in conformity with the pipe manufacturer's recommendations. The use of oxyacetylene flame cutter will not be permitted. The edges of the cut together with those parts of the pipes from which the coating has been removed shall be given two coats of bituminous paint and the internal lining repaired. When the cut pipe is to be inserted in a "Tyton" type joint it shall be bevelled for 10mm at 30º to pipe the axis.

HDPE, uPVC and GRP pipes shall be cut with an approved mechanical pipe cutter and in conformity with the pipe manufacturer's recommendations. Where the cut end of the pipe is to be incorporated in a joint the pipe shall be turned down to the correct diameter required for forming the joint by and approved mechanical turning machine. The length of turning shall be accurately bevelled by mechanical means to the dimensions specified in the manufacturer's recommendations.

Steel pipes shall be cut by using a mechanical pipe cutter approved by the Project Manager. The use of an oxyacetylene flame cutter will not be permitted. The edges of the cut shall be given two coatings of liquid epoxy compatible with the original coating. The external coating and the internal lining shall be repaired to the approval of the Project Manager. The cut end shall be bevelled as required to suit the form of joint used.

5.12. Proprietary Joints and Couplings

Proprietary joints and couplings shall be assembled in accordance with the manufacturer's instruction as approved by the Project Manager. Where pipes are laid above ground and jointed with bolted couplings the joint shall be protected against vandalism by sheathing with an approved heat-shrink moulding as manufactured by Raychem of Swindon UK or similar approved.

5.13. Flanged Joints

Flanged joints shall be made with two washers per bolt, one under the bolt head and the other under the nut. The tightening of the bolts shall be carried out in the sequence and to the torque recommended by the manufacturer. A torque wrench shall be used.

Buried flange joints shall be protected by painting with approved bitumen paint and by wrapping using 'Denso' paste, mastic tape and outer wrap, or similar approved materials all in accordance with the manufacturer's instructions as approved by the Project Manager, unless supplied with epoxy coating and galvanized bolts.

Flanged adaptors and mechanical couplings shall have a RILSAN nylon coating applied by the manufacturer.

5.14. Steel Pipelines Welded Joints

If specifically required under the contract pipes shall not be welded. If permitted by the Project Manager for particular conditions the Contractor shall submit to the Project Manager a detailed method statement for constructing the pipeline using welded joints which shall include, but not be limited, to:

(i) details of the Contractor's skilled labour and supervision staff who have direct experience in the construction of welded steel pipe;
(ii) details of the Contractor's plant to be deployed;
(iii) details of temporary staging, access and craneage;
(iv) procedure for construction of supports and anchorages, and welding joints;
(v) quality assurance proposals for testing the integrity of the welds.

These details shall be submitted to the Project Manager for his approval not later than 21 days before the Contractor wishes to commence pipe laying.

All field welds shall be inspected visually with special attention given to the line up and down the root run

or stringer beads. Non-destructive testing of the completed weld shall be carried our using radiographic methods with procedures in accordance with BS 2910.

On completion and inspection of joint welding, remedial works shall be carried out on the internal lining and external coating. No more than five pipe joints shall be welded without completion of remedial works to joints.

5.15. Fixing Valves and Penstocks

Valves, penstocks and other fittings shall be securely fixed. Extension spindles and headstocks shall be properly aligned and fixed in a vertical position and valve caps shall be fixed securely using the locking nut.

5.16. Thrust and Anchor Blocks

Concrete thrust and anchor blocks shall be formed at bends, tees and valves in accordance with the details shown on the Drawings or as directed by the Project Manager. Excavation shall be made after pipelaying and the blocks concreted immediately after excavation. The back supports and blocks shall abut in to solid undisturbed ground with all loose material being removed before concreting.

No pressure shall be applied in any section of main until the concrete has achieved adequate strength and at least three day's curing.

Flexible joints shall not normally be cast in. Where the size of the block does not make this possible, additional flexible joints shall be provided no greater than half a pipe diameter beyond each face of the block.

5.17. Concrete Surround to Pipes

Where pipelines pass under streams and rivers or where directed by the Project Manager, the pipeline shall be surrounded with concrete as shown on the Drawings.

Concrete surround shall be "broken" at all pipe joints to retain flexibility in the pipeline. No joints shall be concreted in without the prior approval of the Project Manager.

5.18. Flotation of Pipelines

The Contractor shall ensure that flotation of the pipeline does not occur during construction. Sufficient backfill shall be placed over each pipe after laying and before testing to prevent flotation.

5.19. Pressure Rating

The pressure rating of pipes shall be as indicated on the drawing or Bill of Quantities or if not indicated then selected such that the maximum pressure in the pipeline inclusive of surge pressures shall not exceed the maximum allowable sustained working pressure rating of the pipe;

The surge pressure amplitude (the difference between maximum and minimum surge pressures) shall not exceed one half of the maximum allowable sustained working pressure rating of the pipe.

5.20. Testing of Water Supply Pipelines

All pressure pipelines shall be hydrostatically tested. Site test pressures shall be1.5 times the maximum working pressure or allowance pressure plus 5 bar whichever is the smaller measured at the lowest part of the pipeline, unless otherwise specified on the drawings.

The Contractor shall give the Project Manager not less than 48 hours' notice of his intention to carry out a pressure test. Testing shall not commence without the Project Manager's approval. Before a length of pipe is tested, each pipe shall be securely anchored. All thrust and anchor blocks shall have been constructed and, the barrel of each pipe shall be backfilled to the extent necessary to prevent flotation or movement of the pipeline and shall be not less than 600mm.

Normally joints shall be left exposed until pressure testing has been satisfactorily completed. Any need to backfill a pipeline before pressure testing shall not relieve the Contractor of his responsibility to excavate to locate and repair any leaks.

Pressure testing shall be carried out as the work proceeds in such lengths as are convenient but not exceeding 500m. The ends of the length of pipeline under test shall be closed by means of securely anchored caps or blank flanges. Pipeline valves shall not be used for this purpose. All washout valves shall be fitted with blank flanges and the valves opened before the commencement of any pressure test. At each air valve location, a special air release arrangement shall be provided to allow manual release of air during filling operations. Pressure testing shall not be carried out with permanent air valves in place.

The pipeline to be tested shall be filled slowly with water in such a manner that all air is expelled. Air vents shall be checked to ensure that no air is trapped at high points.

The pressure in the pipeline shall slowly be raised to the working pressure, the test pump disconnected and the pipeline left charged under pressure with air valves opened for a period of not less than 24 hours to allow air in the pipeline to be expelled and pipe linings and pipe walls of absorbent materials to become saturated. At the end of this period of time air valves shall be closed and the test pump shall be reconnected and the pressure in the pipeline raised to the test pressure and this pressure maintained for a period of 24 hours or such other period as directed by the Project Manager.

Throughout this period the pressure in the pipeline shall not be allowed to fall or rise more than 6m head of water above the test pressure and this shall be accomplished by pumping water into or releasing water from the pipeline as required. The volume of water pumped into or released from the pipelines shall be carefully measured. At the end of the test period the pressure in the pipeline shall be adjusted to the test pressure by pumping water into or releasing water from the pipeline as required.

The apparent leakage from the pipeline shall be ascertained from the net volume of water that has been pumped into the pipeline during the test period. The permissible loss shall not exceed 2 litres per metre nominal bore per kilometre length per m head per 24 hours.

During the pressure test exposed joints shall be inspected and any leakage or seeping joints shall be remedied. All signs of leakage shall be remedied whether total apparent leakage from the pipeline under test is less than the apparent allowable leakage or not. Should any length of pipeline fail to pass the pressure test the Contractor shall at his own expense carry out all work necessary to locate and remedy the faults and to retest the pipeline until it satisfactorily passes the test.

A low pressure air test (not exceeding 0.3 bar) may be used as a preliminary joint tightness test prior to backfilling and hydrostatic testing. The water used for pressure testing shall be provided by the contractor and shall be free from impurities and of such a quality which will not pollute or injure the pipeline. The Contractor shall be responsible for obtaining the water, transporting it and for its safe disposal on completion.

5.21. Cleansing and Sterilizing of Pipelines

After the pipelines have been completed and pressure tested satisfactorily as herein specified the Contractor shall flush out and cleanse the pipelines. Where water is provided by the Employer, the cost of this will be reimbursable under a provisional sum.

Diameters 300 mm and greater:

Pipelines shall be cleansed in sections and this shall be carried out by means of passing through polyurethane foam swabs. The swabs shall be to the approval of the Project Manager.

Diameters less than 300 mm:

Pipelines shall be cleansed in sections by flushing with potable water, for a period of time to be decided by the Project Manager's Representative.

Cleansing of any section shall be repeated as required by the Project Manager's Representative in the event of the initial or subsequent operation not being to his satisfaction. The cost of such water shall be charged to the Contractor.

The Contractor shall supply all necessary equipment for the cleansing and sterilizing operations, including all swabs and swab detectors which shall be handed over to the Employer on completion of the Works.

Swabs shall be passed through pipelines at speeds of between 0.2 and 0.4 metres per second to obtain. the best cleaning results with the minimum number of passes. Should it be apparent from the debris collected by the swab that damage to the lining has occurred, the Contractor shall be wholly responsible for repairing the lining to the satisfaction of the Project Manager's Representative.

The swabbing operation shall be controlled by an experienced Project Manager to ensure that no undue surges in the pipeline, heavy docking of the pig or pressurising of the pipeline occur causing damage to any of the permanent works. Any damage caused shall be made good by the Contractor to the satisfaction of the Project Manager's Representative.

The Contractor shall make all necessary arrangements for the transportation of water from the point of supply from the Employer to the required location, and make all arrangements for the disposal of the water. All disposal methods and locations shall be to the approval of the Project Manager's Representative.

When the pipelines have been cleansed to the satisfaction of the Project Manager's Representative the Contractor shall introduce at a slow rate of water flow by a portable chlorinator or other approved means of a solution of sterilizing agent in such quantity and of such strengths as will result in the concentration of chlorine throughout the length of the pipelines of not less than 30 parts per million. This sterilizing charge shall be allowed to remain in the pipelines for 24 hours after which time the pipelines shall be thoroughly flushed using the supply water to remove chlorine in excess of that in the supply water.

When this flushing has been satisfactorily completed samples of water will be taken by the Project Manager's Representative for bacteriological analysis by the Employer. If any of the results of the analyses are unsatisfactory when compared with those of the control sample of the supply water the sterilizing process shall be repeated until satisfactory results are obtained. On completion of sterilizing and flushing the pipelines shall be left full of supply water.

The Contractor shall be solely responsible for the provision of all labour, materials and chemicals necessary for carrying out the foregoing operations.

The cost of water used for repeated cleansing, sterilizing and flushing pipelines in accordance with this clause of the Specification will be charged to the Contractor and the Contractor shall be responsible for all temporary works and other arrangements in connection with cleansing, sterilizing and flushing the pipelines.

The costs of the initial sampling analyses and preparing reports on the bacteriological quality of the water shall be borne by the Employer but the costs of any subsequent sampling analyses and preparing reports should the initial reports be unsatisfactory shall be borne by the Contractor.

5.22. Painting

All steel or ductile iron pipes and fittings exposed to view including above ground pipelines shall be painted after making good the external protection with two coats of “Bitumastic Aluminium solution D. 5909” manufactured by Wailes Dove Bitumastic Ltd, Hebburn, Durham, England, or similar approved.

Pipes and fittings in chambers shall be painted with two coats of “Bituros Solution” manufactured by Wailes Dove Bitumastic Ltd, or similar approved. Valves and Surface Boxes shall be similarly painted.

5.23. Connections to and Diversions to Existing Pipework

5.23.1. General

The Contractor shall be responsible for connecting new pipework and service connections laid under the Contract to existing pipework, and for blanking-off existing pipework and service connections. The connection shall be made in a manner to minimize any disruption to supply.

Before blanking-off or making a connection to existing pipework the Contractor shall notify the Project Manager in writing no less than 14 days in advance of the date on which he proposes to carry out the work. After giving such notice the Contractor shall obtain from the responsible Authority agreement on the precise date, times and method that the connection will be made. The connection or blanking-off shall be made at such times of the day or night as stipulated by the Project Manager.

The Contractor shall prepare a detailed method statement, programme of the work and a schedule of all plant and materials to be used and shall obtain the approval of the Project Manager not less than 72 hours before commencement of the work. The programme shall allow for the immediate re-commissioning on completion of the work.

The Contactor shall be responsible for locating the exact line and level of the existing pipework and service connections and shall agree with the Project Manager and the responsible Authority the precise location of the connection or blanking-off.

5.23.2. Materials

Before commencing the connection, the Contractor shall excavate trial pits as necessary and shall check the outside diameter of the existing pipework and ensure that the couplings to be used for making connections to the existing pipework and the materials used for blanking-off existing pipework are dimensionally suitable.

The Contractor shall ensure that all the materials are on site not less than 24 hours before the commencement of the work.

5.23.3. Personnel

The Contractor shall ensure that at least one senior member of his field supervisory staff, who is experienced in such operations and fluent in both English and the language of his labourers is on site throughout the duration of the work.

The Contractor shall also ensure that all necessary skilled artisans and an adequate number of labourers for the operation are on site throughout the work.

5.23.4. Preliminary Work

The Contractor shall execute all works possible before disconnection of the supply including:-

a. Excavation and supports to the excavation.
b. Blinding with concrete the immediate working areas, but not less than the whole of the bottom of the excavation.
c. Putting in all drains, or where this is not possible a sump of adequate size from which a pump may operate.
d. Casting the floor of any chamber which is later to be constructed around any of the works.
e. Casting the thrust blocks or any other works which may be required.
f. Exposing and cleaning pipes in readiness for the work.

5.23.5. Carrying out the Work

The Contractor shall be responsible for emptying the section of existing pipework on which the work is to be carried out, by a method agreed with the Authority and approved by the Project Manager.

The Contractor shall take all precautions necessary to prevent dirt and other foreign matter entering the pipelines.

The Contractor shall provide at the Site a sufficient quantity of clean water containing approximately 10 parts per million (10mg/l) of chlorine before proceeding with the cutting of the existing pipeline. Each item of pipework including the joints shall be submerged in the solution for a minimum period of 15 minutes immediately prior to installation.

5.23.6. Water Pipes and Chambers to be abandoned

Where existing water pipes are to be replaced with new pipework the existing pipework is to be abandoned. Where new works conflict with existing pipework to be abandoned, abandonment of pipework shall consist of removal and disposal to a site approved by the Project Manager. Water supply pipework shall not be abandoned until suitable alternative means of supply are in place and ready for connection.

Where chambers are to be abandoned these shall be broken down and disposed of and the void filled and compacted with suitable material approved by the Project Manager. Chambers deeper than 1 metre will be broken down to 1 metre below finished ground level and the remaining void filled and compacted with suitable material approved by the Project Manager.

f) DRAINS, SEWERS AND MANHOLES

6.1. Excavation for Drains, Sewers and Manholes

The ground shall be excavated to the lines and depths shown on the drawings or to such other lines and depths as the Project Manager may direct. Trenches shall be of sufficient width to enable the pipes to be properly laid and jointed. In case of pipes of greater diameter than 300mm, the width of trench shall be external diameter of pipe, plus 400mm.

When any excavation has been taken out and trimmed to the levels and dimensions shown on the drawings or as directed by the Project Manager, the Project Manager shall be informed accordingly so that he may inspect the completed trench and no excavation shall be filled in or covered with concrete until it has been so inspected and the Contractor has been authorised to proceed with the work. All surplus materials from such excavations not required for refilling shall be carted away to tips, or otherwise disposed of, as directed.

All excavations shall be kept dry, and all bailing and pumping, timbering, shoring and supporting of sides that may be required, and any refilling, ramming and disposal of surplus materials necessary in carrying out the excavations and backfilling of trenches shall be taken to provide a solid and even bed for barrels of the pipes and, where a concrete bed is not specified, the floor of the trench shall be properly shaped to receive the sockets and the backfill must be thoroughly rammed along the sides of the pipe.

6.2. Supports for Pits, Trenches and Other Excavations

The sides of pits, trenches and other excavations shall, where necessary, be adequately supported to the satisfaction of the Project Manager, and all such excavations shall be of sizes sufficient to enable the pipes and bedding to be laid accurately, and proper refilling and compacting to be carried out.

The Contractor shall take all precautions necessary for the safety of adjoining structures and building by shoring, opening in short lengths or otherwise, during the time the trenches are open.

6.3. Rock Excavation

Where solid rock is met within trenches, it shall be cut out to a depth of 100mm below the intended level of the bottom of the pipes, and replaced with 100mm of approved material as specified. In measuring such rock excavation, the following trench widths shall apply

Pipe diameter (mm)	Trench width (mm)	Pipe diameter (mm)	Trench width (mm)
150	600	600	1350
225	700	675	1450
375	1050	750	1500
450	1150	900	1900
525	1200		

The Contractor shall dispose of all surplus material arising from rock excavation in a manner to the approval of the Project Manager.

Rock shall be classified as follows;

a) **Soft rock**: Range of unconfined compressive strength shall be 1.25 to 12.5 Mpa. While carryying out field test, shallow indentations is possible (1–3 mm) by firm blows with point of geologic pick. Peels with difficulty with a pocket knife. Resists denting by the fingers, but can be abraded and pierced to a shallow depth by a pencil point. Crumbles by rubbing with fingers.

b) **Hard rock**: Unconfined compressive strength over 12.5 Mpa. specimen requires more than one hammer blow to break it. Resistant to abrasion or cutting by a knife blade.

6.4. Water in Trenches for Pipelines

Trenches shall be kept free from water at all times during construction of works until, in the opinion of the Project Manager, any concrete or other works therein are sufficiently set, and the Contractor shall construct any sumps or temporary drains that the Project Manager may deem necessary.

The Contractor shall be responsible for the removal and disposal of all water entering the excavations from whatever source and shall deal with and dispose of such water in a manner approved by the Project Manager so as to ensure that excavations are kept dry while ensuring that the disposal of this water does not cause a nuisance to adjacent plot holders or works. The Contractor shall provide all plant, labour and materials required for such work.

6.5. Laying and Jointing Rigid Jointed Concrete Pipes

Concrete pipes shall be laid true to line and level, each pipe being separately boned between sight rails.

For spigot and socket joints, the spigot of each pipe shall be placed home in the socket of the one previously laid, and the pipe then adjusted and fixed in its correct position with the spigot of the pipe accurately centred in the socket. A ring of tarred rope yarn shall next be inserted in the socket of each pipe previously laid and driven home with a wooden caulking tool and wooden mallet, such yarn when in position shall be 25mm in depth. The socket shall then be completely filled with cement mortar 1 to 2 and a fillet of the same worked all round the side. The fillet shall be levelled off and extend for a length of not less than 50mm from the face of the socket.

For ‘Ogee’ jointed pipes, the joints shall be thoroughly cleaned before laying, and cement mortar, shall be applied evenly to the ends for jointing so as to completely fill the joint. The pipes shall then be neatly pointed with a band of cement mortar approximately 125mm wide and 20mm thick. The inside of each joint shall also be pointed up as the work proceeds.

Special care shall be taken to see that any excess of cement mortar etc. is neatly cleaned off while each joint is being made and any earth, cement or other material cleaned out of the pipes by drawing a tight-fitting wad through them as the work proceeds, or by other approved means. A properly fitting plug shall be well secured at the end of the last laid pipe and shall be removed only when pipe laying is proceeding. The trenches, pipes and joint holes shall be kept free from water until the joints are thoroughly set.

Where shown on the drawings or directed by the Project Manager, concrete pipes shall be bedded and haunched or surrounded with concrete.

6.6. Pipes Laid with Open Joints

O.G. porous concrete pipes shall be laid unjointed with a space of 12mm between the spigot and the inner end of the socket.

All pipes shall be packed and surrounded as directed by the Project Manager with approved broken stone, sand or gravel aggregate, to the gradings as shown on the drawings or stated in the Bill of Quantities.

6.7. Drains to be Left Clean on Completion

On completion, all drains, manholes, etc. shall be flushed from end to end with water from an approved source and left clean and free from obstructions.

6.8. Refilling Trenches

Trenches shall be refilled with suitable excavated material of 100mm surround but not before the work has been measured and approved by the Project Manager. For pipes which are not surrounded with concrete, the first layer of filling material shall be free from stones and shall not be thrown directly on to the pipes, but shall be placed and packed with care all round them. All filling shall be deposited and compacted in layers, not exceeding 225mm loose depth, to a dry density not less than that of the adjoining soil. The last 450mm of filling must be returned in the order in which it has been removed. Timber and framing shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill all the spaces left by the withdrawn timber.

6.9. Connections of Existing Sewers and Drains

Where shown on the drawings, existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drains or channels. All such connections shall be made during the construction of the main sewer, drain or other work and a record of their positions kept for future use or reference. Where pipe connections are made to a sewer, stone pitched or lined channel, the pipes shall be well and tightly built into the concrete, or masonry work and be so placed as to discharge in the direction of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe sewers or drains, special connecting pipes as shown on the drawings shall be supplied and be truly laid and properly jointed.

6.10. Manholes and Chambers

Manholes and chambers shall be constructed in accordance with the drawings and in the position shown on the drawings or directed by the Project Manager. The side walls shall be fair faced or rendered internally as specified on drawings. They shall be brought up vertically to receive a precast slab formed of concrete of the appropriate classes specified and reinforced all as shown on the drawings. Composite material covers and frames (heavy duty with a load bearing capacity of 40 tons) shall be provided and frames shall be bedded in cement mortar 1 to 3 and so set that the tops of the covers shall be flush at all points with surrounding surface of the footway, verge or carriageway, as the case may be. Any slight adjustment of the slab level which may be necessary to accomplish this shall be effected by topping the side walls with concrete integral with the slab.

If required, half channel pipes, bends and junctions as specified shall be laid and bedded in cement mortar 1 to 3 to the required lines and levels, and both sides of the channel pipes shall be benched up with concrete of the appropriate class and finished smooth to the slopes and levels as shown on the drawings or directed by the Project Manager. The ends of all pipes shall be neatly built in and finished flush with cement mortar 1 to 3. Where the depth of the invert exceeds 1 metre below the finished surface of the carriageway or the adjacent ground, iron steps shall be built in with alternate steps in line vertically and with such additional hand irons as the Project Manager may direct.

All manholes and chambers when completed shall be watertight and to the satisfaction of the Project Manager. The Contractor shall ensure that all manholes and chambers are free from water and any water ingress shall be remedied as directed by the Project Manager.

The prices inserted in the Bill of Quantities shall include for excavation, provision of all materials, construction, refilling and disposal of surplus.

6.11. Precast Concrete Manholes

Precast concrete manholes shall be supplied and laid generally in accordance with the drawings.

6.12. Cast In-situ Manholes

The Contractor may wish to construct cast in-situ manholes. This shall be reinforced concrete and in accordance with the drawings. Moulds for the manholes shall be steel and will be approved by the Project Manager before use.

6.13. Gullies

Gullies complete with gratings and with rodding eyes where necessary shall be supplied and laid in accordance with the drawings. Where directed by the Project Manager, precast concrete gullies shall be laid on and surrounded with 100mm of concrete of the appropriate grade. The concrete surround is to be brought up to the underside of the frame or flush with the top surface as the case may be. Masonry gullies shall be constructed from 225mm building stone and rendered internally. Gullies shall be trapped where leading into foul sewers or into combined foul and surface water sewers.

6.14. Provision for Future Connection to Manholes

Inlet pipes of the required diameters shall be built into the walls of manholes and elsewhere for future use and shall be of the diameters shown on the drawings. The external ends of all such connections shall be sealed off with temporary stoppers, approved by the Project Manager. The pipes shall be laid and jointed and during the placing of the concrete they shall be adequately supported.

6.15. Surrounding or Haunching of Pipes with Concrete

Surrounding or haunching of pipes shall be carried out using concrete of the grade specified in the drawings. In carrying out this work the Contractor shall take care to pack the concrete under and around the pipes to ensure even bedding and solidity in the concrete and the concrete shall not be thrown directly on to the pipes. The upper surface of the concrete shall be struck off with a wooden screed or template and neatly finished off.

6.16. Invert Block and Stone-Pitched Drains

Precast concrete invert blocks and side slabs shall be formed of concrete of the appropriate grade and dimensions shown on the drawings. Each course of side slabs required in the Bill of Quantities shall be interpreted as one complete row of side slabs to one side of the channel concerned. Stone used for channels shall be 225mm x 100mm building stone. Drains should not normally be laid to a radius of curvature less than 10 times the actual width of the drain.

Invert block and stone-pitched drains shall be constructed in the positions and to the levels and dimensions shown on the drawings and laid to true line and even fall. Where under-filling is required it shall be in 100mm maximum thickness layers of compacted murram. The earth sides to such channels shall be neatly finished to a slope of 1 to 1 or such other slope as the Project Manager may direct.

Invert blocks and side slabs shall be laid on a 100mm minimum thickness of compacted murram and be neatly jointed with cement mortar 1 to 3 as the work proceeds. The excavation, murram bedding, providing, laying and jointing invert blocks or stone, backfilling and disposal of surplus shall all be as specified and all in-situ connections shall be in concrete of the appropriate grade.

6.17. Testing of Jointed Pipes and Manholes

Sealed jointed drains, up to and including 600mm diameter shall be tested in sections (e.g. between manholes) by filling with water under a head of not less than 1.2 metre. Drains found to be water-tight after a period of 30 minutes will be passed as satisfactory but the water must be retained in the pipes until a depth of at least 450mm of filling has been deposited and compacted on top thereof. Drains failing to stand the test shall be taken out and the pipes re-laid and re-jointed until completely water-tight.

Drains exceeding 600mm in diameter shall be tested by means of a smoke test before they are covered up. Both ends of the lengths of drain to be tested shall be sealed to the satisfaction of the Project Manager, and smoke shall then be pumped into the section from an approved machine. Should any joint in the section show an escape of smoke, the section shall be taken out and the pipes re-laid and re-jointed until there is no further escape of smoke.

Should the Project Manager so direct, manholes shall be tested by completely filling with water, and there shall be no appreciable loss over a period of 2 hours.

On completion of the works, or at suitable intervals during construction, infiltration tests will be carried out. The permissible amount of infiltration shall be 1 litre per hour per linear metre of nominal internal diameter.

The Contractor shall provide all labour and apparatus for the above tests.

All testing will be done in accordance with the procedure of the British Standard Code.

6.18. Pipes with Rubber Ring Joints

Rubber rings shall be entirely suitable for the pipe being used and will be provided by the Contractor. They will be laid in the socket and the pipes then jointed as specified. The jointing of pipes shall be carried out in accordance with manufacturer's instructions and in conformity with any modifications proposed by the Project Manager.

6.19. Laying, Jointing and Backfilling for Flexible Jointed Pipes

The Contractor shall ensure that any hard spots and loose stones are removed from the formation prior to laying of bedding materials. The Contractor shall lay a bed of thickness 100mm consisting of granular material i.e. sand, gravel, or approved soil of friable nature.

After laying of pipes the Contractor shall lay bedding material on the sides of the pipe compacted by tamping into soffit of sewer.

After completion of this operation the Contractor shall lay the bedding material on top of the pipe in 150mm layers to a thickness of 300mm. The material is to be compacted by tamping. However, precautions are to be taken to avoid excessive tamping on top of the pipe. The remaining trench excavation is to be backfilled.

The pipes shall be laid with flexible ring seal joints provided that solvent cement joints could be used for fittings where necessary subject to the approval of the Project Manager. Pipes and fittings shall be checked for deformities prior to laying. Deformed pipes and fittings shall not be accepted.

6.20. Flexible Rubber Ring Joints

The Contractor shall ensure that the spigot end is free from grit, dust or dirt and sealing rings should be seated evenly in the socket grove. Pipe lengths and fittings are supplied with a chamfer on the spigot. Where pipes are to be cut or are supplied without a chamfer on the spigot end the Contractor shall ensure that the pipe is cut square and then form a chamfer on the spigot end with a medium file to an angle of 15 degrees. Remove saw flashing by scraping with a pen-knife.

6.20.1. Expansion Gap

It is necessary to leave a gap between the edge of the spigot end and the base of the socket to allow for expansion. Moulded fittings are supplied with an embossed line indicating the correct depth of insertion. In other cases where the marking is not done, the Contractor shall ensure that an expansion gap of at least 3mm per metre length of pipe or at least 15mm per pipe length is provided. This can be done by marking spigot ends or by pushing spigot fully home, making a small mark on pipe and then withdrawing the pipe by 15mm.

After completing jointing the pipe shall be laid on the prepared bed making sure that a suitable depression is created in the bed for the socket.

6.20.2. Solvent Cement Joints

For solvent cement joints make sure that mating surfaces are clean and free of grease and dirt. Roughen mating surface with sandpaper, clean both surfaces with cleansing fluid using a clean cloth. Apply solvent cement on both mating surfaces. Without delay bring mating surfaces together and hold in position firmly for a few seconds. A layer of cement should be visible at the edges. Joints should not be disturbed for at least 10 minutes after assembly.

g) BUILDINGS AND STRUCTURES

7.1. Concrete Building Blocks

Concrete building blocks shall be of approved manufacture and shall be formed in a press. The blocks manufactured in Class C30 concrete shall be cured for at least 10 days before use.

Blocks shall be well and evenly formed with true corners and unbroken arises, and shall be carefully handled and stacked.

7.2. Laying Building Blocks

Joints between blocks shall be filled solid with mortar and shall be of regular thickness of 5 to 10mm. The blocks shall be laid in level courses and bonded so that each vertical joint is midway above the face of the block below, except at junctions and piers where a bond of not less than 100mm shall be provided. The walls shall be raised in lifts not exceeding three metres in height in any one day, and truly vertical. All blocks shall be wetted before being laid.

Joints of exposed work shall be raked out and neatly flush-pointed in the same mortar. The whole of the visible faces of the walls shall be left perfectly cleans and all surface mortar and droppings shall be removed before they have set.

Joints in work to be rendered shall be raked out to a depth of 8mm to provide a key for the rendering.

Blockwork shall be tied into adjoining structural members at the same level as blockwork reinforcement using 150mm long butterfly tangs or equivalent fixed and mortared into proprietary vertical strips.

7.3. Precast Concrete Units Generally

All precast concrete units shall include all fixing plugs and strips to enable screw ties or other fixing devices to be firmly attached. For all precast units to be set in block of masonry walls the plugs and strips shall be so positioned as to provide fixing at course and in no case exceeding 450mm centres.

7.4. Masonry Using Natural Irregular Stones

Stones shall come from selected quarry layers to the approval of the Project Manager. They shall be homogeneous, frost resistant, flawless, free of any cracks or bousins, solid, and of equal grain and shall have all the required quantities to give a regular facing. They shall give out a clear sound when hit by a hammer.

Mortar shall be removed from the external surface of the wall. The Contractor shall prepare a wall sample approved by the Project Manager which shall be kept at the construction site until all the masonry is completed.

7.5. Screen Walling

Screen walling shall consist of perorated precast concrete blocks 100mm thick of approved shape, design and manufacture laid to an approved pattern in cement mortar wit perfectly even joints which shall be neatly flush or recess pointed as directed.

7.6. Damp-Proof Course

All external walls of buildings are to be provided with damp-proof course (DPC) of textured PVC strip of width equal to the total thickness of the wall and any external rendering. The DPC is to be lapped with the damp-proof membrane and bedded in mortar specified for the type of block used. The greatest lengths possible are to be used for the DPC's but any end laps required are to be at least 200mm long made dry without intervening mortar. Piers are to have complete DPC's lapped with the wall DPC.

7.7. Damp-Proof Membrane

Damp-proof membranes shall be laid, as directed by the Project Manager, beneath all floor slabs resting on the ground. They shall be composed of single sheets of minimum thickness 0.300mm black polyethylene film of an approved manufacturer specially made for use as damp-proof membrane.

The film shall be laid on sand and turned up around all edges of the slab and with 150 mm margin above the top of the slab to be tucked into the perimeter walls of the building. Where the building is so large as to exceed the maximum sheet size available, several sheets shall be used and the joints shall be lapped 150mm and fused together using a welding tool designed for that purpose. Every care should be taken by the following trades to prevent perforation of the membrane but in the event of the puncture the perforation shall be covered by a patch of similar material of dimensions exceeding the area of the puncture by 300mm and the two sheets welded together as described above.

7.8. Composition of Mortars

a) Cement mortar for bonding concrete shall be composed of cement and sand mixed in the proportion of the jointed concrete.

b) Cement mortar for setting precast concrete or pitching shall be composed of cement and sand mixed in the proportion of 50kg of cement to 0.14m3 of sand, with the addition of an approved plasticizer.

c) Cement mortar for blockwork in concrete blocks shall be composed of cement and sand mixed in the proportion of 50kg of cement to 0.14m3 of sand.

d) Sand and Cement for mortars shall be as described in the specification for concrete.

7.9. Mixing of Mortars

The materials of mortars shall be measured out in their correct proportions and shall first be thoroughly mixed together in a dry state by turning them over upon a clean wooden stage until they are of a homogeneous appearance in consistency and colour. Clean water shall then be added while the mixture is being turned over until it attains a suitable consistency. Plasticizer shall be added in accordance with the manufacturer's recommendations as approved by the Project Manager.

The mortar shall be used immediately after it has been mixed. No mortar which has commenced its first set shall be used, or mixed up again. Mortar shall, where possible in hot weather, be protected from too rapid action by covering with impervious material such as polyethylene film.

Mixing by hand will be allowed only if the Project Manager gives specific approval. Mixing by machine using the same sequence of operations described above shall be carried out whenever possible.

7.10. Cement Rendering

Rendering shall be in a 50 kg to 125kg cement: sand mix but where approval had been given to the use of a plasticizer or other additives these proportions may be modified to the approval of the Project Manager.

All surfaces to receive a finishing coat of cement rendering or fine concrete shall be thoroughly prepared and cleaned and the rendering or screeding shall be placed immediately after such surfaces have been thoroughly wetted.

All rendering shall be put to a minimum of two coats, the first being left rough to a minimum of 10 mm thickness, but the second coat shall be trowelled up to a fair faces as soon as possible after it is applied.

All internal rendering shall be finished to an even and polished surface with a float, trowel or other suitable tool, special care being taken to obtain perfectly smooth and glazed faces. It shall not be less than 15mm thickness when finished unless instructed otherwise.

All external rendering shall be brought to an even surface with a wood float following which a tyrolean finish of approved colour shall be applied unless otherwise stated.

All rendering shall be protected from sun and rain by adequate and suitable coverings which shall be supplied and fixed in advance of these conditions arising. The renderings shall be kept damp while setting and protected from drying winds.

7.11. Tanking to Buried Concrete Surfaces

External concrete surfaces to be tanked shall be coated with a bituminous waterproofing membrane 3mm minimum thick. The tanking shall be dressed into structure as shown in the Drawings and be protected by non-rotting boarding prior to backfilling.

7.12. Waterproof Rendering

Waterproof rendering slurry shall comprise a 50kg to 125kg cement sand mix with an approved waterproofing admixture such as styrene arcrylate copolymer.

The material shall block capillaries and minor shrinkage cracks to prevent water ingress while allowing the passage of water vapour through the structure.

The render shall be applied to a total thickness of not less than 20mm the first coat shall be applied levelled scratched and left to dry for not less than 3 days.

7.13. Grouting in Ironwork

All brackets, rag-bolts and other ironwork for which holes have been boxed out or left in the concrete of a structure shall be carefully grouted in to their correct positions in all particulars. The grouting in shall be carried out with cement and sand grout in such a manner that there shall be no apparent difference in the texture or colour throughout the face of the finished structure and that there shall be no seepage of water either between the ironwork and the set grout or between the set grout and the surrounding structure.

The above instructions shall apply also to the building-in of pipes except that Class C25/10 concrete shall be used in lieu of cement grout.

All holes left for building-in shall be free from any sign of infiltration of water before the building-in is carried out. No reliance shall be placed upon the building-in process for the sealing of such leakage.

7.14. Cable Duct Covers and Frames

7.14.1. Recessed Covers

Cable duct covers recessed for flooring finishes shall be provided with galvanized rolled steel angles of height equal to the thickness of the floor finishing and fixed to the surface of the structural floor slab along all edges of the trenches so that the top edge is level with the finished floor level. The angle shall be laid so as to form seating for duct covers and all additional galvanized rolled steel tee sections shall also be provided to support the duct covers.

The duct covers shall be galvanized to suit the ducts and the seating described above. A lightweight galvanized steel mesh shall be fixed to the upper surface of the trays to provide a key for floor finishes. The seating and trays shall be so laid that the finished floor is perfectly level and all trays fully supported at all edges without the use of loose packing. At least one tray in every series of trays covering a length of duct shall be provided with cast-in lifting eyes and a pair of suitable lifting keys shall be handed to the Project Manager on completion.

7.14.2. Checker Plate Covers

Checker plate covers shall be hot dipped galvanized mild steel fitted flush with the floor surface and fully supported.

7.15. Fences and Gates

Fences generally shall be in accordance with the relevant parts of BS 1722 Part 1: 1986. Chain link fencing shall be as shown in the drawings. The mesh and line wires shall be galvanized and the posts shall be reinforced concrete.

The straining posts, intermediate posts and struts shall be manufactured and erected complete as specified in BS 1722. The fencing shall be true to line and vertical, following profile of the ground, previously graded so as to prevent access beneath the bottom wire. Gates shall be hung on adequate post, and shall be truly vertical.

Ornamental fabricated metalwork fences and gates shall be constructed of mild steel bar, strip or tube in accordance with the Drawings. All welded joints and drillings for bolts shall be made before painting, and all bolts, nuts and washers shall be galvanized or plated in an approved manner. Any metalwork sunk into the ground shall be treated with two coats of bituminous paint.

7.16. Joint Sealing Compound and Sealants

Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in which they are to be placed, and capable of providing durable, flexible and watertight seal by adhesion to the concrete throughout the range of joint movement.

Hot poured joint sealants shall comply with BS 2499, Ordinary Type A1 sealant.

Cold poured polymer-based joint sealants shall comply with BS 5212: Part 1, Normal Type N sealant.

Two part polysulphide based sealants shall comply with the relevant provisions of BS 4254. Pouring Grade shall be applied to horizontal upward facing joints and Gun Grade to joints of any other aspect or inclination. Other two part polymer based sealants of Gun or Trowel Grade shall comply with the physical and test requirements of BS 4254.

Silicon bases building sealants shall comply with the relevant provisions of BS 5889. Primers for use with joint sealants shall be compatible with, and obtained from the same manufacturers as, the adjacent sealant. Primers shall have no harmful effects on the concrete.

Sealants and primers which will be in contact with water to be used for potable supply shall not impart to water taste, colour, or any effect known to be harmful to health, and shall be resistant to bacterial growth. Sealants and primers which will be in contact with sewage or sewage sludge shall be resistant to biodegradation.

7.17. Openings in Walls, Floors and Ceilings

The Contractor shall chase put and/or cut openings through walls, floors and ceilings for the passage of pipes and cables where described in the contract shall provide and fix in position approved tube sleeve cut off flush with the finished surface. All openings and ducts shall be sealed on completion to prevent the passage of toxic or explosive gases.

7.18. Structural Steelwork

Material for structural steel work shall comply with BS EN 10137 and workmanship with BS 5950. The steelwork shall be securely fixed to the foundations or building and designed to have such strength and stiffness that its deflection and movement under the loads to be applied shall be within tolerable limits.

All bolts and nuts shall comply with the requirements of BS 3693 except for High Strength Friction Grip Bolts which shall comply with BS 4395. Mild steel electrode shall comply with the requirements of BS EN 499 and High Yield Steel with BS 2540.

All structural steel fabrication shall conform to the requirements of BS EN 5400. The use of High Strength Friction Grip Bolts shall be in accordance with BS withdrawn.

All structural steel work shall be fabricated using welded joints where possible for shop joints and bolted joints for field assemble.

7.19. Open Mesh Walkways and Covers

Open mesh type walkways, platforms and covers shall be of aluminium or galvanized steel, suitable for a superimposed load of not less than 6kN/m2. The walkways, platforms and covers shall include all necessary supports not detailed on the Drawings.

Open mesh panels shall be trimmed with full depth nosing bar along all edges and bolted to each other when in place to help ensure a firm walkway. Panels shall be cut in such a way and fixing so as to provide a continuity of pattern.

Covers shall incorporate a hinged lockable open mesh access panel with a 750 x 750mm clear opening, strong durable hinges and heavy duty non-corrodible padlock. Openings for valve keys shall be just sufficient in size for the valve key and shall incorporate a cover hinged only.

All panels shall be securely bolted to the supporting structure. Where the supporting structure is concrete, galvanized mild steel angle curbs shall be provided and securely grouted into rebates left in the concrete such that the tops of the panels are flush with the top of the concrete.

7.20. Handrailing

Hand railing shall be approximately 1000mm in height with an intermediate horizontal rail with standards not more than 2000mm apart. Hand railing shall be designed for a horizontal loading of not less than 220N/mm. Hoops shall be welded on where required for fixing guard chains. Standards and rails shall be manufactured from black mild steel tube to BS 1387:1985, from steel tubing to BS 1775 or from extruded aluminium alloy approved by the Project Manager. The nominal bore of

steel tubing shall be not less than 32mm. Adequate provision shall be made for thermal movement. Steel hand railing shall be hot dipped galvanized after fabrication.

7.21. Guardrail

Guardrails shall be 750mm in height with a single top rail. In all other respects it shall comply with the specification for hand railing.

7.22. Chains

Chains across openings in handrails at tops of ladders shall be galvanized mild steel having 3 SWG x 3 links per 100mm and shall be supplied complete with 'S' hooks and split rings.

7.23. Steel Access Covers

Steel access covers shall be to the duty required and sized to suit the opening shown on the Drawings. They shall be complete with frame and shall be weatherproof (prevent ingress of water) when closed and shall in all respects be strong and durable.

The covers shall be hinged and lockable and provided with stays to prevent the covers opening more than 105º. The Contractor shall provide with each cover a heavy duty non-corrodible padlock and four keys. The covers and frames shall be galvanized.

7.24. Isolation of Aluminium

All items of aluminium construction shall be isolated from concrete by the use of bituminous felt or DPC material or two coats of bituminous paint. The aluminium shall be isolated from dissimilar metal by the use of fibre washers and spacers.

7.25. Galvanising

Where galvanizing has been specified the items shall after fabrication be hot dipped galvanized in accordance with BS 6530 Part 1 to a thickness of 0.15mm (005'). All items to be protected shall be prepared as specified in the above standards. Articles altered at the manufacturer's works in any way after galvanizing are to be re-galvanized as specified. Articles subject to minor alternations at site or requiring minor repair at site shall be wired brushed to remove all rust and coated with 3 coats of approved zinc rich cold galvanizing compound.

7.26. Fixings to Structures.

Where fixings to structures previously constructed are to be made by setting a bolt system into performed holes, such fixings shall be made either by Rawlbolt Projecting Bolt Type or by using an approved proprietary resin anchor system. Where performed holes have not been provided a self-drilling expanding bolt system shall be used.

Where thin sections are involved or where stresses are likely to be set up which might cause damage to the structure the use of the resin anchor system only will be permitted. Only in special circumstances will the Project Manager or the Project Manager's Representative permit rawlbolts to be uses. Performed holes shall be accurately set to template prior to placing the surrounding concrete and shall be kept rigidly in place until the concrete has properly set.

Where resin anchorage is used the Contactor shall ensure that the setting time of the resin is appropriate to the requirements for setting up, plumbing and aligning the work before is sets. Bolts shall be set

to template and hole diameters shall conform to the recommendation of the suppliers. Whatever system is used, all bolts shall be plated to resist corrosion.

h) ROADS AND SURFACING

8.1. Access Tracks

Permanent access tracks shall be constructed only where shown on the Drawings. Tracks shall be unsurfaced. Filling to bring formation to the required level shall be locally excavated material which shall be placed in layers and compacted by tracking with the excavation plant. The road formation shall be tracked and graded with a dozer blade or bucket to give a cross fall of not less than 1 in 40. Surface undulations shall not exceed 200mm over a length of 3.0m, unless otherwise approved by the Project Manager.

The maximum gradient shall not exceed one vertical to 6 horizontal and the minimum tuning circle radius measured to track centre line shall not be less than 15.0m.

8.2. Access Roads

The road formation shall be the surface obtained after completion of any earthworks. Filling to bring the formation to the required level shall be selected material. It shall be laid and compacted in layers not exceeding 150mm in thickness, the compaction being carried out by a roller of not less than 8 tonne weight.

The Employer and the Contractor may at any time after the completion of the access road (after 14 days in the case of concrete surfaces) use them or allow their use by their employees or sub-contractors.

At such times during the Period of the contract of Period of Maintenance as the Project Manager may direct, the Contractor shall at his own expense make good any deterioration which may have occurred in the condition of the roads, whether as result of the use of roads by the Employer or otherwise. In particular, any parts of the foundations into which soil has penetrated shall be dug out and replaced with clean materials.

8.3. Macadam Roads and Macadam Hardstandings

The sub-base shall consist of 150mm compacted thickness of free draining granular material conforming to the grading limits specified in the contract. The plasticity index shall be 0-6% maximum and the California Bearing Ratio at maximum density (Test 12, BS 1377:1990) shall be 25% minimum. The material shall be compacted to 95% of the maximum density as determined by Test No. 13, BS 1377:1990 (heavy compaction) by means of a roller of not less than 8 tonnes weight.

If the quality of foundation soil is considered inadequate, the Project Manager may direct that the sub- base be 300mm thick, in which case construction shall be carried out as described above but as two 150mm thick layers.

The road base shall consist of 150mm compacted thickness of free draining crushed limestone conforming to the grading limits stated in the Contract. The plasticity index shall be 0-6% maximum and the California Bearing Ratio at maximum density (Test 13, BS 1377:1990) shall be 80% minimum.

The base shall have a prime coat applied not more than seven days after the completion of the base and not later than twenty four hours after approval by the Project Manager. The asphalt used for the prime coat shall generally conform to the relevant AASHTO specification.

Before laying the tarmacadam base course onto the primed base, all loose blinding material shall be brushed off the road and removed. The tarmacadam base course shall consist of 60mm compacted thickness of 20mm nominal size dense base course macadam. The aggregate and asphalt shall be generally in accordance with the relevant AASHTO specification.

A tack coat shall be applied between successive layers of asphalt material and shall generally conform to the relevant AASHTO specification. Machine laying shall normally be used and compaction shall be carried out with a roller of not less than 12 tonnes weight so as to achieve a dense, smooth and even surface. Where new road construction is to be joined to an existing road, the surface shall be cut back to a straight line and primed.

Should the Contractor wish to lay Macadam on the roads early in the Contract for use by the construction traffic, he may do so provided construction is stopped at completion of the Macadam base course and this single layer blinded with bituminous grit to seal the surface.

When all concreting, earth moving and heavy crainage and haulage has been completed, and in general towards the end of the Contract, the base course so provided shall be thoroughly cleaned off and repaired, and re-levelled where necessary, and a suitable cold bituminous emulsion tack coat generously applied by spray in accordance with the manufacturer's instructions, care being taken to avoid spattering kerbs or other adjacent concrete. The wearing course may then be laid and blinded as described in sub- section (i) above. Any additional costs involved in the adoption of the method of laying described in this sub-section shall be included by the Contractor in his rates for road making.

Notwithstanding the time of placing of the roadworks, the condition of the finished road at the completion of the Contract shall be of 'as new' quality, with clean, accurately profiled, rolled and sealed surface throughout, free from concrete spotting or staining, patch marks, trench outlines, paint, oil or fuel spillages or other visible or structural defects.

8.4. Unsurfaced Roads and Hardstandings

Unsurfaced roads and hardstandings shall be constructed from 300mm of crushed lime stone conforming to the grading limits specified in the Contract, laid in two layers of 150mm.

Each layer shall be compacted to 95% of the maximum density (Test 12, BS 1377:1990).

8.5. Pea Shingle Surfaced Areas

The sub-base to pea shingle areas shall be as defined in 8.3 above. Pea shingle consisting or 20mm thick 5mm nominal single sized stone laid and raked to a level finish.

8.6. Precast Concrete Kerbs and Channels

Kerbs shall be laid before the adjacent carriageway is constructed and sufficiently in advance to meet the Project Manager's requirements. Kerbs shall be bedded solidly and accurately in their concrete foundations before the initial set of the concrete has started. Each kerb shall be set solidly and accurately to the required line and level with joint no more than 6 mm wide, neatly pointed with cement mortar and filled for their full depth with cement grout as specified. At every tenth kerb joint, the pointing and grout shall be omitted. A piece of 4mm thick approved jointing material shall be placed in these joints, neatly trimmed to be flush with the face of the kerb. The bedding shall be well haunched up to the back of the kerb, to within 100mm of the top of the kerb. All cutting shall be neatly formed so as to show no damage to the exposed faces and to leave the ends square for the full width of the kerb.

The kerbs and channels shall be 130mm wide by 250mm deep. Kerbs shall be half battered. Kerbs damaged at the exposed faces will not be accepted.

8.7. Precast Concreting Edging

Edging shall be 50mm x 150mm in size. Edging shall be laid in the same manner as kerning and in short lengths, where required to be circular on the plan.

8.8. Footpaths and Paving

For surfaced footpaths and similar paved the base material shall be laid on hard fill or selected materials as directed by the Project Manager's Representative and compacted by a roller of 0.75 to 3 tonnes weight. The footpath base shall be formed of crushed rock graded from 50mm to 10mm suitable for the purpose and laid as wet-mix or dry macadam and rolled or compacted to the final form and grading of the final surfacing to a thickness of 100mm.

The base course shall consist of 100 mm compacted thickness of bituminous macadam of 14mm nominal sized material. After laying and rolling the base course, a wearing course shall be laid to provide a final finish. This shall consist of 15mm compacted thickness of 100mm nominal size bituminous macadam. As soon as possible after laying the wearing course, it shall be blinded with bituminous grit (fine cold asphalt) to weather-seal.

For concrete paving, the precast concrete flags shall be of approved colour and size not less than 30mm thick unless otherwise indicated. They shall be laid and bedded in cement mortar upon a 100mm thick bed of compacted crushed limestone.

The Contractor will be required to lift and relay at his expense flags which have sunk through consolidation of settlement of the ground beneath and the Project Manager's maintenance certificate will not be issued until such work has been completed to his satisfaction.

8.9. Laying to Grade

All new and reinstated roads, alleyways and hard standings shall be completed in a manner that ensures cross-falls are towards the storm water drainage intakes.

i) SAFETY, HEALTH AND ENVIRONMENT

9.1. Introduction

The prevention of injury and/or illness to the site personnel and the public, damage to the Works and to public and private property, protection of the environment, and compliance with applicable laws, are primary objectives of the Employer. Because of the importance the Employer places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Specifications with which Contractors shall comply while working on this contract. Given that these Specifications cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Specifications, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

The Employer nor its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.

The Contractor shall throughout the execution and completion of the Works and the remedying of any defects therein:

a) have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;

b) know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and subcontractors;

c) take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment;

d) avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequent of carrying out the Works.

9.2. Compliance with Specifications

The Contractor shall comply with the requirements of these Safety, Health and Environmental Specifications and all other applicable regulations or requirements under Kenyan laws, laid down by relevant authorities or issued by the Employer or the Project Manager concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract.

In so far as these Specifications are applicable, they shall apply to sites and personnel outside the Site associated with the performance of the Contract.

The Specifications equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Specifications.

The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Specifications by the Employer, Project Manager or relevant authorities within the time specified in the notification or instruction.

The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action, by:

a) ensuring the Specifications are enforced and followed by the Contractor's personnel. Any

failure by the Contractor's personnel to follow the Specifications shall be regarded as a failure by the Contractor.

b) paying attention to possible injury to unauthorized persons entering the site, particularly children.

Whenever in these Specifications the Contractor is required to provide test certificates for equipment and personnel and to comply with the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Kenya, the Contractor shall provide:

a) in lieu of independent test certificates:

- for equipment – details of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;
- for personnel – details of the training and experience of the personnel and a written statement that the Contractor has satisfied himself that they have the required level of competency;

b) in lieu of relevant authorities' requirements – details of the Contractor's own rules, regulations, requirements and procedures regarding safety, health and the environment.

If the Project Manager is dissatisfied with the details provided by the Contractor, the Contractor shall provide further details or carry out further tests or provide further written statements as may be reasonably required by the Project Manager.

When the Project Manager has satisfied himself regarding the Contractor's own rules, regulations, requirements and procedures provided in accordance with (b) above, such rules, etc. shall be deemed to form part of these Specifications and to which Clause 3 shall equally apply.

9.3. Failure to Comply with Specifications

Should the Contractor fail to comply with any of the Specifications or requirements of the Project Manager:

a) the Project Manager may suspend the Works of part of the Works until the Contractor has taken the necessary steps, to the satisfaction of the Project Manager, to comply with the Specifications or requirements.

b) the Employer may, following written notice to the Contractor, carry out themselves or arrange for another contractor to carry out such measures as they may consider appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.

c) the Project Manager may, by written notice of suspension to the Contractor, suspend all payment to the Contractor under the Contract if the Contractor fails to rectify any breach of the Specifications within the period specified by the Project Manager, provided that such notice of suspension:

   (i) shall specify the nature of the failure or failures; and

   (ii) shall request the Contractor to remedy each such failure within a specified period after receipt by the Contractor of such notice of suspension.

Such suspension of payment shall remain in force until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Project Manager. No interest shall be paid on the suspended payments.

Failure to comply with the Specifications or requirements shall be considered a breach of the Contract by the Contractor and may result in termination of the Contract by the Employer. In the event of the Employer

taking action based on this Clause, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date. All costs incurred by the Employer pursuant to Sub-Clause 703.1.1 (b) shall be deducted from the amounts otherwise due to the Contractor.

9.4. General Requirements

All references to safety shall be deemed to include health and the environment.

9.4.1. Safety Officer

The Contractor shall appoint a competent Safety Officer who shall be responsible for safety, health and the environment. The Safety Officer shall be given sufficient time by the Contractor to carry out his duties; minimum requirements shall be as follows:

Workforce on site of over 250	-	full time Safety Officer;
Workforce on Site of 100 – 250	-	50% of Safety Officer's time;
Workforce on site below 100	-	as required for the Works but a minimum of 5 hours per week of Safety Officer's time where more than 20 workers.

The Contractor shall provide the Safety Officer with appropriate identification, including a white hard hat with red cross symbol and an identification badge. The appointment of the Safety Officer shall be in writing and copied to the Project Manager. The appointment shall include specific instructions to enforce these Specifications and delegated authority to take any action, measure or to issue instruction regarding their enforcement. All persons on Site shall be made aware of the name and authority of the Safety Officer and instructed to comply with any instruction or direction in safety matters, verbal or in writing issued by the Safety Officer.

The Safety Officer shall be provided with a mobile phone or other similar means of communication. The Safety Officer shall be accessible and available at all times including normal working hours.

9.4.2. Safety Training

The Contractor shall provide safety induction training for all site personnel upon starting on site. The Contractor shall provide safety refresher/reinforcement training at regular intervals for his staff.

9.4.3. Safety Meetings

The Contractor shall hold regular safety meetings to provide safety instructions and receive feedback from site personnel on safety, health and environmental matters. A weekly safety Meeting shall be chaired by the Safety Officer and minutes shall be taken of the meeting. The meeting/minutes shall be given to the Project Manager. The Safety Officer should attend the Contractor's weekly site meetings and "Safety" shall be an item on the agenda.

9.4.4. Safety Inspections

The Safety Officer shall make regular safety inspection of the work site. The Safety Officer shall prepare a report of each inspection. This report shall include details of all breaches of these Specifications and any other matters or situations relating to safety found during the inspection, instructions issued by the

Safety Offices and actions taken by the Contractor. A copy of the Safety Officer's reports shall be given to the Project Manager.

9.4.5. Control of Substances Hazardous to Health

Hazardous materials shall be stored in approved safety containers and handled in a manner specified by the manufacturers and/or prescribed by relevant authorities.

Only properly trained and equipped personnel shall handle hazardous materials.

9.4.6. Potential Hazards

The Contractor shall inform employees of potential hazards, take the appropriate steps to reduce hazards and be prepared for emergency situations. The Contractor shall make an assessment of every operation involving hazardous substances. The assessment shall be recorded on a Hazardous and Flammable Substances Assessment Method Statement which shall be submitted to the Project Manager prior to the delivery and use of the substance on Site.

9.4.7. Accident Reporting

The Contractor shall report all accidents and dangerous occurrences to the Project Manager. The Contractor shall prepare a report on each accident or dangerous occurrence and a copy of the report, together with witness statements and any other relevant information, shall be submitted to the Project Manager. A reportable accident or dangerous occurrence shall include any accident to any person on site requiring medical attention or resulting in the loss of working hours or any incident that resulted, or could have resulted, in injury, damage or a danger to the Works, persons, property or the environment.

In the event of an accident or dangerous occurrence, the Contractor shall be responsible for completing all statutory notifications and reports. Copies of all statutory notifications and reports shall be passed to the Project Manager.

All accidents and dangerous occurrences shall be recorded in a Site Accident Book. The Site Accident Book shall be available at all times for inspection by the Project Manager.

The Contractor shall immediately rectify any situation or condition that could result in injury, damage or a danger to the Works, person, property or the environment. If the situation or condition cannot be corrected immediately, the Contractor shall provide temporary barriers and appropriate warning signs and devices and/or take other appropriate action necessary for the protection of persons, property and the environment.

9.4.8. Notices, Signages.

All safety, health, environmental and other notices and signs shall be clearly displayed and written in English. All requirements, instructions, procedures, etc. issued by the Contractor concerning these Specifications shall be printed in English and displayed and readily available to the Contractor’s personnel.

9.4.9. First Aid and Medical Attention

The Contractor shall have comprehensive First Aid Kit(s) on Site at all times. First Aid Kits shall be conveniently located and clearly identifiable.

The Contractor shall have one employee on site trained in first aid for every 25 employees. Such persons shall be provided with appropriate identification, including a red hard hat with a white “red cross” symbol; and an identification badge.

The Contractor shall make contingency arrangements for calling a Doctor and transporting injured persons to hospital. The telephone numbers of the emergency services and the name, address and telephone number of the Doctor and nearest hospital shall be prominently displayed in the Contractor’s site office.

9.4.10. Employee Qualification and Conduct

The Contractor shall employ only persons who are fit, qualified and skilled in the work to be performed. All persons shall be above the minimum working age. Contractor's personnel shall use the toilet facilities provided by the Contractor.

The Contractor shall ensure:

a) that no firearms, weapons, controlled or illegal substances or alcoholic beverages are brought onto the Site and that no personnel under the influence of alcohol or drugs are permitted on Site.

b) That all personnel obey warning signs, product or process labels and posted instructions.

c) That drivers or operators of vehicles, machinery, plant and equipment follow the rules for safe operations. Drivers shall wear seat belts and obey all signs and posted speed limits.

9.5. Safety Requirements

9.5.1. Personal Protective Equipment

The Contractor shall provide personal protective equipment, including hard hats, safety glasses, respirators, gloves, safety shoes, and such other equipment as required, and shall take all measures or actions for the protection and safety of Contractor's personnel.

Non-metallic hard hats shall be worn at all times by all personnel at the worksite with the exception of those areas where the Project Manager has indicated it is not necessary to do so. Safety glasses shall meet international standards and be available for use and worn in specified worksite areas. As a minimum, safety glasses shall be worn for the following types of work: hammering, chipping, welding, grinding, use of electrically powered or pneumatic equipment, insulation handling, spray painting, working with solvents, and other jobs where the potential of an eye injury exists. Face shields and/or goggles shall be worn where possible exposure to hazardous chemicals, cryogenic fluids, acids, caustics or dust exists and where safety glasses may not provide adequate protection.

When handling acids, caustics and chemicals with corrosive or toxic properties, suitable protection, such as acid suits or chemical resistant aprons and gloves, shall be worn to prevent accidental contact with the substance.

Personnel shall not be permitted to work whilst wearing personal clothing or footwear likely to be hazardous to themselves or others.

The wearing of safety shoes with steel reinforced toes is recommended for all Contractor's personnel on site. In all cases, Contractor's personnel shall wear substantial work shoes that are commensurate with hazards of the work and the work site area.

Hearing protection, including muffs, plugs or a combination thereof, shall be provided for all personnel operating in areas where the noise level exceeds 90 decibels. Such protections shall also be provided for operators working with equipment exceeding such a level. This may include equipment such as excavators, shovels, jackhammers, saws, drills, grinders and the like are being used.

The Contactor shall encourage employees to wear substantial work gloves whenever practical and safe to do so.

9.5.2. Fire Protection and Prevention

The Contractor shall comply with fire protection instructions given by the Authorities having jurisdiction in regard to fire protection regulations. The Contractor shall, upon moving on site, provide to the Project Manager and the Authorities a fire prevention and evacuation plan. This shall include drawing(s) showing the fire assembly points. The fire prevention and evacuation plan and drawing(s) shall be updated from time to time as the Works progress. The Contractor shall ensure all personnel are fully informed on escape routes and assembly points and any changes thereto. Fuel storage will not be permitted in construction work areas. Contractors may establish fuel storage tanks in specified areas set aside for the purpose and approved by the Project Manager. Storage tanks shall be adequately bunded to control spillage. Fire extinguishers shall be provided and installed in a suitable nearby location.

Highly combustible or volatile materials shall be stored separately from other materials and as prescribed by relevant authorities and under no circumstances within buildings or structures forming part of the permanent Works. All such materials shall be protected and not exposed to open flame of other situations which could result in a fire risk.

No combustible material shall be located inside or within 10 metres of a building if structure forming part of the permanent Works. Where units have to be used in these circumstances, they shall be constructed of non-combustible materials and have a half-hour fire rating inside to outside and outside to inside. Non-combustible furniture shall be used where practical.

All temporary accommodation and stores shall be provided with smoke detectors and fire alarms. Smoking shall be banned in high risk areas.

Expanded polystyrene with or without flame retarding additive, polythene, cardboard and hardwood shall not be used as protection materials. Plywood and chipboard shall only be used as protection on floors. Vertical protection shall be non-combustible. Debris netting and weather protection sheeting shall be fire retardant.

When using cutting or welding torches or other equipment with an open flame, the Contractor shall provide a fire extinguisher close by at all times. All flammable materials shall be cleared from areas of hot works or work locations prior to welding or oxy/gas burning operations. All hot works shall cease half an hour before the end of a work shift to allow for thorough checking for smouldering materials. Where appropriate, areas of hot works are to be soused in water before the shift ends.

An adequate number of fire extinguishers of types suited to the fire risk and the material exposed shall be provided. These shall be placed in accessible, well-marked locations throughout the job site. Contractor's personnel shall be trained in their use. Extinguishers shall be checked monthly for service condition and replaced or recharged, as appropriate after use.

Only approved containers shall be used for storage, transport and dispensing of flammable substances. Portable containers used for transporting or transferring gasoline or other flammable liquids shall be approved safety cans. Fuel burning engines shall be shut off while being refuelled. Adequate ventilation to prevent an accumulation of flammable vapours shall be provided where solvents or volatile cleaning agents are used.

Flammables shall not be stored under overhead pipelines, cable trays, electrical wires or stairways used for emergency egress. Paints shall be stored and mixed in a room assigned for the purpose. This room shall be kept under lock and key.

Oily waste, rags and other such combustible materials shall be stored in proper metal containers with self-closing lids and removed every night to a safe area or off site. Every precaution shall be taken to prevent spontaneous combustion.

9.5.3. Electrical Safety

All temporary electrical installations, tools and equipment shall comply with current regulations dealing with on-site electrical installations. The Contractor shall establish a permit-to-work system for work in or in proximity to energized circuits of any voltage. Contractor's personnel shall not commence work on such circuits unless a permit to work has been issued and adequate safety measures have been taken and the work operation has been reviewed and approved by the Project Manager.

Only authorized personnel shall be allowed to work or repair electrical installations and equipment. Portable tools and equipment shall be 240 volt, unless otherwise agreed by the Project Manager.

When portable or semi-portable equipment operates at voltages in excess of 240 volts, the supply shall be protected by a Residual Current Device (RCD) regardless of any such device fitted to the equipment. The RCD must have a tripping characteristic of 30 milliamps at 30 milliseconds maximum.

All static, electrically powered equipment, including motors, transformers, generators, welders and other machinery, shall be properly earthed, insulated, and/or protected by a ground fault interruption device. In addition, the skin metal buildings and trailers with electric service shall be earthed. Metal steps, when used shall be securely fixed to the trailer.

Lampholders on festoon lighting shall be moulded to flexible cable and be of the screw in type. Clip on guards shall be fitted to each lamp unit.

All tungsten-halogen lamps shall be fitted with a glass guard to the element. These lamps must be permanently fixed at high level.

Electrical equipment shall be periodically inspected and repaired as necessary by competent persons.

Any work in electrical equipment and systems shall be made safe through locking, tagging, and/or isolation of the equipment before work commences. Prior to the start of the work, the equipment or systems shall be tested to ensure that they have been properly de-energised and isolated.

Electrical repair work on energized systems shall be avoided whenever possible.

Electrical trouble shooting shall be conducted only after getting written approval of the Project Manager.

Unauthorized personnel shall not enter enclosures or area containing high voltage equipment such as switchgear, transformers or substations.

9.5.4. Oxygen/Acetylene/Fuel Gases/Cartridge Tools

Compressed oxygen shall never be used in the place of compressed air. Flash-back (Spar) arrestors shall be fitted to all gas equipment. Liquid petroleum Gas (LPG) cylinders shall not be stored or left in areas below ground level overnight. Cylinders must be stored upright.

The quantity of oxygen, acetylene and LPG cylinders at the point of work shall be restricted to a maximum of one day's supply. Cylinders shall be kept in upright vertical rack containers or be safely secured to a vertical support.

Cartridge tools shall be of the low velocity type. Operators must have received adequate training in the safe use and operation of the tool to be used.

9.5.5. Scaffolding/Temporary Works

No aluminium tube shall be used, except for proprietary mobile towers, unless otherwise agreed with the Project Manager.

Drawings and calculations shall be submitted to the Project Manager, prior to commencement of work on the site, for all Temporary Works, including excavations, falsework, tower cranes, hoists, services and scaffolding. Designs shall conform to international standards.

The Project Manager will not approve Temporary Work designs but the Contractor shall take account of any comments on such designs made by the Project Manager.

The Contractor shall inspect and approve all Temporary Works after erection and before access, loading or use is allowed. Completed and approved Temporary Works shall be tagged with a scaff-tag or similar safety system and the Safe Structure insert displayed. For scaffolding, one tag shall be displayed every 32 m2 of face area. A central record system shall be kept on all Temporary Work. Temporary Works shall be inspected weekly and similarly recorded.

All mobile scaffold towers shall be erected in accordance with the manufacturer's instructions and a copy of these shall be submitted to the Project Manager prior to any use on site. Additionally, all towers shall be erected complete with access ladder, safety rails and kick boards whatever the height.

The Contractor shall repair or replace, immediately, any scaffold, including accessories, damaged or weakened from any cause.

The Contractor shall ensure that any slippery conditions on scaffolds are eliminated as soon as possible after they occur.

All scaffolds used for storing materials, for brick or block laying, for access to formwork or for any other purpose where materials may be accidentally fall, shall be provided with wire mesh guards of a substantial material, in addition to kick boards.

9.5.6. Use of Ladders

Manufactured ladders shall meet the applicable safety codes for wood or metal ladders. Metal ladders shall not be used where there is any likelihood of contact with electric cables and equipment. All metal ladders shall be clearly marked: "Caution – Do not use around electrical equipment". Job made ladders shall not be permitted.

Extension or straight ladders shall be equipped with non-skid safety feet, and shall be no more than 12 m in height. The maximum height of a step ladder shall be 2 m. Ladders shall not be used as platforms or scaffold planks.

Ladders rungs and steps shall be kept clean and free of grease and oil.

Extension and straight ladders shall be tied off at the top and/or bottom when in use. Only one person shall be allowed in a ladder at a time.

Defective ladder shall be taken out of service and not used. Ladders shall not be painted and shall be inspected for defects prior to use.

9.5.7. Elevated Work

The Contractor shall provide all personnel, while working at an elevated position, with adequate protection from falls. Details of such protections shall be submitted to the Project Manager.

The Contractor shall carry out daily inspections of all elevated work platforms. Defects shall be corrected prior to use.

9.5.8. Roofing and Sheet Metal Laying

(a) A Method Statement detailing the procedures to be adopted shall be submitted to and

agreed with the Project Manager prior to commencement of work on the site.

(b) Mobile elevating work platforms or the equivalent shall be used to install roofing and sheet materials wherever practicable and a suitable base is available.

9.5.9. Erection of Structures

(a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Project Manager prior to commencement of work on the site.

(b) Safety harness and lines shall be provided by the Contractor for use by the erection personnel and worn at all times.

(c) Mobile elevating work platforms or the equivalent shall be used to erect structures wherever practicable and a suitable base is available.

9.5.10. Mobile Elevating Work Platforms

Operators shall be trained in the safe use of such platforms and hold a current Certificate of Competence.

9.5.11. Hoists

(a) A copy of the current Test Certificate shall be submitted to the Project Manager before any hoist (personnel or material) is brought into operation on the site. Where the range of travel is increased or reduced a copy of the revised Test Certificate shall be submitted.

(b) Each landing gate shall be fitted with a mechanical or electrical interlock to prevent movement of the hoist when any such gates is in the open position.

(c) Safety harness must be worn and used by personnel erecting, altering and dismantling hoists.

9.5.12. Suspended Cradles

(a) Suspended cradles shall be installed, moved and dismantled by a specialist contractor.

(b) Suspended cradles shall comply with local regulations.

(c) All powered suspended cradles shall incorporate independent safety lines to overspeed braking devices and independent suspension lines for personal safety harness attachment.

9.5.13. Use of Temporary Equipment

The safe design of any piece of equipment shall not be exceeded, nor shall the equipment be modified in any manner that alters the original factor of safety or capacity. Mobile equipment shall be fitted with suitable alarm and motion sensing devices, including back-up alarm, when required. The Contractor shall ensure that the installation and use of equipment are in accordance with the safety rules and recommendations laid down by the manufacturer, taking into account the other installations already in place or to be installed in the future.

The contractor shall inspect Equipment prior to its use on the Works and periodically thereafter to ensure it is in safe working order. Special attention shall be given to such items as cables, hoses, guards, booms, blocks, hooks and safety devices. Equipment found to be defective shall not be used and immediately removed from services, and a warning tag attached.

Natural and synthetic fibre rope made of material such as manila, nylon, polyester, or polypropylene shall not be used as slings. Only trained, qualified and authorized personnel shall operate equipment. All drivers

and operators shall hold a current Certificate of Training Achievement for the equipment being used. A safety observer shall be assigned to watch movements of heavy mobile equipment where hazards may exist to other personnel from the movement if such equipment, or where equipment could hit overhead lines or structures. The observer shall also ensure that people are kept clear of mobile equipment and suspended tools.

When mobile or heavy equipment is travelling onto a public thoroughfare or roadway, a flagman shall ensure that traffic has been stopped prior to such equipment proceeding. While the mobile or heavy equipment is travelling on a public roadway, a trailing escort vehicle with a sign warning of a slow-moving vehicle that is dangerous to pass shall be provided.

9.5.14. Cranes:

(a) The Contractor shall give a minimum of 48 hours' notice to the Project Manager prior to bringing a crane on site.

(b) No cranes shall be erected in the site without the prior approval of the Project Manager. The Project Manager may direct the Contractor as to location where cranes may not be located. The Contractor shall take such directions into account when submitting his proposals for crane location points, base footings, pick up points and swing radius. Compliance with any such direction shall not entitle the Contractor to any extension of the Period of Completion or to any increase of the Contract Price.

(c) Safety harness shall be worn and used at all times by personnel engaged on the erection, alterations and dismantling of tower cranes.

(d) The Contractor shall provide a copy of the current Test Certificate (see Sub-Clause 702) to the Project Manager before any crane (tower or mobile) is brought into operation on the Site.

(e) All lifting tackle must hold a current Test Certificate. All lifting tackle must be thoroughly examined every 6 months and an inspection report raised.

(f) All fibrous/web slings shall be destroyed and replaced 6 months after first use.

(g) All crane drivers/operators shall hold a Certificate of Training Achievement for the class of crane operated.

(h) All banksman/slingers shall hold a Training Certificate from a recognized training agency.

(i) The maximum weekly working hours of a crane driver or banksman shall be restricted to 60 hours.

(j) Under no circumstances shall a crane or load come within 4 m of any energized overhead power line or other critical structure.

9.5.15. Locking-out, Isolating and Tagging Equipment.

Equipment that could present a hazard to personnel if accidentally activated during the performance of installation, repair, alteration, cleaning, or inspection work shall be made inoperable and free of stored energy and/or material prior to the start of work. Such equipment shall include circuit breakers, compressors, conveyors, elevators, machine tools, pipelines, pumps, valves, and similar equipment.

Where equipment is subject to unexpected external physical movement such as rotating, turning, dropping, falling, rolling, sliding, etc., mechanical and/or structural constraints shall be applied to prevent such movement.

Equipment which has been locked-out, immobilized, or taken out of services for repair or because of a potentially hazardous condition shall be appropriately tagged indicting the reason it has been isolated and/or taken out of service.

Where safety locks are used for locking out or isolating equipment, the lock shall be specially identified and easily recognized as a safety lock.

9.5.16. Installation of Temporary or Permanent Equipment

During installation and testing the Contractor's specialists Project Manager shall be in attendance. All control mechanism panel and wiring diagrams shall be available and printed in English.

9.5.17. Laser Survey Instruments

Details of the types and use of laser instruments shall be submitted and agreed with the Project Manager.

9.5.18. Working in Confined Spaces

Confined spaces, including tanks, vessels, containers, pits, bins, vaults, tunnels, shafts, trenches, ventilations ducts, or other enclosures where known or potential hazards may exist, shall not be entered without prior inspection by and authorization from the Site Safety Officer and the issuance of a Hazardous Work Permit.

Prior to entering the confined space, the area shall be completely isolated to prevent the entry of any hazardous substances or materials which could cause an oxygen deficient atmosphere. All equipment that could become energized or mobilized shall be physically restrained and tagged. All lines going into the confined space shall be isolated and/or blanked.

Personnel working in a confined space where emergency escape or rescue could be difficult, shall wear a safety harness attached to a lifeline. A qualified attendant(s), trained and knowledgeable in job-relater emergency procedures, shall be present at all times while persons are working within the confined space. The attendant shall be capable of effecting a rescue, have necessary rescue equipment immediately available, and be equipped with at least the same protective equipments as the person making entry.

All equipment to be used in a confined space shall be inspected to determine its acceptability for use. Where a hazard from electricity may exist, equipment utilized shall be of law voltage type. The atmosphere within the confined space shall be tested to determine if it is safe to enter. Acceptable limits are:

- oxygen: 19.5% lower, 22% higher;
- flammable gas: not to exceed 10% of lower explosion limit;
- toxic contaminants: not to exceed the permissible exposure limit.

Subsequent testing shall be done after each interruption and before re-entering the confined space, as well as at intervals not exceeding 4 hours. Continuous monitoring is preferable and may be necessary in certain situations.

Adequate ventilation shall be provided to ensure the atmosphere is maintained within acceptable limits.

9.5.19. Demolition

A detailed Method Statement detailing the demolition procedures/techniques to be used shall be submitted to and approved by the Project Manager prior to commencement of work on site.

The Method Statement must include full details of measures to be taken to ensure that there are no persons remaining in the building/structure and to distance members of the public and Contractor's personnel from the building/structure prior to demolition.

9.5.20. Use of Explosives

The Contractor shall not use explosives without the written permission from the Project Manager and relevant authorities.

The Contractor shall observe all regulations regarding proper purchasing, transportation, storage, handling and use of explosives.

The Contractor shall ensure that explosives and detonators are stored in separate special building. These secured buildings shall be constructed, located and clearly marked in English:

"DANGER – EXPLOSIVES"

All as approved by the Project Manager and relevant authorities. The Contractor shall ensure that all possible precautions are taken against accidental fire or explosion, and ensure that explosives and detonators are kept in a proper and safe condition. The contractor shall ensure that explosives and detonators are always transported in separate vehicles and kept apart until the last possible moment and that metallic tools are not used to open boxes of explosives or detonators.

Blasting Procedure: the contractor shall carry out blasting operations in a manner that will not endanger the safety of persons or property. The Contractor shall, along with other necessary precautions:

(a) clear all persons from building and the area affected by the blasting. All such persons shall be given adequate notice of the actual time and date of blasting;

(b) ensure that police and other local authorities are kept fully informed, in advance, of the blasting programme so that they may be present when blasting takes place if they so require;

(c) erect warning notices around the area affected that blasting operation are in progress;

(d) carry out a thorough search of buildings and the area affected prior to blasting;

(e) ensure that blasting is only carried out by experienced shot firers. Priming, charging, stemming and shot firing shall be carried out with greatest regard for safety and in strict accordance with the rules and regulations of the relevant authorities.

(f) ensure that explosive charges are not excessive, charged boreholes are properly protected and proper precautions are taken for the safety of persons and property.

The Contractor shall maintain an up-to-date inventory of all explosives and explosive devices and shall submit a monthly report to the Project Manager, detailing the use of all explosives by date and location.

9.5.21. Excavation and Trenching

An excavation permit signed by the Project Manager must be issued before excavation proceeds in any work location. The contractor shall investigate and identify the location of existing services by study of the drawings, a visual/physical study of the site, sweeping by appropriate detection equipment and where necessary hand excavation of trial holes.

Following this investigation, the Contractor shall submit a written request for an excavation permit to the Project Manager.

The Project Manager will return the permit signed and dated to indicate:

- services which are to be maintained.
- services which are to be isolated.
- any special precautions to be taken.

A sample Excavation Permit is given in Annex 1 to this Specification. The issue of an Excavation Permit by the Project Manager shall not relieve the Contractor of his responsibilities under the Contract.

The side of all excavations and trenches which in the opinion of the Project Manager might expose personnel or facilities to danger resulting from shifting earths shall be protected by adequate temporary supports or sloped to the appropriate angle of repose.

All excavations, slopes and temporary supports shall be inspected daily and after each rain, before allowing personnel to enter the excavation.

Excavations 1.3 metres or more in depth and occupied by personnel shall be provided with ladders as a means for entrance and egress. Ladders shall extend not less than 1 metre above the top of the excavation.

The Contractor shall provide adequate barrier protection to all excavations. Barriers shall be readily visible by day of night.

Excavated or other materials shall be stored at least 0.65 metres from the sides of excavations.

9.5.22. Concrete Reinforcement Starter Bars

The Contractor shall ensure concrete reinforcement starter bars are not a danger to personnel. Where permitted by the Project Manager, starter bars shall be bent down. Alternatively, the starter bars shall be protected using either hooked starters, plastic caps, plywood covers or other methods agreed with the Project Manager.

9.6. Environmental and Health Requirements

9.6.1. Contractor environmental and social management plan

The Contractor shall develop his own Environmental and Social Management Plan to ensure actions and mitigation necessary to protect the environment as contained in the Project ESIA Report and License, are incorporated into all site procedures. At a minimum, the contractor's ESMP must address the following:

- Policy
- Planning
- Implementation and Operation

9.6.2. Policy

The Contractor shall develop an environmental policy that includes, as a minimum, the following:

- A commitment to comply with applicable regulations and other requirements that the construction company subscribes to;
- A commitment to provide a safe work environment;
- A commitment to provide the training and equipment necessary for employees to conduct their work safely;
- A commitment to continuously improve performance and to pollution prevention; and
- A commitment to communicate the policy to all persons working for and on behalf of the company.

9.6.3. Planning

Environmental issues and the legal and other requirements in construction of the project have been identified in the project's ESIA Report. The Contractor must demonstrate within his plan that he has read and understood the ESIA Report and its provisions for environmental management and monitoring.

9.6.4. Implementation and Operation

Roles, responsibilities and authorities must be defined, documented and communicated to ensure effective environmental and social management. A specific management representative with requisite qualifications shall be assigned the responsibility for ensuring that the ESMP is established, implemented and maintained and shall be responsible for reporting performance, reviewing the Plan and making recommendations for improvement. Documented confirmation is required that the training needs of all persons working for or on the company's behalf whose work pose significant hazards to their health and safety and/or may create a significant impact on the environment has been identified. Records of all training must be maintained.

Management, supervisory, and employee responsibilities must be communicated to all employees through training, formal job descriptions, work experience, hiring practices, etc. Awareness training shall be provided that include the importance of conforming to the policy and procedures, the significant environmental issues, and the roles and responsibilities of management and staff.

Records shall be legible, identifiable and traceable to the activity. Records shall be stored and maintained in such a way that they are retrievable and protected against damage, deterioration or loss.

The Contractor shall establish, implement and maintain procedures to identify potential emergency situations and potential accidents that can have an impact on the environment, surrounding communities, the employees, and/or the public.

The Contractor shall be prepared to respond to actual emergency situations and accidents and prevent or mitigate associated adverse environmental or social impacts. The ESMP must also address how the Contractor will receive, document and respond to external interested parties.

9.7. Protection of the Environment

The Contractor shall be knowledgeable of and comply with the Environmental Management Plan (EMP) and with all environmental laws, rules and regulations for materials, including hazardous substances or wastes under his control. The contractor shall not dump, release or otherwise discharge or dispose of any such materials without the authorization of the Project Manager.

Any release of a hazardous substance to the environment, whether air, water or ground, must be reported to the Project Manager immediately. When releases resulting from Contractor action occur, the Contractor shall take proper precautionary measures to counter any known environmental or health hazards associated with such release. These would include remedial procedures such as spill control and containment and notification of the proper authorities.

9.7.1. Air Pollution and Water Pollution

The Contractor, depending on the type and quantity of materials being used, may be required to have an emergency episode plan for any releases to the atmosphere. The Contractor shall also be aware of local ordinances affecting air pollution.

The Contractor shall take all necessary measures to limit pollution from dust and any windblown materials during the Works, including damping down with water on a regular basis during dry climatic conditions.

The contractor shall ensure that all trucks leaving the Site are properly covered to prevent discharge of dust, rocks, sand, etc.

9.7.2. Water Pollution

The contractor shall not dispose of waste solvents, petroleum products, toxic chemicals or solutions on the city drainage system or watercourse, and shall not dump or bury garbage on the Site. These types of waste shall be taken to an approved disposal facility regularly, and in accordance with requirements of relevant Authorities. The Contractor shall also be responsible for the control of all run-offs, erosion, etc.

9.7.3. Solid Waste

General Housekeeping

(a) The Contractor shall maintain the site and any ancillary areas used and occupied for performance of the Works in a clean, tidy and rubbish-free condition at all times.

(b) Upon the issue of any Taking-Over Certificate, the Contractor shall clear away and remove from the Works and the Site to which the Taking-Over Certificate relates, all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave the said Works and Site in a clean condition to the satisfaction of the Project Manager. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Notification Period.

Rubbish Removal and Disposal

(a) The Contractor shall comply with statutory and municipal regulations and requirements for the disposal of rubbish and waste.

(b) The Contractor shall provide suitable metal containers for the temporary storage of waste.

(c) The Contractor shall provide suitable metal containers from site as soon as they are full. Rubbish containers shall not be allowed to overflow.

(d) The Contractor shall provide hard standings for and clear vehicle access to rubbish containers.

(e) The Contractor shall provide enclosed chutes of wood or metal where materials are dropped more than 7 meters. The area onto which the material is dropped shall be provided with suitable enclosed protection barriers and warning signs of the hazard of falling materials. Waste materials shall not be removed from the lower area until handling of materials above has ceased.

(f) Domestic and biodegradable waste from offices, canteens and welfare facilities shall be removed daily from the site.

(g) Toxic and hazardous waste shall be collected separately and be disposed of in accordance with current regulations.

9.7.4. Asbestos Handling and Removal

The Contractor shall comply with all local regulations regarding the handling of asbestos materials. In the absences of local regulations, relevant International Standards shall apply.

9.7.5. Pest Control

The Contractor shall be responsible for the rodent and pest control on the Site. If requested, the contractor shall submit to the Project Manager, for approval, a detailed programme of the measures to be taken for the control and eradication of rodents and pests.

9.7.6. Noise Control

The Contractor shall ensure that the works is conducted in a manner so as to comply with all restrictions of the Authorities having jurisdiction, as they relate to noise.

The Contractor shall, in all cases, adopt the best available plant/and or machinery shall be used. All equipment shall be maintained in good mechanical order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable. Stationary noise sources shall be sited as far away as possible from noise-sensitive areas and, where necessary, acoustic barriers shall be used to shield them. Such barriers may be proprietary types, or may consist of site materials such as bricks or earth mounds as appropriate.

Compressors, percussion tools and vehicles shall be fitted with effective silencers of a type recommended by the manufacturers of the equipment. Pneumatic drills and other noisy appliances shall not be use during days of rest or after normal working hours without the consent of the Project Manager.

Areas where noise levels exceed 90 decibels, even on a temporary basis, shall be posted as high noise level areas.

9.8. Additional Requirements for Work in Public Areas

9.8.1. General

Those additional requirements shall apply to all works carried out in Public Areas.

Public Areas are defined as areas still used by or accessible to the public. These include public roads and pavements, occupied buildings and areas outside the Contractor's boundary fencing.

All work in Public Areas shall be carried out to minimize disturbance and avoid dangers to the public.

Before commencing work, the Contractor shall ensure that all necessary resources, including labour, plant and materials will be available when required and that the works will proceed without delays and be completed in the shortest possible time. Period of inactivity and slow progress or delays in meeting the agreed programme for the Works, resulting from the Contractor's failure to provide necessary resources or other causes within the control of the Contractor, will not be accepted. In the event of such inactivity, slow progress or delays, the Contractor shall take immediate action to rectify the situation, including all possible acceleration measures to complete the works within the agreed programme. Details of the actions and acceleration measures shall be submitted to the Project Manager. If the Project Manager is dissatisfied with the Contractor's proposals, the Contractor shall take such further actions or measures as required by the Project Manager. All costs incurred shall be the responsibility of the Contractor.

9.8.2. Method Statements

The Contractor shall submit to the Project Manager a method statement for each separate area or work in Public Areas. The Method Statement shall include:

a) a general description of the Works and methodology of how it will be carried out.

b) Details of the measures and temporary works to minimise disturbance and safeguard the public.

These shall include temporary diversions, safety barriers, screens, signs, lighting, watchmen and arrangements for control of traffic and pedestrians and advance warning to be given to the public.

c) Details of temporary reinstatement and maintenance of same prior to final reinstatement.

d) For works involving long lengths of trenches or works to be completed in sections, the lengths or sections of each activity (e.g. up to temporary reinstatement, final reinstatement) to be carried out at any one time.

e) Details of the availability of necessary resources (labour, plant, materials, etc.) to complete the work.

f) A programme showing start and completion dates and period for all activities of each length or section, including temporary works, and the works overall.

g) Such further information as necessary or required by the Project Manager.

The Contractor shall not commence work, including temporary works, until after the approval of the Contractor's Method Statement by the Project Manager.

Method Statements shall be updated bases on actual progress or as and when required by the Project Manager.

9.8.3. Closure of Roads, Etc.

The closure or partial closure of roads, pavements and other public areas will only be permitted if approved by the Project Manager and Relevant Authorities. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure, and where appropriate, proposed diversions. A sample Street Closure Permit is given at Annex 2 to this Specification.

9.8.4. Trench and Other Excavations

The requirements covering trench and other excavations will depend on the location and type of the excavation and the potential risks to the public.

The following guidelines apply particularly to trenches but shall also apply to other types of excavations:

(a) before commencing work the Contractor shall:

- notify the Project Manager of the location and duration of the work. An excavation permit signed by the Project Manager must be issued in accordance with Sub-Clause 705.16 before excavation proceeds in any work location;
- obtain permission from relevant authorities including the police when required;
- erect all temporary works such as barriers, warning signs, lighting, etc.;
- have available adequate materials for temporary supports to sides of excavations and necessary labour, plant and materials to complete the work within the shortest possible time.

(b) in carrying out the works the Contractor shall, unless otherwise permitted or required by the Project Manager:

- not open more than one excavation within a radius of 250 metes;
- limit the length of trench excavation open at one time to 150 metres;
- maintain and alter or adapt all temporary works including supports to sides of excavations;
- remove all surplus excavated material the same day it is excavated;

- complete the works, including final reinstatement within ten days;
- where final reinstatement is not achieved within the required time, to carry out temporary reinstatement;
- ensure that any temporary reinstatement is maintained at the correct level until final reinstatement is achieved.

The above guidelines shall not relieve the Contractor of his obligations and responsibilities.

9.8.5. Safety Barriers

Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as manholes, draw pits and the like. When exposed to the public, safety barriers shall be provided to both sides and ends of trenches and around all sides of openings.

The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Project Manager prior to commencing work. No work shall commence until the safety barriers are in place.

The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:

- Type 1 - excavated material;
- Type 2 - non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;
- Type 3 - rigid barrier of timber, steel or concrete. Such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted onto the ground.

The following are guidelines on the type of safety barriers that could be used in differing situations. They apply particularly to trenches but also apply to other types of excavation, existing openings onto the perimeter of work areas:

- areas not subject to vehicular traffic - Types 1 or 2;
- roadways (low traffic speed) - Types 1 or 2;
- roadways (high traffic speed or where excavation are greater than 2 m) - Type 3.

The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

9.9. Contractor's Site Check List

A sample Contractor's Site Check List is included in Annex 1,2 & 3 to this Specification. This is included to assist contractors should they wish to introduce such a system as part of their site management procedures. The list is not exhaustive and further items will need to be added by the Contractor.

The list is issued for guidance only, and does not, in any way, revise or limit the requirements covered elsewhere in these Specifications.

Annex 1
Sample Excavation Permit

To: …….. (Project Manager)

From: …….. (Contractor) Date: …….

Contract No:
Request for Excavation Permit No: ……

Please give approval for excavation to proceed in the following area: Work

to start on:

Existing services have been checked and identified by:

Drawings # Physical Survey #

Catscan # Trial Holes Excavation #

Signed (Contractor): ……

Approval by Project Manager

The above excavation may proceed, subject to the following:

Service to be maintained:

Services to be isolated before work proceeds:

Other matters:

Signed (Project Manager): …….

Date: ……

Annex 2
Sample Street Closure Permit

To: …….. (Project Manager)

From: …….. (Contractor) Date: …….

Contract No:
Request for Street Closure Permit No: ……

Please give approval for the closure of the following street(s) from …… to …… (dates) Street(s):

Reasons:

Proposed diversions:

Signed (Contractor): ……

Approval of the Project Manager

The above street(s) may be closed for the periods stated subject to the following conditions: Approval has been given by the relevant authorities and the police;

Other:

Signed (Project Manager): ……

Date: ……..

Annex 3
Sample Contractor's Site Check List

Safe Access:

- arrangements for visitors and new workers to the site
- safe access to working locations
- walkways free from obstructions
- edge protection to walkways over 2m above ground
- holes fenced or protected with fixed covers
- tidy site and safe storage of materials
- waste collection and disposal
- chutes for waste disposal, where applicable
- removal or hammering down of nails in timber
- safe lighting for dark or poor light conditions
- props or shores in place to secure structures, where applicable

Ladders:

- to be used only if appropriate
- good condition and properly positioned
- located on firm, level ground
- secure near top. If not possible, to be secured near bottom, weighted or footed to prevent slipping
- top of ladder minimum 1 metre above landing place

Scaffolding:

- design calculation submitted
- proper access to scaffold platform
- properly founded uprights with base plates
- secured to the building with strong ties to prevent collapse
- braced for stability
- load bearing fittings, where required
- uprights, ledgers, braces and struts not to be removed during use
- fully boarded working platforms, free from defects and arranged to avoid tipping or tripping
- securely fixed boards against strong winds
- adequate guard rails and toe boards where scaffold is 2m above ground
- designed for loading with materials, where appropriate
- evenly distributed materials
- barriers or warning notices for incomplete scaffold (i.e. not fully boarded)
- weekly inspections and after bad weather by competent person
- record of inspections

Excavation:

- underground services to be located and marked, precautions taken to avoid them
- adequate and suitable timber, trench sheets, props and other supporting materials available on site before excavation starts
- safe method for erecting and removal of timber supports
- sloped or battered sides to prevent collapse
- daily inspections after use of explosives or after unexpected falls of materials
- safe access to excavations (e.g. sufficiently long ladder)
- barriers o restrict personnel/plant
- stability of neighbouring buildings
- risk of flooding
- materials stacked, spoil and vehicles away from top of excavations to avoid collapse
- secured stop blocks for vehicles tipping into excavations

Roof Work:

- crawling ladders or boards on roofs more than 10 degrees
- if applicable, roof battens to provide a safe handhold and foothold
- barriers or other edge protection
- crawling boards for working on fragile roof materials such as asbestos cement sheets or glass. guard rails and notices to same
- roof lights properly covered or provided with barriers
- during sheeting operations, precautions to stop people falling from edge of sheet
- precautions to stop debris falling onto others working under the roof work

Transport and Mobile Plant:

- in good repair (e.g. steering, handbrake, footbrake)
- trained drivers and operators and safe use of plant
- secured loads on vehicles
- passengers prohibited from riding in dangerous positions
- propping raised bodies for tipping lorries prior to inspections
- control of on-site movements to avoid danger to pedestrians, etc.
- control of reversing vehicles by properly trained banksmen, following safe system of work

Machinery and Equipment:

- adequate secured guards in good repair to dangerous parts, e.g. exposed gears, chain drives, projecting engine shafts

Cranes and Lifting Appliances:

- weekly recorded inspections
- regular inspections by a competent person
- test certificates
- competent and trained drivers over 18 years of age
- clearly marked controls
- checks by driver and banksman on weight of load before lifting
- efficient automatic safe load indicator, inspected weekly, for jib cranes with a capacity of more than one tonne
- firm level base for cranes
- sufficient space for safe operation
- trained banksman/slinger to give signals and to attach loads correctly, with knowledge of lifting limitation of crane
- for cranes with varying operating radius, clearly marked safe working loads and corresponding radii
- regular maintenance
- lifting gear in good condition and regularly examined

Electricity:

- measures to protect portable electric tools and equipment from mechanical damage and wet conditions
- checks for damage to or interference with equipment, wires and cables
- use of correct plugs to connect to power points
- proper connections to plugs; firm cable grips to prevent earth wire from pulling out “permit-to-work” procedures, to ensure safety
- disconnection of supplies to overhead lines or other precautions where cranes, tipper lorries, scaffolding, etc. might touch lines or cause arcing

Cartridge Operated Tools:

- maker’s instruction being followed
- properly trained operators, awareness of dangers and ability to deal with misfires

- safety goggles
- regular cleaning of gun
- secure place for gun and cartridges when not in use

Falsework/formwork:
- design calculations submitted method statement dealing with preventing falls of workers
- appointment of falsework coordinator
- checks on design and the supports for shuttering and formwork
- safe erection from steps or proper platforms
- adequate bases and ground conditions for loads
- plumb props on level bases and properly set out
- correct pins used in the props
- timberwork in good condition
- inspection by competent person, against agreed design, before pouring concrete

Risks to the Public:
- identify all risks to members of the public on and off site, e.g. materials falling from scaffold etc., site plant and transport (access/egress) and implement precautions, e.g. scaffold fans/nets, banksmen, warning notices, etc.
- barriers to protect/isolate persons and vehicles
- adequate site perimeter fencing to keep out the public and particularly children. secure the site during non-working periods
- make safe specific dangers in site during non-working periods, e.g. excavations and openings covered or fenced, materials safely stacked, plant immobilized, ladders removed or boarded

Fire – General:
- sufficient number and types of fire extinguishers
- adequate escape routes, kept clear
- worker awareness of what to do in an emergency

Fire – Flammable Liquids:
- proper storage area
- amount of flammable liquid on site kept to a minimum for the day's work
- smoking prohibited; other ignition sources kept away from flammable liquids
- proper safety containers

Fire – Compressed Gases, e.g. Oxygen, LPG, Acetylene:
- properly stored cylinders
- valves fully closed on cylinders when not in use
- adopt "hot work" procedures
- site cylinders in use outside huts

Fire – Other Combustible Materials:
- minimum amount kept on site
- proper waste bins
- regular removal of waste material

Noise:
- assessment of noise risks
- noisy plant and machinery fitted with silencers/muffs
- ear protection for workers if they work in very noisy surroundings

Health:

- identify hazardous substances, e.g. asbestos, lead, solvents, etc., and assess the risks
- use of other substances where possible
- control exposure by means other than by using protective equipment
- safety information sheets available from the supplier
- safety equipment and instructions for use
- keep other workers who are not protected out of danger areas
- testing of atmosphere in confined spaces; provision of fresh air supply if necessary. Emergency procedures for rescue from confined spaces

Manual Handling:

- avoid where risk of injury
- if unavoidable, assess and reduce risks

Protective Clothing:

- suitable equipment to protect head, eyes, hands and feet here appropriate
- enforce wearing of protective equipment

Welfare:

- suitable toilets
- clean wash basin, hot/warm water, soap and towel
- room or area where clothes can be dried
- wet weather gear for those working in wet conditions
- heated site hut where workers can take shelter and have meals with the facility for boiling water
- suitable first aid facilities

Work in Public Areas:

- all risks to the public identified
- method statement approved
- road closures approved
- temporary diversions in place
- safety barriers erected/maintained
- labour, materials, plant and other resources sufficient to meet programme
- temporary reinstatement completed and properly maintained
- permanent reinstatement completed at earliest possible date.

9.10. Works Components

The works include construction of the following:

9.10.1. Water Component

a) Laying of approximately 190km distribution network pipeline ranging from DN (800mm-50mm) in the Embakasi.
b) Laying of 25KM pipeline extension in the Eastern, North Eastern and Northern regions (covering Obama, Saika, Mwengenye, Maili Saba, Kamiti Road, Mwiki Road, Lucky Summer, Umoja 3, Donholm, and Njiru Areas)
c) Establishing 1903 new consumer connections.

9.10.2. Sewerage works

a) Laying of approximately 46km of sewer works ranging from DN 300 to DN 600 DWC pipes
b) Installation of approximately 1225 manholes
c) Establishing 1405 no of consumer connections

9.10.3. Plot Connection

Plot /consumer connections have been allowed for in this contract has summarised in the Table below.

Item	Description	Unit	Quantity
1	Property/household water connections	Nr	1903
2	Property/household sewer connections	Nr	1405

9.11. Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) is a practical and achievable plan of management to ensure that any environmental impact during the design, planning and construction phase are minimised. CEMP's have been proposed to deal with the following issues during Project construction:

- Compensation and land take
- Physical setting,
- flora and fauna;
- Interruption of key infrastructure installations;
- Water quality and energy management;
- Dust and air quality;
- Occupational health and safety;
- Noise and vibration; and
- Waste management.

Detailed CEMP's are presented below.

CEMP for Compensation and land take

Objective	To ensure that the land owners are properly compensated and avail land for the proposed Project.			
Management strategy	Since compensation is an integral part of Project design ensure it is dealt with from the earliest stages of Project preparation and comply with the laws of Kenya.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Land take should be minimized where feasible, exploring all viable alternative Project designs e.g. realignment of the pipeline may significantly reduce compensation; and Where displacement is unavoidable, compensation and resettlement plans should be developed with adequate compensation under guidance of various lead agencies including Ministry of Lands, TWSB, Local Councils and the District Development Committees.	Proponent	Prior to construction	TBD
Performance indicators	Lack of complaints / Complaints.	Proponent	Construction Phase	
Monitoring requirements	Documentation; and Land easement	Proponent	Construction Phase	
Reporting	Documentation	Proponent	Construction Phase	
Corrective actions	Implement recommendations.	Proponent	Construction Phase	
Interface	Ensure compliance with the Law of Kenya and the requirements of any donors involved in the Project.	Proponent	Construction Phase	

CEMP for Physical setting, flora and fauna

Objective	Maintain the existing balance within the physical, fauna and flora components in the Project area setting.			
Management strategy	Provide for appropriate measures that guarantee the protection of habitats, flora and fauna.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Provide structures that will not hinder free movement of animals and dispersal of propagation components; Maintain as much as possible the natural drainage systems and patterns; Grade sites to original levels to maintain topography; As much as practical limit the amount of vegetation cleared during works; Discourage bush meat hunting; In the event that considerable damage to vegetation is envisaged, set out a plan for replacement or grading to encourage natural rejuvenation; and Design and plan for use of wayleave by pedestrians and non-motorised systems.	Consulting Engineers Contractor AWSB	Planning. Design & construction	TBD
Performance indicators	Presence of a good balance of flora and fauna; and Minimal or no flooding in Project area.	AWSB	Construction Phase	
Monitoring requirements	Baseline data/Project completion Baseline; and Changes in local hydrology.	AWSB	Commissioning stage.	
Reporting	Site log book and EMCA requirements.	Contractor	Construction Phase	
Corrective actions	Rehabilitation	AWSB	Commissioning stage	
Interface	EMP complies with the EMCA and other applicable laws.	AWSB	Construction	

CEMP for management of infrastructure installations

Objective	Plan construction activities to minimise interruptions of infrastructure and ensure smooth Project implementation while complying with the laws of Kenya			
Management strategy	Liaise with stakeholders in the project area to ensure that access on protected or private areas is granted in good time in order to achieve Project milestones.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Establish the nature of all stakeholders; Identify key interests of each of the stakeholders; Formally liaise with the stakeholder and communicate the Project details to them with a view of developing a work plan; Implement work plan; and Acquire notes on Satisfactory Completion of Works by each affected party.	AWSB Consultant Contractors	Planning, Design and Construction phase	TBD
Performance indicators	Level of complains.	All	Construction phase	
Monitoring requirements	Timely achievement of milestones; and Lack of interruption of services.	All	Construction	
Reporting	Site log book	Contractor	Construction phase	
Corrective actions	Investigate cause of interruptions; Implement corrective measures.	AWSB Stakeholders	Construction phase	
Interface	Comply with the EMP contained in this report.	Contractor	Construction phase	

CEMP for water and energy management

Objective	Minimise impact on water and energy resources within the Project area due to the construction works.			
Management strategy	Conserve water and energy resources, abate pollution and comply with the laws of Kenya.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Provide appropriate and adequate drainage infrastructure where required; Ensure machinery is regularly serviced to avoid leakages and/or spillages; Oils, fuels and other materials to be stored in accordance with the manufacturers' safety data sheets (MSDS); Train staff on spill response; Implement erosion and sedimentation controls; Proper handling/disposal of liquid waste; Energy management through use of sound/appropriate equipment; Application of rated equipment in welding and related works; and Use of efficient mechanical plant and energy savers on sites.	Contractor	Construction phase	TBD
Performance indicators	Minimal interference of water and energy resource in the area.	Contractor	Construction phase	
Monitoring requirements	Physical inspection; and Level of complains.	Consultant	Construction phase	
Reporting	Site activities log book.	Contractor	Construction phase	
Corrective actions	Implementation of monitoring findings and recommendations.	Contractor	Construction phase	
Interface	Comply with laws and guidelines.	Contractor	Construction phase	

CEMP for dust and air quality

Objective	Maintain the quality of the air and minimise any harmful emissions into the atmosphere and comply with the laws of Kenya			
Management strategy	Abate pollution of the atmosphere by airborne particulate matter.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Dampen work areas materials heaps and mulch bare ground to minimise dust emissions; Maintain equipment and machinery to manufacturers' specifications; Use environmentally friendly fuels; Minimise the period for machinery idling; Pursue good practices in energy use and sensitise staff; and Provide appropriate personnel protective equipment to site workers.	Contractor	Construction phase	TBD
Performance indicators	Lack of complaints / Complaints; and Reports / Log book entries.	AWSB	Construction phase	
Monitoring requirements	Physical inspection Site Log books	Consultant	Construction phase	
Reporting	Site logs of inspections and corrective actions.	Contractor	Construction phase	
Corrective actions	Implement recommendations	Contractor	Construction phase	
Interface	Review and comply with laws and regulations.	Contractor	Construction phase	

CEMP for occupational health and safety

Objective	Ensure the safety and health of all the Parties involved in the Project implementation and comply with the laws of Kenya			
Management strategy	Provide proper safety equipments, facilities and conditions that will eliminate or reduce the risk to the Project workers and all those present therein.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Comply to the OSHA; Provide for appropriate signage and warnings at work sites; Provide appropriate personnel protective equipment (PPE) to workers and any visitors; Provide for First Aid facilities as per the Occupational Safety and Health Act; Provide and clearly display emergency contacts; and Develop and implement a detailed and site specific Emergency Response Plans.	AWSB Consulting Engineers Contractor	Construction phase	TBD
Performance indicators	Health and safety awareness among staff; and Frequency of incidents/accidents and fatalities.	Consultant AWSB	Construction phase	
Monitoring requirements	Daily inspection of work sites; and Tool box meetings.	Consultant	Construction phase	
Reporting	Log incidents/accidents and fatalities; and Tool box minutes.	Consultant	Construction phase	
Corrective actions	Investigate incident/accidents and fatalities; and Follow up on complains and other issues from tool box meetings.	Consultant	Construction phase	
Interface	Updates on the OSHA and orders from Directorate	AWSB	Construction phase	

CEMP for noise and vibration management

Objective	Manage activities at construction sites to reduce impacts of noise on surrounding properties and comply with the laws of Kenya.			
Management strategy	Noise to be managed through administrative and maintenance controls during construction.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	All construction activities to be limited to between 7am to 6pm; All equipment used during the construction phase to be regularly maintained to ensure efficient operation; Noise dampening materials to be used where excessive noise generating-equipment are in use; Use of appropriate cushioning for heavy equipment; and Use of personal protective equipment by operations staff.	Contractor	Construction phase	TBD
Performance indicators	Lack of complaints / Complaints.	Contractor	Construction phase	
Monitoring requirements	Periodic inspection of work sites; and Service log for equipment / machinery.	Contractor	Construction phase	
Reporting	Complaints / incidents should be recorded in a log book on location.	Consultant	Construction phase	
Corrective actions	Investigate cause of noise and vibrations; Implement corrective measures prior to commencement of works; and Consider possibility of rescheduling noise and vibration generating activities.	Contractor AWSB	Construction phase	
Interface	Ensure that if the Contractors or subcontractors have an EMP and that it complies with the EMP contained in this report.	AWSB	Construction phase	

CEMP for waste management

Objective	Minimise the potential for environmental impact of wastes generated due to the construction activities and comply with the laws of Kenya.			
Management strategy	Effectively manage the sites and activities that may lead to generation of wastes.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	All wastes shall be contained on site prior to disposal using appropriate storage containers; All wastes shall be regularly cleared from the site and disposed of in approved manner; High level of housekeeping shall be maintained; and Staff shall be trained / sensitised about waste management at the start of the Project and regularly as may be found appropriate.	Contractor	Construction phase	TBD
Performance indicators	No waste at work sites except in approved and marked locations.	Contractor	Construction phase	
Monitoring requirements	Regular site inspections; and Waste disposal documentation and tracking.	Contractor	Construction phase	
Reporting	Review of waste handling slips and other related documentation.	Contractor	Construction phase	
Corrective actions	Provide reports, corrective actions and recommendations where non-conformities occur.	Contractor	Construction phase	
Interface	Ensure that Contractors or subcontractors EMP complies with the EMP contained in this report.	Contractor	Construction phase	

j) MECHANICAL AND ELECTRICAL PLANTS

10.1. Introduction

This Section covers workmanship, materials of construction and other miscellaneous items applicable to all items of plant, together with general requirements for particular items of mechanical plant. All component parts of the Works shall, unless otherwise specified, comply with the provisions of this Section or be subject to the approval of the Engineer.

10.2. Materials and Workmanship

All submerged moving parts of the plant, or the pins and spindles, etc., of the submerged moving parts or the faces, etc., in contact with them shall be of corrosion resistant metals. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall also maintain their properties without ageing due to the passage of time, exposure to light or any other cause.

Where "stainless steel" is specified or used it shall have resistance to atmospheric corrosion not less than that provided by BS 970, Grade 410 S3. Particular attention shall be made to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of materials of suitable relative hardness and surface finish and the application of lubricants. Where bronze is specified or used it shall be zinc free.

Particular attention shall be paid to the prevention of corrosion due to the close proximity of dissimilar metals. Where it is necessary to use dissimilar metals in contact, they shall be selected so that the bimetallic corrosion is as low as possible.

Workmanship and general finish shall be of first class commercial quality and in accordance with best workshop practice.

All similar items of plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items of plant. Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements made to manufacturer's drawings may be readily installed.

All equipment shall operate without excessive vibration and with the minimum of noise. All revolving parts shall be dynamically balanced so that when running at all operating speeds and any load up to the maximum there shall be no vibration due to lack of balance.

All parts which can be worn or damaged by dust shall be totally enclosed in dustproof housings.

10.3. Design Life

Unless otherwise specified, all items of Plant shall be rated for continuous service at the specified duties under the prevailing atmospheric and operational conditions on site.

All materials and equipment shall be designed for long life with a minimum of maintenance and the Contractor may be called upon to demonstrate this for any component either by the service record of similar equipment elsewhere or by records of extensive type tests.

Routine maintenance and repair shall, as far as possible, not require the services of highly skilled personnel.

Except for consumable items such as gland packings, carbon brushes, etc., which normally require replacement more frequently, no part subject to wear shall have a life from new to replacement or repair of less than three years of continuous normal operation and where major dismantling is required to replace a part, such life shall be not less than ten years.

10.4. Welding

Welded parts consisting of steel to BS 7613:1994, BS EN 10029:1991, Parts 1 to 3 of BS EN 10113:1993, BS EN 10155:1993 and BS EN 10210-1:1994, BS 1501 - Grade 490A, RT, DIN 17100 or similar steel shall comply with requirements not less than BS 5135 or equivalent standard. BS 5135 gives the requirements for preheating the work before welding. Circumferential welds, etc. shall be fabricated and tested in accordance with BS 5500, BS 2633 or equivalent standards where applicable. All joints shall have the plate edges accurately prepared to the appropriate profile for welding. The parts shall then be assembled and accurately checked before welding proceeds. The welding and fabricating procedure shall be such that residual stresses are a minimum and distortion avoided. Special attention shall be given to ensure that distortion does not occur after machining to affect the alignment and operation of the part concerned.

Welding procedures shall be in accordance with BS 4870. Each unit shall be fabricated and welding completed before final machining or other fitting work is carried out. All fillet welds shall be continuous.

Electrodes used shall be low hydrogen type and shall comply with requirements not less than BS 639 or equivalent standard for carbon steels, and BS 2926 or equivalent standard for stainless steels. Only stainless steel electrodes shall be used for welding stainless steel. Stainless steel to be welded shall be suitably stabilised. Heated storage and ovens shall be provided for the electrodes.

Only skilled, qualified and tested welders shall be employed. The welders shall be tested in accordance with BS 4871 Part 1, or other equivalent standard. Detailed records of welding shall be kept, showing the name of each welder against each run in a weld and any welder found to be producing an unacceptable amount of defects shall be removed until he has passed the test again.

Where valve bodies, sleeves, etc., are of welded construction all longitudinal butt welds in the shell plates shall be completely radiographically tested. All circumferential butt welds in pipes shall, where possible, have at least 100mm in 1000mm of their lengths radiographically tested.

All production welds shall be subject to visual inspection by the Engineer. Visual inspections may be carried out at any stage of the welding of a joint.

Each weld shall be clearly marked adjacent to the weld indicating the identification of the welder. Steel die stamping will not be permitted.

All welds shall be 10 per cent ultrasonically tested. Ultrasonic testing shall be carried out in accordance with BS 3923 and the Contractor shall propose a standard of acceptance. All fillet welds shall be tested by ultrasonic crack detection, or other approved means.

Non-destructive testing shall be carried out on all welds in the factory and on the site (if permitted). All longitudinal butt welds shall be radiographically tested. All circumferential butt welds carried out in the shop shall have 10% of their length radiographically tested at positions indicated by the Engineer. Junctions between longitudinal and circumferential welds shall be included in this test. The remainder of the shop and site welds shall be ultrasonically tested throughout 100% of their length. Ultrasonic testing shall be carried out in accordance with BS 3923 and the standard of acceptance shall be approved by the Engineer.

Where ultrasonic tests indicate a flaw or defect in the weld this shall be examined using radiographic means. In the case of fillet welds the Engineer may require dye penetrant tests to be carried out on selected welds. The Contractor will pay for the testing and he should include these costs and expenses during pricing of the Bill of Quantities.

The Engineer retains the right to have cut out and removed one weld only for each welder at no cost to the Employer.

Welds rejected by the Engineer shall be cut out and replaced by the Contractor. If the cut out weld is found on test not to meet the Specification, the cost of the cutting out and rejoining shall be borne by the Contractor. If the weld is found satisfactory, the cost shall be borne by the Employer.

Welds rejected by the Engineer may, at his discretion, be repaired subject to the following:

Repairs to the filler weld which would penetrate the stringer bead will not be permitted.

Arc burns shall not be repaired by welding, but shall be removed by grinding provided that no reduction in wall thickness is made in excess of 12-1/2 percent of the nominal wall thickness.

For all other items of plant the Contractor shall allow for the cost of radiograph examination of the welds. The positions to be examined will be indicated by the Engineer.

The "International Institute of Welding Collection of Reference Radiographs of Welds" shall be used as a guide for the interpretation of radiographs and as a basis for comparison regarding the nature and extent of weld defects. The minimum grade for acceptance shall be blue.

10.5. Fixings

Nuts, bolts, studs and washers for incorporation in the Plant shall conform to the requirements of the appropriate British or other approved standard. Nuts and bolts for pressure parts shall be of the best quality bright steel, machined on the shank and under the head and nut. Bolts shall be of sufficient length such that one thread shall show through the nut when in the fully tightened condition.

Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of a diameter such that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.

Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Engineer.

Where bolts pass through structural members taper washers shall be fitted where necessary to ensure that no bending stress is caused in the bolt.

Where there is a risk of corrosion, bolts and studs shall be designed so that the maximum stress in the bolt and nut does not exceed half the yield stress of the material under all conditions.

All bolts, nuts and screws which are submerged in water shall be made of nickel-bearing stainless steel.

10.6. Lubrication

10.6.1. General

Provision shall be made for suitable lubrication to ensure smooth operation, heat removal and freedom from undue wear. Plant selected shall require minimum lubrication attendance and down time for lubricant change.

A complete schedule of recommended oils and other lubricants shall be furnished by the Contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Engineer for approval before incorporation in the instruction manuals. In the case of grease lubricated roller type bearings for electric motors a lithium base grease is preferred.

The Contractor shall supply the first fill of oil and grease from approved lubricant suppliers.

All grease nipples, oil cups and dip sticks shall be readily accessible, being piped to a point as near as practicable to the lubrication point.

10.6.2. Grease Lubrication

Where lubrication is effected by means of grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Frequent, for this purpose means more than once weekly and grease systems having shorter periods between greasings should be avoided. Where necessary for accessibility grease nipples shall be placed at the end of the extension piping and, when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position with spacing in accordance with the recommendations of BS 1486 Part 1. Button head type nipples shall be used for normal grease lubrication. (Anti friction bearings requiring infrequent charging shall be fitted with hydraulic type nipples). Where more than one special grease is required a grease gun for each special type shall be supplied and permanently labeled.

10.6.3. Oil Lubrication

il sumps shall be fitted with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The normal, maximum and minimum levels at 30^{o} C shall be clearly visible in the sight glass type as viewed from the normal access floor to the particular item of plant, and they shall be easily dismantled for cleaning.

All sight glasses shall be firmly held and enclosed in metal protection in such manner that they cannot be accidentally damaged.

All lubrication systems shall be designed so as not to present a fire hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into contact with any electrical equipment, heated surfaces or any other potential source of fire.

Gear boxes and oil baths shall be provided with adequately sized filling and draining plugs and suitable means of oil level indication.

Roller chain drives shall have oil bath reservoir lubrication.

Drain points shall be located or piped to a position such that an adequately sized container can be placed beneath them. Where a large quantity of oil is involved or drainage to a container difficult, a drain valve and plug shall be provided at the point of discharge.

Bearings equipped with force fed oil lubrication shall be automatically charged prior to machinery starting up and pressure monitored during operation with automatic shutdown of machinery and alarm on low oil pressure.

Access, without the use of portable ladders, to lubrication systems shall be such as to permit maintenance, drainage and re-filling, without contamination of the charged lubricant.

The design of breathers shall take into account the humidity and atmospheric contamination at the vent point and measures be incorporated to prevent contamination of the lubricant.

The Contractor shall supply flushing oil for each lubrication system when an item of plant is ready for preliminary running and a sufficient quantity of the approved lubricants for setting to work and for the commercial operation of the plant for two years after the Taking-Over Certificate has been issued.

10.7. Machinery, Lifting, Dismantling, Guards, Noise and Vibration

10.7.1. Alignment

Machinery bedplate design, packing and fixing shall be such as to minimise distortion and vibration. Aligned machinery shall be mounted on either bed or sole plates permitting removal and reinstatement without a requirement to regrout.

Bedplates shall incorporate fine adjustment of the vertical and horizontal alignment between driver and driven members.

Rotating shafts of connected items of equipment shall be aligned to within 0.1 degree of arc from true, and with not more than 0.05 percent of shaft diameter misalignment, measured in any plane along the axis of the two shafts.

10.7.2. Lifting

All machinery shall be fitted with lifting facilities. Large structures shall be provided with jacking points.

10.7.3. Machinery Dismantling

Tapped holes or other provisions must be made in all main castings, for the insertion of jacking screws or the fixing of drawing gear to facilitate dismantling. On items of machinery subject to frequent dismantling, bolts or studs shall be employed in preference to set screws.

10.7.4. Guarding

Guards shall be provided to prevent access to electrical apparatus and moving parts of machinery. They shall be designed to be secure but removable without disturbing other parts of the Plant. The Contractor shall ensure that stationery points, requiring access, are located safely, outside the guards. Large guards shall be equipped with small removable panels for the inspection and checking of enclosed components.

10.7.5. Noise and Vibration

The Contractor shall provide a quiet installation. All items of plant and equipment shown on the drawings shall be carefully chosen with a view to quiet operation.

All plant must be capable of being operated without excessive vibration and the minimum amount of noise. Should the overall sound level of any item of plant exceed 85dB(A) at 1 metre radius the Contractor shall include for suitable sound attenuation to achieve this level. This will apply in the audible frequency range 20 Hz - 20 kHz. Above 20 kHz, the Contractor must state whether any fundamental frequencies are generated in the ultrasonic region. Where plant is operating in the vicinity of residential buildings then the sound level at 1 metre radius from the outside of the pump or plant house enclosure or building shall not exceed 65dB(A).

The Contractor shall provide and fix all material for the prevention of transmission of noise and vibration through the structure. All fans, motors, A/C package units, compressors, diesel engines and other motive plant shall be mounted on resilient mountings in such a manner that the plant foundations are isolated from the floor or structure. In addition, all rotating plant shall be statically and dynamically balanced. Mechanical vibration shall be isolated by the use of anti-vibration mountings and flexible connections to ensure an isolation efficiency of 95% from the building structure.

10.7.6. Gear Boxes

Gear boxes shall have a life of 100,000 hours or above, be selected in accordance with A.G.M.A recommendation for horsepower calculation and service factor application and employ a standard reduction ratio. The service factor on installed motor power shall not be less than 1.8. Gear boxes which have to be angle mounted, shall have a rating, choice of bearings, seals and lubrication system which are suitable for such mounting. Dependence on splash lubrication alone is not acceptable but it may be used in conjunction with a forced feed method to reach all bearings and gears. Calibration of the oil dipstick and its position together with that of the sump drain plug will require special consideration.

10.7.7. Bearings

Below-Water Bearings`

The Contractor shall select the most appropriate type of bearing for the Plant being supplied. Equipment with vertical shafts shall have thrust and guide bearings. All bearings shall be designed to exclude the ingress of water except where the bearings are water lubricated. Sealed for life units are acceptable subject to a minimum design life of 50,000 hours operation at maximum loading. Plant which may be subject to vibration whilst stationary shall be provided with bearings designed to withstand damage from such a cause. Below water bearings shall be of the journal type, of ferrobestos, rubber gunmetal or equal and journals of stainless steel.

Above Water Bearings

Single journal plain bearings shall have phosphor bronze or synthetic lubrication impregnated bushes and carbon or stainless steel journals respectively. Synthetic bearings shall only be used where bearing condition can readily be inspected. Plain type bearings shall be self-lubricating by either grease, forced oil or impregnation. Ball and Roller type bearings shall be adequately lubricated by oil or grease and sealed to prevent leakage of lubricant along the shaft. Attention shall be given to ensure that dismantling of bearings is simple and free from risk of damage.

Bearings fitted to gear boxes shall have a minimum design life of 100,000 hours at maximum loading.

10.8. Pumps

10.8.1. General

Each pump shall be designed and constructed to be suitable for the particular liquid to be pumped. Pumps shall be of the type specified and arranged as indicated in the Specification and Drawings. Pumps shall be designed to give the specified output against all losses including those relating to the pump station pipework and valves. The Contractor shall match his pump characteristics to the pipe system networks to achieve the highest pump efficiency and reliability. The pumps shall have a non-overloading characteristic over the complete range of head and quantity delivered and the drive shall be capable of operating the pumps against maximum run out conditions and still have a 10 per cent margin. Each set must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitations or overload under all operating conditions within the system characteristics given.

The pumps for the works shall be Vertical turbine pumps, vertical shaft submersible pump, long coupled design installed in a vertical orientation. The discharge nominal pressure shall be PN 16.

The whole pumping unit shall be capable of withstanding, without detriment, reverse rotation to a speed that would occur if the pump were to stop when the differential head was at a maximum and the delivery and/or non-return valve failed to close.

Pumps to be installed must have local reputable dealership and service support. Hydraulic performance test shall be in accordance with ISO 9906 class 2B

10.8.2. Pump Casings

The pump design shall ensure that alignment is maintained between the various assemblies by recesses, spigots and dowels and shall be such that all components liable to wear can be replaced. Components shall be permanently marked with the manufacturer's number and where dowels are not used, permanently marked for correct assembly. The pump casing shall have replaceable wear rings. The casings of the pumps shall be of a suitable grade of close grained cast iron to BS 1452 Grade 220 or nickel iron and have flanges to match the specified pipework. The waterways through the pumps shall be smooth in finish and free from recesses and obstructions.

Pumps shall be designed to facilitate maintenance, and manholes or handholes shall be provided to allow the interior of the casings and bearing seals to be examined without dismantling the pump. It shall be possible to remove pump impellers with the minimum disturbance to pipework and by suitable joints to allow the pump to be removed without dismantling the main pipework.

All joints shall be machined and faced and bolt holes shall be drilled and arbored. Locating pins shall be provided where necessary, also starting screw holes, the latter being provided with set screws.

10.8.3. Impellers

The impellers and guide vanes (if any) shall be of suitable material, accurately machined and smoothly finished to minimise hydraulic losses. The rotating elements shall be statically and dynamically balanced before final assembly. The impeller shall be readily withdrawable from the pump casing without the need to disconnect pipework.

10.8.4. Pump Shafts

The pump shaft shall be of high tensile or stainless steel adequately sized, with good fatigue, shock load and corrosion resistance. The duty speed range shall be well below the first critical speed of the shaft. Where a change in diameter of the shaft occurs the shoulder shall be radiussed or undercut to the appropriate BS to reduce stress concentration. The shaft shall be complete with easily renewable stainless steel protecting sleeves at glands and bearings.

10.8.5. Bearings

All bearings shall be liberally rated to ensure cool running and meet the load factors specified.

For vertically mounted pumps, the bearing shall be a combined thrust and journal type, designed to prevent any thrust loads being imposed upon the drive motor. The pump bottom bearing shall be lubricated by an enclosed water lubricated sleeve bearing suitable for potable water applications.

here grease points are necessary they shall be fitted with removable screwed plugs which shall be accessible without removing guards. All bearings having automatic lubrication shall also have provision for hand lubrication.

10.8.6. Shaft Seals

The Contractor shall select a seal, compatible with his plant and best suited for the worst conditions likely to be met when the Plant is in operation. All seal materials shall be compatible with and/or resistant to the fluid or gas being handled. For potable water, seal materials shall be those specifically approved for use in the Water Industry.

Stuffing boxes shall be provided with renewable gland packing. Glands subject to abrasive liquors or negative pressures, shall embody suitably positioned lantern rings and a clean water continuous flushing system, operative whenever the Plant is in motion or a corrosive element is present. Gland adjustment nuts shall be readily accessible for routine maintenance. Gland drain pipework shall be installed, incorporating rodding facilities and adequate inclines discharging to the nearest sump or drainage channel.

Mechanical seals which are on pumps subject to abrasive liquor or gas, or subject to negative pressures or corrosive elements, shall be provided with a clean water continuous gland flushing system, operative when the item of plant is in motion or a corrosive element present. A back-to-back sealing arrangement with a flush/cooling system shall be accepted as satisfying the requirements of this Clause.

Special care in the selection of materials shall be taken in order to avoid binding and electrolytic action between the shaft sleeve and the seal components, particularly where long periods of idleness are inherent in the duty cycle as in the case of standby pumps.

The gland water connections supplying water seals of the pumps shall be provided with suitable filters to prevent abrasive matter in suspension from entering the gland stuffing box. These filters shall be designed to facilitate easy cleaning.

10.8.7. Pumps Miscellaneous

Cooling and lubrication water pipework shall be fitted with flow indicators where specified.

Horizontal pumps shall be mounted on a common fabricated steel bedplate manufactured from substantial rolled steel sections of welded construction with machined pads for mounting both pumps and motors. Folded plate type bedplates shall not be acceptable. Pumps and motors shall be dowelled in position to allow for easy relocation in the event of their being removed. The pump shall be connected to its driving motor by a flexible coupling of a type approved by the Engineer which shall be adequately guarded.

On horizontal pumpsets fitted with hydraulic balance devices the couplings shall permit free movements of pump shafts under load.

On vertical pumpsets where the shaft couplings are of the screwed type the couplings shall be positively locked.

The Contractor shall ensure that adequate NPSH is available to ensure that pumps operate without cavitation under the worst operating conditions.

Indicating pressure gauges each with an isolating cock and snubber shall be provided on the suction and delivery side of each pump except that a suction gauge is not required on submersible type pumps. All pressure gauges shall be provided with high and low level adjustable contacts which can be used to provide additional pump protection where specified.

10.8.8. Performance

The guarantees given in respect of output, overall efficiency and NPSH shall be verified with Class C tests in accordance with BS 5316 at the manufacturer's works in the presence of the Engineer. No negative tolerance shall be applicable to the guaranteed values for flow, head or efficiency. The tests shall be performed by pumps driven by their own motors.

The NPSH tests shall be carried out at the guaranteed duty point, at the maximum run out condition and at three points in between.

10.9. Flanges

10.9.1. General

All flanged connections of pumps, pipework, valves and other relevant equipment shall have flanges in accordance with BS 4504 Table 16, unless otherwise specified in the Particular Specification Sections.

10.9.2. Jointing

All flanged joints shall be made with 3 mm thick full face canvas reinforced rubber insertion gaskets to BS 4865 Part 1. During Installation all pipes shall be hung on their respective supports and lined up so that their joint faces are parallel before flanges are bolted together. In making joints, no springing of pipes into position shall be allowed.

Joints on flanges that exist or have been installed under other contracts shall be made with the same material and suitable for the flange faces.

10.10. Pipework

10.10.1. General

All pipe systems shall be arranged, installed, supported and provided with all necessary means of venting, draining and expansion, all to the approval of the Engineer.

The pipework layout shall be designed so that items of equipment and sections of pipework can be removed from the pipeline without major disturbance to the adjacent pipework. Particular care shall be taken to ensure that pipework thrusts are not transmitted to machinery or associated apparatus. The Contractor shall indicate on his detailed drawings the thrust blocks required to anchor his pipework.

The Contractor shall provide flexibility in the pipework at joints in the main structures and shall submit proposals for the approval of the Engineer. Flexible joints or collars and cut pipes shall be allowed on all pipework where necessary to allow for some margin of error in the building work. Wherever possible flexible joints shall be provided with tie bolts or other means to transfer longitudinal thrust as a whole so that external anchorages may be kept to a minimum. Flexible joints shall also be provided for ease of erection and future dismantling.

All necessary supports, saddles, slings, fixings bolts and foundation bolts shall be supplied to support the pipework and its associated equipment in an approved manner.

Dead legs shall be avoided but where this is not possible provision shall be made for flushing the pipework. Changes in pipe bore sizes shall be by the use of proprietary fittings or fabricated sections to avoid sudden changes.

Where relevant, formed bends and offsets shall be used and be cold formed in a standard pipe bending machine. They shall have an inside radius of not less than 4 times the outside diameter of the pipe.

Flushing and drain connections on pipework below 150 mm shall be made using proprietary welded fittings with G series internal parallel threads to BS 2779 which shall be immediately sealed with hexagon headed shouldered plugs and seals. Holes thus made in the pipe shall have burrs removed and be finally pulled through to remove loose particles.

Template or closure pipes shall be provided where necessary to facilitate erection. The design and construction of the template pipes shall be to the approval of the Engineer, and the Contractor will be responsible for establishing the dimensions of the template pipes such that there will be no strain placed on the connected items after installation.

All nuts, bolts, washers, flanges, gaskets, tied flanged adaptors, drain valves, special connection pieces, together with all terminal point connection materials shall be supplied under the Contract.

Viking-Johnson or approved equivalent flange adaptors shall be fitted where necessary to facilitate the removal of valves, etc.. Adequate provision shall be made for anchoring pipes at these joints.

Hydraulic Pipework shall be sized to maintain fluid velocities below those specified and provide a safety factor of 4:1 on the design pressure, which shall be taken as 120 per cent of the pump closed valve head.

Compressed Air Pipework shall be sized such that the air flow velocity does not exceed 8m/s. To provide adequate condensate drainage, the pipework system shall be run with a horizontal fall of not less than 1 in 50 in the direction of air flow and incorporate drainage points at distances of not less than 30 m. Drainage points shall be formed by use of equal tees with a down-pointing leg fitted preferably where changes of direction of flow occur.

Pipework materials, sizes, pressure ratings, fittings, coupling arrangements and medium carried shall be as detailed in the Particular Specification, pipework being in metric sizes throughout.

10.10.2. Steel Pipework

General purpose steel pipework with screwed fittings shall be of galvanised mild steel to BS 1387 heavy grade with fittings of galvanised malleable iron to BS 143/1256, having tapered internal and external threads to BS 21.

Steel pipe and fittings over 80 mm diameter, shall be carbon steel in accordance with BS 3601 with pipe sizes to BS 3600. Joints shall be flanged. Pipes shall be fabricated in accordance with BS 534 with welding in accordance with BS 2633 or BS 2971 and BS 4515.

After fabrication and machining of flanges all pipework and fittings shall be tested to a test pressure equal to 1□ times the flange pressure rating.

Where pipes are to be joined with sleeves or couplings, a sufficient length of pipe shall be left bare of coating to accommodate the sleeve or coupling.

Plain ended pipes shall be supplied rounded at both ends. An adequate number of pipes shall be supplied rounded throughout their length so that they may be cut and such pipes shall be clearly marked.

Couplings for use with steel pipes shall comply with BS 534 except where other types of couplings are shown on the Contract Drawings or specified in other sections of this Specification. Components of flexible joints from different manufacturers shall not be used together.

Tests on pipes shall be made in accordance with the relevant British Standard in the manufacturer's works when required by the Engineer and in the presence of the Engineer. Two copies of the results of all such tests shall be submitted to the Engineer.

Flanges on steel pipes shall be welded in accordance with BS 2633 or BS 2971 and shall have raised or flat faces. Gaskets for use in flanged joints shall consist of rubber complying with BS 2494 for type 1 rings or rubber reinforced with cotton and complying with BS 5292 or as instructed by the Engineer. On flat face flanges the gaskets shall extend over the full flange

area and on raised face flanges they shall cover the raised face only. No asbestos shall be used on any flange of pipework or fitting carrying potable water.

Steel pipes which are to be welded shall have the ends prepared by the manufacturer to suit the type of welded joint shown on the Contract Drawings. The pipes shall be free of external and internal coating for a distance of 75 mm from each weld line.

After fabrication all welding scale and beads as well as hardened fluxes shall be removed and joints shall be free of pores and as smooth as possible. Where specified all pipes and specials shall then be degreased and grift blasted prior to coating with an approved fusion bonded epoxy coating. The coating shall be tested to ensure the correct thickness and the absence of pores using spark testing equipment.

Bends, branches and other fittings for use with steel pipe shall comply with the British Standard or other approved standard. Calculations for the design of all special fittings shall be submitted to the Engineer before manufacture commences.

Pipes shall be stacked on a firm base using two timber packers only under the barrel of pipes.

Fittings and specials of any type shall be stored in a single layer only. Pipes and fittings shall at all times be adequately protected from damage during transport, storage and handling. Pipes shall be fitted in the factory with end caps and reinforcement adequate to prevent distortion during transport, storage and handling. Rubber rings and other pipe jointing material shall be stored under cover away from direct sunshine.

10.10.3. Cutting Pipes

The cutting of pipes for making up lengths shall be carried out by a method which leaves a clean square end. Steel pipes used for cutting shall have been rounded throughout their length and shall be clearly marked as such. Cutting shall be carried out by cutting disc or by oxy-acetylene and the cut end shall subsequently be ground to the correct profile for the method of jointing in use.

10.10.4. Welded Joints

Line-up clamps shall be designed to prevent tears, scars, or indentations of the pipe walls and keep misalignment of pipes at a minimum. Interior line-up clamps are required for large diameter pipe.

All welding shall be carried out in accordance with specific procedures prepared by the Contractor and approved by the Engineer. Adequate precautions shall be taken to protect welding operations from wind, rain, blowing sand, etc..

All welders employed on the Works shall be fully qualified and shall have successfully passed all tests required by BS 4871 or the relevant API codes for the type of work each individual welder does. Welder qualification tests shall be carried out in the presence of the Engineer or his authorised representative. The Contractor shall provide all necessary labour, pipe welding materials, and equipment for performing welder qualification tests on site. Arrangements for laboratory tests of coupons, if required, will be made and paid for by the Contractor. The Contractor shall maintain a list of approved welders agreed upon with the Engineer and no other employees shall perform welding operations on the Permanent Works.

Before welding, the pipe ends shall be swabbed with a leather or canvas belt disc to remove dirt, loose mill scale, rust, oil, grease, and other matter which may be injurious to the weld. Cleaning of pipe ends shall be done by power wire brushing and/or grinding. Pipe ends damaged such that they no longer meet joint specifications shall be rebevelled by a suitable machine. Pipe ends shall be aligned with line-up clamps such that the longitudinal weld seams of the adjacent pipes are staggered by at least 20 degrees. Stringer bead shall be applied by

at least two welders welding in opposite quadrants. The number of filler and finish beads shall be in accordance with approved procedures.

Completed weld shall have a substantially uniform cross-section around the entire circumference of the pipe. At no point shall the crown surface be below the outside surface of the pipe nor be raised above the parent metal by more than 1.5 mm. All joints on which welding has started shall be completed before the end of each day's work. At night or when work is not in progress, pipe ends of the pipeline shall be securely capped with a suitable cover to prevent the entrance of dirt, small animals, water, and foreign matter into the pipeline. Tie-ins shall be carefully aligned to limit residual and/or reaction stresses after completion of the weld. Tie-ins shall be made within the temperature range of 10o to 30o C. All production welds shall be subject to visual inspection by the Engineer. Visual inspections may be carried out at any stage of the welding of a joint. Each weld shall be clearly marked adjacent to the weld indicating the identification of the welder. Steel diestamping will not be permitted.

Non-destructive testing shall be carried out on all welds, both in the shop and on the site. All longitudinal butt welds shall be radiographically tested. All circumferential butt welds carried out in the shop shall have 10 per cent of their length radiographically tested at positions indicated by the Engineer. Junctions between longitudinal and circumferential welds shall be included in this test. The remainder of the shop and site welds shall be ultrasonically tested throughout 100 per cent of their length.

10.10.5. Flexible Joints

Any flexible joints in steel pipework shall be of the type specified or as shown on the Drawings. Flexible joints between pipes having integral sockets shall be formed by a shaped rubber gasket fitted within the socket or by a rubber ring of circular cross section (O-ring) placed on the pipe spigot. The type of flexible joint to be used shall be subject to the approval of the Engineer. Before any joint is made all parts of the joint shall be clean and free from mud, oil, grease or other deleterious matter. Fixed gaskets shall be lubricated strictly in accordance with the manufacturer's recommendations. O-ring gaskets shall not be lubricated. Components of flexible joints from different manufacturers shall not be used together. After jointing, the position of O-rings shall be tested with a feeler to ensure that they are correctly positioned. If any ring shows a significant departure from a line following a pipe circumference, the joint shall be broken and remade using a new ring. After completing the joint any damage to the protective coating shall be made good.

10.10.6. Flanged Joints

Flanged joints shall be made with rubber gaskets and shall be fitted without twist or distortion. Pipes and fittings shall be fully supported so that the flange faces are parallel and concentric. The flanges shall be drawn together uniformly by tightening opposite pairs of bolts in succession and no bolts shall be omitted. The size and number of bolts in flanged joints shall be in accordance with BS 4504 and BS 4772 for the pressure rating of the pipeline given on the Drawings. Bolt threads shall be coated with an approved paste such as Loctite before use unless otherwise instructed by the Engineer.

10.10.7. Deviations at Joints

The maximum deflection at each joint shall not exceed the following:

- For any type of flexible joint, three quarters of the maximum permissible deflection stated by the manufacturer;
- For welded joints in steel pipework, the deflection shown on the Contract Drawings. The ends of the pipes shall be cut to suit.
- No deviations shall be made at flanged or solvent welded joints.

10.10.8. Protection of Buried Pipes

External and internal protection to pipes shall be made good after completion of joints as directed by the Engineer. Protective tape of a type acceptable to the Engineer shall be applied in two separate layers. Each layer shall be wound with an overlap equal to half the tape width and shall extend at least 150 mm beyond the area requiring protection.

10.10.9. Gaps for Equipment

Where gaps have to be left in pipework for the later installation of equipment such as valves and other items, the ends of the pipes shall be accurately aligned one with the other across the gap paying strict attention to bolt positions if relevant. The length of the gap shall be accurately determined with the aid of dimensional sketches which shall be submitted to the Engineer before the work is carried out.

All gaps left for valves or other equipment shall include space for a dismantling joint.

10.10.10. Ductile Iron Pipework

Where specified Ductile Iron pipework shall be in accordance with ISO 2531, BS EN 545:1995, BS EN 598:1995 and BS EN 969:1996 with flanged joints and fittings unless otherwise specified. All pipes and fittings shall be protected against corrosion with an internal lining of cement mortar and an external coating of zinc and bitumen in accordance with BS 4772. The bitumen solution shall be in accordance with BS 3416 for use with potable water supplies.

10.10.11. uPVC Pipework and GRP Pipe and Fittings

- Unplasticised PVC (uPVC) pipes shall comply with:-
  ISO 161/1 as stated on the drawings. Joints shall be either made with rubber sealing rings or shall be solvent welded as specified. Solvents shall comply with BS 4346 Part 3. Ferrules, straps and other metal fittings shall be gunmetalor
- Unplasticised PVC pipes shall comply with BS 4660:2000:2000:2000 or BS EN 1401-1:1998 as applicable for drain pipes.

- GRP pipes and fittings shall comply with BS EN 14364:2006+A1:2008.

10.10.12. Small Bore Pipework

Small bore pipework up to 15 mm OD shall be manufactured from stainless steel tubing with suitable compression type fittings. All small bore pipework and capillary tubes shall be adequately and securely clipped or clamped. Compression fitting bends shall be kept to a minimum as pulled bends of generous radii are preferred. Compression couplings shall be heavy series to BS 4368 Part 1.

Any gauges, transducers or switches, etc., fed via small bore pipework shall have an individual isolating cock adjacent to each component with adequate space being allowed for component removal for servicing.

10.10.13. Puddle Flanges

Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the Contract Drawings and the

resultant thrust clearly indicated. Puddle flanges shall only be fitted with the Engineer's prior approval.

After the pipework is installed, the Contractor shall seal the ends of all ducts, pipes, or trenches leading into buildings. The seals shall be approved water, gas and fire sealing transit units with appropriate fillers. Insert blocks shall be fitted to duct and trench entries. All steelwork on such transit assemblies and frames shall be hot dip galvanized. Where detailed in the Specification or shown on the Contract Drawings, transit frames will be incorporated in the construction by the Civil works Contractor.

10.10.14. Reference Marking

Prior to despatch from the manufacturer's works each pipe section shall be marked with an appropriate reference number for future identification.

10.10.15. Protection of Pipework

Immediately after the completion of fabrication at the works or on site and during transport and storage, pipe ends shall be protected from external damage and sealed against ingress of dirt by suitable caps, plugs or other similar means. After cleaning and inspection, machined surfaces of all steel and ironwork shall be covered with preserving fluids of approved types or otherwise protected and all flanges shall be fitted with blank discs bolted to each face.

10.10.16. Branch Pipes and Bosses

Whenever any small bore pipework makes a connection into the pipeline system, a boss or branch pipe shall be provided which shall be at least twice the diameter in width and one diameter in thickness of the tapped hole which it contains.

Bosses shall be located at the main pipe horizontal centre line and those provided for water sample cocks shall be tapped 38 mm BSP and have reasonable access for sampling. Bosses provided for instrumentation equipment shall be tapped 25 mm BSP with a reducer fitted to suit the small bore pipework and isolating cock. Unused bosses shall be fitted with blank plugs having a central squared projection for tightening or removal.

Bosses shall be provided for pump performance monitoring. These shall be installed on all pump suction and delivery pipes at least 2 pipe diameters from the pump flange unless otherwise specified in the Particular Specification. Each tapping shall be provided with □ inch isolating cock.

Within 24 hours of the completion of any test the Contractor shall submit two copies of a full record of the test to the Engineer. The record shall be in a form acceptable to the Engineer.

The pipe work to be tested shall be filled with clean water, making sure that all air is expelled. Mortar lined pipe shall then be kept under nominal working pressure for 24 hours. The pressure shall then be raised to the specified test pressure using a suitable pump which is fed from a calibrated tank. The test pressure will depend upon the particular circumstances and will be specified by the Engineer but for general guidance only, it will be 1.5 times the maximum sustained operating pressure.

The test pressure shall be held for the period instructed by the Engineer, pumping in water as required from the calibrated tank, and the amount of water used per hour shall be noted. The pressure shall be held for 24 hours and there shall be no loss of water.

10.11. Valves and Penstocks

10.11.1. General

Valves shall be provided as shown on the Drawings and in this Specification, and shall be specifically designed for use in drinking water. Valves shall, unless otherwise specified, be double flanged.

All valves and penstocks shall be of the sizes shown on the Drawings or stated in the Documents and shall be obtained from manufacturers approved by the Engineer.

Where specified valves shall be fitted with easing screws and a clean-out box in the base.

All valve bodies shall give the following information:-

- Manufacturer's name
- Hydraulic test pressure
- Size of valve
- Direction of flow `Arrow'

10.11.2. Valve Access

All valves, hand wheels, spindles and headstocks shall be positioned to give good access for operational personnel.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements.

Valves buried or installed in underground chambers where access to a handwheel would be impractical shall be key operated.

It shall be possible either to remove and replace or to recondition seats and gates. Gland packings shall be accessible without removal of the valve from the pipework.

10.11.3. Operation

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15 per cent in excess of the maximum service value and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required operating torque of 150 Nm.

All handwheels shall be arranged to turn in a clockwise direction to close the valve or penstock and the direction of rotation for opening and closing shall be indicated on the handwheels.

Unless otherwise stated the handwheels shall be coated with black plastic and incorporate facilities for padlocking in either the open or closed position.

Headstocks and valves of 50 mm, or greater, nominal bore shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. 0.25, 0.50, 0.75, 1.

10.11.4. Materials

Valve bodies, discs and wedges shall be of cast iron, with facing rings, seating rings, wedge nuts and other trim of corrosion resistant bronze, all as specified.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

Valve bodies and other components of plastic or other non-metallic materials shall be compatible with the medium and of robust industrial design.

10.11.5. Extension Spindles and Pedestals

Extension spindles shall be adequately sized to prevent buckling and shall be attached to the valve/penstock stem by a suitable adaptor incorporating two muff couplings, scarf lap jointed and pinned with at least two coupling joints included. Universal joints and waterproof sleeves shall be provided where specified. Extension spindles shall be manufactured from 080M40 (EN 8) steel.

Intermediate bearing support or guide brackets of cast iron, with slotted holes for site adjustment, shall be fitted to long shafts where necessary. Bearings shall be of PTFE or similar approved type.

Penstock and valve pedestals shall be of cast iron or heavy duty, welded, mild steel construction, with a substantial base and fixing provision. The base and top of the pedestals shall be machined normal to the axis of the drive shaft.

Where necessary, support guide bushes shall be fitted at the base of the pedestal.

The pedestal height shall be such that the handwheel is approximately 1 metre above the operator's floor level.

Covers of an approved type shall be provided for all rising spindles to totally enclose them when in the fully raised position.

10.12. Instruments and Ancillaries

10.12.1. General

All instruments, gauges and control equipment which perform similar duties shall be of uniform type and manufacture throughout the Works in order to facilitate maintenance and the stocking of spare parts.

Panel mounted instruments shall have damp-protecting and dust-protecting cases. Instruments mounted outside instrument panels shall have weatherproof and dustproof cases. Instrument cases shall be of corrosion-resistant material or finish. Instrument screws (unless forming part of a magnetic circuit) shall be of brass or bronze. Access to terminal compartments of instruments mounted outside panels or other enclosures shall not expose any working part. Moving parts and contacts shall be adequately protected from the ingress of dust.

Unless otherwise specified instruments shall be finished in the manufacturer's standard colour. Instrument dials shall be of such material that no peeling or discoloration will take place with age.

Plant-mounted indicators and gauges shall be sized to give full legibility when viewed from a position with convenient and easy access or from the point at which any operation requiring observation of the gauge is performed. The minimum diameter for any gauge shall be 100 mm except where forming part of standard instruments and accessories such as air sets.

Dials and bezels shall be of bronze and internal components shall be of stainless steel, bronze or other corrosion-resistant material.

Equipment mounted in enclosure shall be suitable for continuous operation at the maximum internal temperature possible in service, due account being taken of internally-generated heat and heat dissipated by other plant. All components shall be rated adequately and circuits shall

be designed so that changes of component characteristics within the manufacturers' tolerances shall not affect the performance of plant. All equipment shall be designed to operate without artificial cooling. Instruments shall be easily withdraw able from cases without interrupting their circuits.

Equipment provided with anti-condensation heaters shall be capable of operating without damage if the heaters are left on continuously.

Measuring instruments shall have zero and span adjustment.

Instruments not mounted in panels shall be supplied complete with all brackets, stands, supporting steelwork and weatherproof enclosures (separate from the instrument cases) necessary for securing them in their working positions and affording complete protection at all times including periods of servicing, adjustment, calibration and maintenance. Instruments mounted in open areas which could be vandalized shall be mounted in lockable vandal proof boxes.

10.13. In-Line Flow Meters

In-line flow meters shall be of the electromagnetic type complying with the requirements of BS 5792. They shall operate on electromagnetic induction principles and give an output signal directly proportional to the liquid rate of flow.

Each meter shall have a stainless steel metering tube (detector head) and a non-conductive liner suitable for potable water. End connections shall be steel flanged. The detector head shall be complete with corrosion resistant earthing rings and matching flange adaptors of the self-locking type (Flexlock or equal) suitable for use on the pipes described in the Particular Specifications. One flange of the detector head shall be connected to a flanged pipe, while the other shall be connected with the flange adaptor to facilitate removal.

The flow meter shall be carefully sited in the process pipework in accordance with BS 5792 and the flow meter supplier's instructions. Particular attention should be paid to the provision of the correct velocity range, earthing rings and the correct number of upstream and downstream clear diameters. A bypass and isolating valves shall be provided to allow the removal of the flow meter for maintenance.

Any taper pieces necessary to give the correct velocity range through the flowmeter shall be provided by the Contractor.

The primary flow head shall be suitable for continuous submersion to BS 5490: IP68 or better. The maximum depth of submergence shall be 3 metres. The primary flow head shall have electrodes which may be removed for cleaning or replacement without interrupting the flow.

Plant mounting enclosures for signal converters shall be to IEC 529, standard IP65 or better. Measuring ranges shall be continuously adjustable from 1 to 9.999 metres per second with facility to change to 0.5 to 5.5 m/s for high accuracy measurement of low flows.

For flows between 50-100% of the range, the accuracy shall be better than or equal to "0.5% of the actual flow rate; for flows between 10-50% of the range accuracy shall be better than or equal to "0.3% of the actual flow rate; and for flows between 1-10%, accuracy shall be better than or equal to "0.1% full scale value.

The effects of ambient temperature on the output signals shall not exceed 0.15% per 10^{o} C.

Relay units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall have conductivity discs.

10.14. Pressure Gauges and Switches

Pressure gauges shall comply with BS 1780. Pressure gauges, transmitters and switches shall have over range protection. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze or approved corrosion-resistant material. Pressure gauges shall have concentric scales.

Where compensation of more than 2% of the instrument span is needed for the difference in level between the instrument and the tapping point, the reading shall be suitably adjusted and the amount of compensation shall be marked on the dial.

Recorder scales and charts shall be in accordance with BS 1794 and BS 3693 as applicable. Single-pen recorders used for more than one measurement shall have rotary switch selectors with plates engraved to show the identity of the selected measurement.

10.15. Electrical Indicators and Integrators

Indicators for use with analogue signal transmission systems shall comply with BS 89 and have an accuracy class index of 1.0. Indicator movements shall be critically damped (dead-beat). Indicators for use on more than one circuit shall have rotary switches to select the circuit, with engraved plates to show the circuit selected.

Indicators shall have circular scales or shall be of the vertical edgewise type and shall be designed to avoid parallax error. Scales shall be clearly marked in the specified units and shall comply with BS 3693. All instruments which are mounted on one panel or board, or are in adjacent groupings, shall have similar styles of figures and letters. Dials shall be white with black scales and lettering not subject to fading.

The material for scales shall be such that no peeling or discolouration will take place with age under all environmental conditions.

Major scale marks and numerals shall be of the same size and thickness and shall be separated by not more than twenty five minor marks. Pointers shall taper to the width of the scale marks.

Integrators shall be of the multi-digit cyclometer type. Each integrator shall have an integral or separate current-to-pulse converter with sufficient adjustment of the pulse rate to avoid the use of any multiplying factor except in integer power of 10. Each integrator shall incorporate an adjustable limiter whereby any input below a preset value is inoperative. Unless otherwise specified, integrators shall have a minimum of eight digits with a decimal point where applicable.

10.16. Corrosion Protection

10.16.1. Surface Preparation

(a) **General**

All surfaces to be coated with non-metallic coatings shall, where possible, be blast cleaned as specified below. Where blast cleaning is not possible because the material is thin gauge steel, the surfaces shall be cleaned by alternative means, but the Contractor shall obtain the approval of the Engineer before resorting to such alternative methods of surface preparation.

Surfaces to be coated with metal coatings shall be prepared in accordance with the standards governing the particular type of coating to be applied, e.g. BS 729 for surfaces to be hot dip galvanised. Surfaces to be coated with zinc metal spray shall be blast cleaned as specified below.

Any items not to be coated, which are in contact with or adjacent to surface due for coating, shall be removed or covered prior to surface preparation and coating operations.

Surface preparation and coating of metal surfaces shall not be performed: during rain, wind, fog or when dust is in suspension in the air. if the surface is likely to become damp after surface preparation and before coating. in areas where harmful particles are in suspension when surface temperature is less than 3^{o}C above the surrounding air's dew point. When air relative humidity is greater than 85% (or outside the range 50 to 85% when applying zinc silicate).

When air or surface temperature is below 5^{o}C for conventional solvent-based coatings or below 13^{o}C for chemically cured coatings, or when air or surface temperature is above that specified by the Coating Manufacturer. at any time when the above conditions are likely to occur before the coating is dry to handle.

(b) **Preparation and Priming of Blast-Cleaned Steel Surfaces**

10.16.2. Degreasing

All surfaces shall be degreased before blast cleaning. If grease or similar contamination is introduced during the cleaning process, then the affected areas need to be degreased again, and the source of the contamination eliminated.

Grease and dirt shall be removed from the surface by emulsion cleaners followed by thorough rinsing with clean fresh non-saline water, by steam cleaning or by high pressure clean fresh non-saline water jetting. If white spirits or similar solvents are used then the use of a detergent or emulsion cleaner shall follow and the operation completed by thorough rinsing with clean fresh non-saline water. Detergent or emulsion cleaning with solvents without subsequent washing and rinsing with clean fresh non-saline water shall not be permitted. The surface shall then be allowed to dry thoroughly.

10.16.3. Blast Cleaning Equipment

Only dry blasting techniques shall be permitted.

All blast cleaning equipment shall be well maintained and the correct type of pot valves fitted for the specified grit. Blast nozzles shall be of the Venturi type and of suitable size and shall be replaced once the internal diameter is 33% greater than its original size.

Air for blast cleaning shall be of adequate capacity and capable of maintaining a steady optimum pressure. Efficient water and oil traps shall be installed and these cleaned regularly to ensure that the air used is both clean and dry. Condensation shall not be allowed to form in the delivery lines after the initial water and oil traps.

The blasting equipment shall be such that, at the end of the operation, the treated surfaces are completely dry and grease free.

10.16.4. Abrasives

Abrasives shall consist of angular chilled iron or steel grit, treated sand, or copper slag.

Chilled iron or steel grit shall have a hardness of 60-80 Rc. It shall have a good angularity of form with sharp cutting edges and shall be free of "half rounds", and shall be either grade G17 or Grade G24 to BS 2451.

Where sand is permitted as the blasting medium, then it shall be quartz sand washed, clean and dry and shall be gypsum and salt free. Sea sand shall not be used. The particle size shall

be between 0.7 mm and 2.0 mm. Sand blasting shall not be used on surfaces to be subsequently metal sprayed.

All abrasives shall be maintained in a dry condition, adequately graded to remove overfine and detritus removed from the surface of the blast cleaned component. In the case of sand or copper slag, only virgin abrasives shall be used.

In the event of any grit being found under or embodied in the subsequent coating film, then the affected areas shall be re-blasted and the complete coating system re-applied.

10.16.5. Surface Cleanliness and Profile

Prior to the commencement of surface preparation surface irregularities including cracks, surface laminations, shelling, deep pitting, laps, fins, sawcuts and burrs shall be removed and all sharp edges radiused to at least 3mm. All bolt holes shall be drilled and the edges smoothed before blasting. All welds shall be continuous and they shall be made smooth and free from undercuts, slag inclusions and residues before blasting. Surfaces shall be made free from weld spatter and mineral scale before blasting. Irregularities which become apparent after blast cleaning shall be removed by grinding and dressed areas shall be reblasted to restore the required standards of cleanliness and roughness. Grinding must not reduce the metal thickness to below the required minimum metal thickness.

Blast-cleaned steel surfaces that shall be subsequently coated with a sprayed metal coating shall be cleaned to Sa 3 with a profile of 75 to 115 microns. Other surfaces to be coated shall be blast cleaned to Sa 22 or Sa 3 with a profile of 50 to 75 microns or 75 to 115 microns as by the Coating Manufacturer and approved by the Engineer. It is accepted that there will be isolated rogue peaks where the amplitude is abnormal but nowhere shall these exceed 150 microns for surfaces profiles of 75-115 microns and 100 microns for surfaces profiles of 50-75 microns.

The surfaces of steel shall, after completion of the blasting process, be cleaned using stiff bristle brushes or be air-blasted or vacuum cleaned to ensure that all traces of abrasive material and blast-cleaning products are removed.

If oil or grease gets on the surface of steel after blast-cleaning, then the oil or grease shall be removed by washing with an emulsion cleaner and the surface thoroughly rinsed with clean fresh non-saline water and dried. The surfaces shall then be blast-cleaned again to the specified standard.

Surface preparation operations for coating shall be terminated early enough during the day to permit application of the adopted primer on the prepared surface within daylight hours. The primer or first coat shall be applied as soon as possible, and not later than 4 hours after commencement of surface preparation and before any deterioration or contamination occurs of the cleaned surface. In the case of sprayed metal coatings, the first coat shall be applied as soon as possible and not later than 2 hours after commencement of surface preparation.

10.16.6. Preparation and Priming of Non-Ferrous and Stainless Steel Metal Surfaces

Any oil, grease or lubricant shall be removed by washing with an emulsion detergent cleaner followed by thorough rinsing with clean, fresh, non-saline water followed by drying. Degreasing by solvent washing is not allowed unless it is followed by the above mentioned emulsion cleaning. Dirt, adherent matter and corrosion products (such as form on zinc and aluminium surfaces) shall be removed by light abrasion in conjunction with washing and rinsing with clean, fresh non-saline water followed by drying. Non-metallic inert abrasives shall be used such as fine abrasive paper, nylon pads or stiff brushes. Metal wire wool or wire brushes shall not be used.

Prior to priming, the surface shall be keyed either by light abrasion or light (sweep) blasting using non-metallic materials which are free from chlorides, copper and iron. This does not apply to matt or porous surfaces such as are produced by metal spraying or electrolytic deposition where the primer can be applied directly. In case of thin metallic coatings eg galvanised or metal spray, particular care shall be taken not to damage or deplete the coating. Surfaces which are too thin for blasting techniques shall be prepared as recommended by the coating manufacturer.

Before priming (or sealing as in the case of metal spray surfaces), the surface shall be perfectly clean, dry and in the correct environmental conditions as specified in section 2.1. The primer used shall meet the coating manufacturers recommendations for the particular non-ferrous metal surface to be coated. Oil/alkyd based primers are not to be used on zinc surfaces where the alkaline conditions at the zinc/coating interface can cause saponification and coating failure.

Noble metal trim that is to be coated with High Build Epoxy shall be prepared to the requirements stated in Section 3.22.1

10.16.7. Machined Surfaces

Machined parts, where immediate protective coating is not required, shall be coated with two coats of an anti-rust solution which can be removed easily when required. Permanently bolted machined interfaces, such as flanges, shall be coated with a thin coat of anti-rust compound before assembly.

10.16.8. Preparation of Other Precoated Surfaces

If, with the approval of the Engineer, an item has been supplied in its intermediate coating prior to installation, then the Coating Manufacturer's recommendations, with the approval of the Engineer, shall be followed with regard to surface preparation prior to the application of the top coat.

10.16.9. Preparation by Power Tools

Surfaces to be prepared by power tools shall be degreased as per Section 3.22.1.2(a) prior to any surface preparation. The surface preparation shall be such that, at the end of the operation, the surfaces are completely dry and free of grease and contamination.

Surface cleaning by power tools shall follow the recommendations of BS 7079 and shall be cleaned to ISO 8501-1 Grade St 3. Preparation by power tools shall not burnish the surface.

Any resulting loose material shall be removed by brushing, vacuum cleaning, or blasting with clean, dry, oil-free compressed air. Reference photographs shall then be taken prior to the application of any coating.

Surfaces prepared by power tools shall be primed by a surface tolerant epoxy primer

10.16.10. General Requirements for Coating Systems

The majority of coating systems are conventional liquid applied coating systems and the requirements set out in this specification relate strongly to the associated standard painting schemes. Attention is drawn to the following specialist coating systems:

Two pack solvent-free polyurethane
Vinyl ester with glass flake pigment
Extruded polyethylene
Vulcanised rubber
Fusion bonded epoxy

These systems are expected to have specific additional requirements and shall only be applied by specialist staff who have experience in applying these systems and who are approved by the coating manufacturer. Particular attention shall be paid to the Coating Manufacturers recommendations for application, inspection and testing, and repair method. Fully detailed vendor data as detailed below shall be submitted for Engineer review and approval prior to item manufacture.

In the case of coatings being applied by the Vendor or his Subcontractors, the Vendor shall maintain all documentation related to the purchase, storage and use of materials with reference made to the product type, material test certificates and storage life.

The Vendor shall submit fully detailed surface preparation and coating procedures to the Contractor for approval before commencing the coating operations which shall include the following information for each coating system as a minimum:

- Description of the items and substrates to be prepared and coated
- Description of the general application conditions at the coating site
- Method, equipment and abrasives for surface preparation
- Standard of surface cleanliness and surface profile
- Ranges of temperature, relative humidity and control methods
- Method and equipment for coating application
- Time between surface preparation and first coat
- Minimum and maximum dry film thickness of a single coat
- Number of coats and minimum total dry film thickness
- Relevant dry characteristics e.g. recoatability in relation to temperature and relative humidity
- Procedure for repair of damaged coatings
- Methods and frequency of inspection and testing
- Coating Manufacturers' technical data/application sheets
- Colour of each coat
- Potable water certification, where applicable the Coating Manufacturers' approval to apply specialist coating systems an Inspection and Test plan
- Cathodic disbondment test results (where applicable)

Zinc rich epoxy primers shall be based on 2-pack epoxy media, shall contain a minimum of 91% metallic zinc by weight in the dry film, and shall comply with the requirements of BS 4652 'Metallic Zinc-Rich Priming Paint (Organic Media)'.

Ethyl zinc silicate primer shall contain a minimum of 85% metallic zinc by weight in the dry film and shall comply with the requirements of Type 1 of SSPC Paint 20.

All coating used on any part of the plant in contact with water shall be non-toxic, non-carcinogenic, not impart taste, odour, or turbidity to the water or foster microbial growth.

To avoid the possibility of the presence of the carcinogenic polyaromatic hydrocarbons, all bituminous paints and coatings coming in contact with the water must be manufactured from petroleum or asphaltic bitumen, and not from Coal-Tar bitumen.

Lead based paint shall not be used.

All materials coming into contact with the conveyed water shall have current potable water certification from recognised certification authority.

Coatings used together with cathodic protection systems shall meet the cathodic disbondment criterion of the British Gas Corporation standard PS/CW6 when tested under conditions equivalent to Appendix F of that standard.

All coating materials shall be purchased from Coating Manufacturers well established in the manufacture of high performance coating materials for large projects for a period of at least ten years and all materials shall have a proven track record of at least five years. All coatings within a system shall be purchased from a single Coating Manufacturer to ensure compatibility.

All epoxy coatings shall be based on 2-pack formulations (apart from FBE) and all solvent based polyurethane top coats shall be 2-pack polyurethane acrylic formulations.

Special attention shall be paid to the design of e.g. valves, pumps, vessels, to ensure that all wetted surfaces can be properly prepared and effectively sealed by coating.

10.16.11. Coating Containers

All coatings shall be delivered in containers sealed by the Coating Manufacturer.

The name of the Coating Manufacturer, colour, type of coating, batch number shelf life and information regarding special storage requirements shall be clearly shown on each container. The markings on the containers shall clearly identify coating prepared with a special consistency for spray application.

The capacity of containers for single pack coating shall generally not exceed 5 litres. Single pack coating shall only be delivered in containers larger than 5 litres when the Coating Manufacturer has demonstrated that the method of preparing and applying coating delivered in larger containers is satisfactory. Zinc-rich coatings shall not be supplied in containers larger than 5 litres.

Two-pack coatings shall be supplied in kits by the Coating Manufacturer in sealed containers. Each kit shall have sufficient materials for a full batch of coating.

10.16.12. Storage of Coatings and other Materials

Coatings shall be stored under cover, in conditions as recommended by the Coating Manufacturer.

Coatings shall be stored in such a manner that each batch can be issued for use in the order of delivery.

A separate store shall be provided for cleaning solvents used for brush or other cleaning purposes. They shall not be stored where coatings or coating thinners are stored or where coatings are prepared for application.

Coatings with a limited safe shelf life shall not be used after the expiry date shown on the container.

Any coating which has "livered" or gelled or otherwise deteriorated in storage shall not be used. Thixotropic materials which may be stirred to obtain normal consistency are not subject to this restriction. Suspect materials shall either be rejected or referred to the Coating Manufacturer.

10.16.13. Preparation of Coatings for Use

Coatings shall only be prepared for use as recommended by the Coating Manufacturer.

All single pack coating, which is not to be applied by spray, shall be prepared before it leaves the store and no adjustment shall be permitted to coating in painter's kettles or other containers used in the application process.

Two-pack coatings and/or coatings for spray application may be prepared adjacent to the location where the coating work is to be carried out.

Mechanical mixing of coatings shall be by means of mechanical high-speed shakers or rotary mixers fitted with a flat blade and speed control.

All coatings shall be mixed to an even consistency before being used. Coatings shall not be used unless all the pigment, including that which requires to be loosened from the bottom of the containers, has been dispersed evenly throughout the coating.

Thinners shall not be added to a coating unless their use is in accordance with the Coating Manufacturer's recommendations.

Two-pack coatings shall be mixed in strict accordance with the Coating Manufacturer's instructions, immediately before application and batches shall be mixed using the full contents of the containers. The size of containers shall ensure a correctly proportioned mixture when the whole contents of the appropriate containers are used.

The pot life of the coatings shall be specifically noted and any mixed coating which has exceeded its pot life shall be discarded irrespective of its apparent condition. pots, containers and spay equipment shall be cleaned out and a fresh batch of coating prepared.

10.16.14. Certification

The Vendor shall furnish to the Contractor certificates of compliance showing that all batches of all coatings meet all the requirements defined in this Specification. All material certificates shall comply with DIN 50049, inspection certificate 3.1 B.

10.16.15. Colours and Tints

The colour of the undercoats shall contrast with the colour of the next coat so that each stage of work can be readily identified.

10.17. Particular Coating Requirements

10.17.1. Vinyl Ester Glass Flake

In addition to the requirements stated in this document, the glass flake shall have a maximum diameter of 0.365 mm.

10.17.2. Extruded Polyethylene

A UV stabilised grade, type S (special)-n (normal) to DIN 30670 of extruded polyethylene shall be used, with a softening point of between 120 and 130 EC. Softening point of extruded polyethylene to be Vicat test to BS 2782 Part 1 : 1990 method 120A.

10.17.3. Vulcanised Rubber

The rubber used for lining valves shall be a polyisoprene based ebonite, with WRC approval. The hardness shall be 60 to 75 Shore 'D'.

10.17.4. Fusion Bonded Epoxy

Materials shall conform to WIS 4-52-01:The use of polymeric anti-corrosion (barrier) coatings.

10.17.5. Cementitious Modified Polymer

Cements used shall comply with BS 12 Specification for Portland Cement.

Materials shall be based on a cementations modified styrene acrylic copolymer such as Liquid Plastics Flexcrete FCR 8951.

10.18. Coating Application

10.18.1. General

Environmental conditions during coating application shall be in accordance with the requirements of Section 3.22.1.1 of this Specification.

Adequate ventilation shall be provided during coating application. Respirators shall be worn by all persons engaged in spray coating. Adjacent areas shall be protected by the use of drop cloths or other approved precautionary measures.

At the time of application, coating shall show no signs of deterioration and the suspension of pigments shall remain uniform.

All coatings shall be applied by personnel approved by the Vendor in the application of that particular coating.

The method of application of coating shall be executed in accordance with the Coating Manufacturer's recommendations. In case of conflict between this Specification and the Coating Manufacturer's recommendations, the latter shall apply.

Special precautions to avoid over thickness shall be adopted when zinc silicate primers are being applied.

The pressure and volume of the compressed air used for spray application shall meet the work requirement and be free from oil and water contamination. Traps, separators and filters shall be emptied and cleaned regularly.

Brush application shall be used where spray application cannot be employed e.g. surfaces not accessible to the spray gun or for cutting in at edges and similar locations.

Each coat shall be applied in a continuous, even layer free of runs, sags, missed areas, holidays, pinholes or any other defect. Each area which has not been properly coated or missed shall be recoated. The exception is thickly applied, 100% solids coatings such as two-pack solvent-free polyurethane and vinyl ester with glass flake where minor runs and sags are not detrimental to coating performance and may remain unless unacceptable for cosmetic reasons.

Surfaces inaccessible after assembly shall be prepared and fully coated prior to assembly.

All ferrous metal surfaces to be insulated shall be prepared and fully coated prior to application of insulation. Metal surfaces of anodised aluminium, stainless steel, chromium plate, copper and bronze and similar finished materials shall not require finishing coating, unless otherwise indicated.

Parts of operating units (mechanical and electrical) such as valve and damper operating linkages, heat sinks, sensing devices, motor and fan shafts, shall not be coated unless otherwise specified.

Any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating name or nomenclature plates shall not be coated.

In situations where the build up of static electricity may affect the quality of the paint finish, the spraying equipment and component being sprayed shall be adequately earthed.

10.18.2. Joint and Tape Wrapping

The joints of pipes and fittings protected by wrapping shall be cleaned, coated with primer solution, profiled with mastic and wrapped with tape in accordance with the following requirements or other alternative Engineer approved joint protection system.

(c) Primer

A bitumen solution shall be applied to the cleaned surfaces of the joint to provide a continuous coat of well adhered primer.

(d) Mastic

The mastic shall be a non-setting material, impervious to moisture and resistant to mineral acids, alkalis, salts and temperatures up to 70 degrees centigrade. It shall be approved for use with potable water applications.

(e) Tape

Cold applied self adhesive tropicalised UV stabilised bituminous laminate PVC backed tape having a minimum thickness of 1.65 mm and spirally wound to give a 55% overlap.

Pipework to be tape wrapped shall be precoated.

Tape wrapping of pipework shall conform to AWWA C209. If there is disagreement between this Specification and the requirements of the Standard, then the requirements of the standard shall be followed after prior approval by the Engineer.

10.18.3. Brush Coating

Brushes shall comply with the requirements of BS 2992 where appropriate. Brushes shall be in good conditions and be of the correct type and size to suit the type of coating, and the surface being coated.

10.18.4. Spray Coating

The recommendations on spraying made by the Coating Manufacturers shall be followed.

Spray equipment, especially spray guns using compressed air, shall not be used in locations where over-spray, rebound, drift or spray mist causes a nuisance in the vicinity of the spraying operations.

For "Hi-build" coatings, where airless spray coating is specified by the Coating Manufacturer, alternative methods of application shall not be acceptable.

10.18.5. Galvanising

Hot dip galvanising shall conform to the requirements of BS 729 or ASTM A153. Continuous hot dip galvanising of sheet steel shall follow the recommendations of BS 2989.

The minimum weights of galvanised coating are:

Buried orifice plates	1000 g/m^2
Sheet steel for ducting	275 g/m^2
Orifice plates in chambers	610 g/m^2
Air and vent pipework	610 g/m^2
Compressed air pipework	610 g/m^2
Cable tray, trunking, and conduit	610 g/m^2
Firefighting pipework and fittings	610 g/m^2

Surface preparation of galvanised surfaces prior to coating shall be by the use of flash blasting using an abrasive free from iron, copper and chloride or prepared as per Coating Manufacturer's recommendations for overcoating galvanising.

Threaded fasteners including washers, excluding those in contact with fuel, oil, shall be hot dip galvanised in accordance with BS 729 or ASTM 153 to give a minimum zinc coating weight of 305 g/m^2 of galvanised surface.

Hot dip to BS 729 or ASTM 153 shall be carried out after completion of all welding, drilling, grinding and other fabrication activities associated with the items to be galvanised. In particular welding of galvanised items after galvanising is not permitted. All galvanising shall be applied by the hot-dip process with spelter, of which not less than 98.5% by weight of zinc shall be pure zinc. The zinc coating shall be uniform, clean, and smooth.

No parts likely to come in subsequent contact with fuel oil shall be galvanised.

All galvanised parts shall be protected from damage to the zinc coating due to poorly ventilated damp conditions and abrasion during the periods of transit, storage and erection.

Galvanised parts shall be overcoated.

10.18.6. Metal Spray

Sprayed zinc coatings shall comply with BS 2569 Part 1. The minimum thickness of the coating, unless otherwise specified, shall be 250 microns. The coating shall be sprayed in multiple passes with each one at right angles to the previous one (at least two passes on every part of the item).

Metal spraying and overcoating shall only be carried out by specialist Subcontractors equipped to apply the full protective treatment. The specialist Subcontractors shall be subject to approval by the Contractor.

Zinc sprayed surfaces shall be sealed within 4 hours with an epoxy seal coating system

10.18.7. Cement Mortar Lining

Cement Mortar lining of factory finished steel pipes and fittings shall comply with the requirements of Section 29 of BS 534.

Cement Mortar lining of ferrous items exposed to water shall have hand rendered coatings in compliance with the composition, curing, finishing and inspection and testing requirements of Section 29 of BS 534. The lining shall only be applied by specialist Sub-contractors who are fully equipped for this type of application.

The cement and coating shall be ordinary Portland Cement to BS 12 or ASTM C150 (type II). Single thickness coating shall be to BS 534 in pipes where the coating is applied by centrifugal spinning.

Surfaces of spigot and socket joint portions and flange faces shall be free from cement mortar to permit jointing of pipes and fittings.

10.18.8. Miscellaneous

Colour code marking for piping systems shall be provided as directed. Marking shall be by coloured, pressure-sensitive adhesive tape, and flexible pipe marker or coating.

Lettering shall be black enamel water-type decalcomania, finished with a protective coating of spar varnish. Samples shall be approved before application.

All erection markings shall be clearly legible afterwards. The integrity of the material to be coated must not be altered by the cleaning and coating process.

10.18.9. Manufacturer's Standard Finishes

Manufacturer's Standard Finishes shall comply with this Specification.

Special care shall be taken to ensure standard finishes are suitable for the particular conditions applicable to the individual items of plant.

10.19. Coating Application

10.19.1. General

Equipment which has been delivered for coating on-site shall be cleaned and coated according to this specification and with the required coating. Surfaces which are delivered to site coated with a transit primer (e.g. blast, holding, shop or prefabrication primer), shall have the transit primer removed prior to surface preparation and application of the permanent coating system.

10.19.2. Coating Repair

(a) General

Coating repairs shall be done in accordance with the recommendations of the Coating Manufacturer utilising materials from the same Coating Manufacturer. The Coating Manufacturer's recommendations shall be followed at all times.

Damage to each coat of coating, whether shop or field applied shall be repaired before succeeding coats of coating are applied. The repair to the coating shall reinstate completely the original coating system, including the surface preparation quality

The extent of repair to the damaged area shall extend 50mm into the sound coating. If the substrate is exposed the surface shall be prepared by spot blasting back to the substrate, feathering the sound coating and removing any signs of oxidation on any exposed bare metal.

If the substrate has not been exposed then the area of the damage shall be lightly abraded to remove evidence of the damage and the individual coats reapplied to give the correct final minimum dft.

Prior to the mechanical preparation and application of primer the metal surface and feathered area of undamaged coating shall be detergent cleaned and thoroughly washed with clean fresh non-saline water to remove all soluble salts and dried in a manner which shall not re-deposit contaminants on to the cleaned surfaces.

The coating used shall be as originally specified or shall be compatible with the original coating system and surface preparation technique.

(b) Hot Dipped Galvanised Surfaces

The repair of minor scratches or scuffed areas where the steel substrate has not been exposed shall be carried out in accordance with the requirements of BS 729 Appendix-D. The surface shall be detergent cleaned and washed with clean fresh non-saline water followed by light spot blasting to obtain a surface finish with a surface profile of 20 to 30 microns and using the two pack metallic zinc rich epoxy primer defined therein, which shall be applied in at least two coats to a minimum dry film thickness to equal that of the original coating.

Major damage as defined by BS 729 Appendix D shall require regalvanising or else repairing by a procedure approved by the Engineer.

(c) Metal Sprayed Surfaces

Minor scratches or scuffed areas where the steel surface is not exposed and the metal spray thickness is above the minimum specified thickness shall be degreased, cleaned and dried as per section 2.3 and recoated with the same overcoat as originally installed according to the Coating Manufacturers recommendations.

Major damage where the steel surface is exposed or the metal coating is below the specified minimum thickness shall have the damaged coating removed and the substrate prepared and the metal sprayed coating reinstated as originally specified. This repair shall be carried out by specialist Subcontractors.

(d) Cement Mortar Linings

Damaged coatings shall be removed to expose sound coating at least 25mm around the damaged area. The exposed area shall be thoroughly degreased and rinsed with clean fresh non-saline water and dried thoroughly.

The surface shall be lightly abraded and new mortar, mixed to the same cement sand ratio of the original coat, shall be applied by trowel to the cleaned exposed area to reinstate the required coating thickness.

10.20. Inspection and Testing

(a) General

All coating work, achieved in accordance with this Specification, is subject to inspection. Each phase of the work shall be inspected. Unacceptable conditions shall be corrected, reinspected and accepted before proceeding to the next phase. The level of inspection by the Vendor or his Subcontractors shall be 'full' as defined in BS 5493. All Vendors shall submit an inspection and test plan for the coating operations.

All tape wrapped pipe shall be inspected in accordance with AWWA-C209 Section 4.

Vulcanised rubber coatings shall be inspected and tested in accordance with Sections 5 and 6 of BS 6374 Part 5 and shall be subjected to 100% visual inspection.

Cement mortar/concrete linings of pipes and steel fittings shall be inspected and tested in accordance with Section 29 and of BS 534.

Extruded Polyethylene coatings shall be inspected and tested in accordance with DIN 30670.

(b) Environment

Accurate daily records shall be kept of air and surface temperatures, dew point and relative humidity conditions and the times of commencement and cessation of all phases of the cleaning, surface preparation and coating operation. These records shall be available for review.

Relative humidity shall be measured with a sling hygrometer. Air and surface temperatures, dew point and relative humidity shall be measured prior to commencement of surface preparation and/or coating and a minimum total of 4 times during a normal working shift and the results recorded. Work shall not be undertaken unless the results obtained are within the limits of this Specification.

(c) Surface Preparation

All surfaces shall be inspected visually to ensure compliance with the requirements of this Specification and the results recorded. The surface profile of abrasive blast cleaned steel shall be measured after preparation using replica tape and a portable micrometer. A minimum of one measurement or impression shall be made per square metre of prepared surface and the results recorded.

(d) Dry Film Thickness

The film thickness of each coat, and the total dry film thickness, shall be measured and all results recorded.

As a general rule the dry film thickness shall not exceed the specified minimum dry film thickness by more than 25%. Surfaces with coating film thicknesses below that specified, shall receive additional coat(s) of coating, as recommended by Coating Manufacturer, to obtain specified thickness. The dry film thickness shall not be below that specified.

Where the quality of film is impaired by excess film thickness, (e.g. wrinkling, mud cracking or general softness), the unsatisfactory coating shall be removed and re-coated in accordance with this Specification.

The thickness of dry coating films shall be measured by means of a suitable, properly calibrated electronic thickness gauges with an accuracy of at least +/- 10% of the measured thickness, as specified in BS 3900 part C5, method No. 6.

On substrates where electronic thickness gauges cannot be used or on coatings where the over coating times are too short to permit the use of electronic thickness gauges, the dry film thickness shall be estimated from wet film thickness measurements used by comb or wheel gauges as specified in BS 3900 part C5 method No. C7.

Measurements shall be recorded in the daily inspection reports. A minimum of two measurements per square metre for each coating is considered an appropriate reading frequency. Records shall be maintained of all thickness tests carried out along with the records of the coating system batch number, and dates of purchase, application, and shelf life.

10.20.1. Holiday Detection

All buried and wetted coatings shall be subjected to 100% holiday detection after final cure of the coating system. Tanks and pipework to be buried shall be subjected to 100% holiday detection immediately prior to burial. The method of holiday testing shall be as specified by the Coating Manufacturer.

The voltage applied shall be as specified by the Coating Manufacturer for that coating system. All defects found shall be marked, repaired and retested.

All results shall be recorded in the daily inspection reports.

10.20.2. Coating Adhesion

The adhesion of all buried and wetted coatings shall be measured using an Elcometer adhesion tester, or equivalent, to BS EN 24624, or equivalent test method, after final cure of the coating system. Since this test can be a destructive test, the coating adhesion shall be measured on test plates of the same material as the substrate being coated, which have been prepared and coated in an identical fashion to, and at the same time as, the surfaces being coated. A test plate shall be prepared for each item to be coated or at least for every 25 square metres of coated area.

At least three adhesion tests shall be carried out per test plate with the coating fully cut down to the substrate around the circumference of the dolly before testing. The minimum adhesion strengths shall meet the requirements of the Coating Manufacturer and shall not be less than 0.42 kg/mm^2.

If the adhesion test result on a test plate is below that specified for that particular coating system, the coating on the entire area to which the test plate relates shall be completely

removed to bare metal and the surface be re-prepared and the complete coating system reinstated and reinspected in accordance with the requirements of this Specification. All results shall be recorded in the daily inspection reports.

10.20.3. Reports

All inspection results and records shall be written up into daily reports for the applied coating system.

10.21. Lighting Requirements

The lighting requirements shall follow the recommendations of the CIBSE Code for Interior Lighting 1984 (1989) lamps of colour rendering group 1A shall be used and the recommendations of BS 950 shall be followed as appropriate. An illuminance of at least 500 lux shall be provided on the task.

10.22. Cleaning

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day.

Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner, coating and other deposits upon adjacent surfaces shall be removed and the entire job left clean and acceptable.

10.23. Health and Safety

In addition to complying with all relevant statutory regulations, all precautions that are necessary to avoid health and safety risks, either to operators or to personnel working in the areas concerned, shall also be undertaken.

Where air operated equipment is used, operators shall be provided with hoods supplied with a filtered clean cool air supply to prevent blasting and coating residues being inhaled. It shall be noted that coatings containing inflammable solvents, and applied in enclosed or confined spaces, present hazards and precautions must be taken to eliminate any danger. To avoid the explosion hazard, sufficient ventilation air must be provided to maintain the ratio of vapour/air at no more than 10% of the lower explosive limit. Data on minimum ventilation air quantity is given in the product data sheets. Similarly, to avoid the toxic hazards present in many coating solvents, sufficient ventilation air must be provided. Data shall be provided by the Coating Manufacturer, setting out the basic safety precautions.

10.24. Floor Trench Covers, Chequer Plate and Flooring

Unless otherwise specified, pipes and cables are to be laid in ducts below the finished floor level. The ducts shall be covered with steel plates with diamond chequering or other approved non-slip pattern, or with egg crate flooring. The plates or flooring sections shall be of sufficient thickness not to bend or spring in ordinary usage and shall fit evenly and truly into steel angle frames or kerbing with suitable attachments for building into the concrete floor.

The Contractor shall supply complete drawings showing the arrangement of trenches, chequer plates and egg crate flooring sections, fully dimensioned so that the trenches can be formed and the kerbs built into the floor by the civil works Contractor. The plates and flooring sections shall be divided into suitable sizes and lengths for lifting, with two holes in each section. One set of lifting keys shall also be supplied at each location.

10.25. Foundation Bolts and Fixing Arrangements

All foundation bolts and fixing bolts required to secure the items to be supplied and erected under this Contract shall be provided.

The Contractor shall provide, within the time(s) specified, dimensioned foundation drawings showing the type of foundation or fixing required for each item of plant. The Contractor shall state the mechanical strength of large fixing bolts, which shall be of an approved size and diameter, galvanized where not embedded in concrete, with galvanized nuts and washers.

10.26. Brackets, Fixings, Anchor Points and Pipe and Valve Supports

All brackets, hangers and fixings, anchor points and supports for the satisfactory installation of all pipework, valves and other equipment shall be supplied and erected. The supports shall prevent excessive movement of the pipework and eliminate extraneous stress on pump casings and other items of plant.

Where pipe and valve supports or anchors at attached to structures, the loadings imposed at the point of attachment shall be stated by the Contractor on submission of the relevant foundation drawings and approved by the Engineer.

All necessary nuts, bolts and washers for such fixings shall be included.

10.27. Guarding and Protection of Moving Parts

Moving parts of machinery including all shafts, couplings, collars, projecting key heads, gear wheels, belt drives, chain drives and all other moving machinery shall be guarded where necessary to give complete protection to operating personnel. All set screw on revolving shafts shall be countersunk or suitably protected. Guards shall be of an approved design, fitted where necessary with inspection doors. All guards shall be arranged so that they can be removed without disturbing the parts of the equipment they protect. Guards for shaft couplings shall at least be equal to BS 5304.

10.28. Schedule of Tests

10.28.1. General

As many tests as possible shall be arranged together. Five copies of the Contractor's records of all tests shall be furnished to the Engineer.

All material which is specified for tests at the manufacturer's works must satisfactorily pass such tests before being painted or otherwise coated.

All test instruments, fuels and consumables required for the tests, commissioning and setting to work the Plant shall be supplied by the Contractor. Test instruments and shall be to approval and shall be calibrated by a competent authority as may be approved by the Engineer.

10.28.2. Tests at Manufacturer's Works

The mechanical equipment supplied under this Contract will be tested to prove compliance with the requirements of this Specification and with the relevant British Standard specification where applicable.

10.28.3. Tests after Erection on Site

All Plant shall pass such tests on site as are required by the Engineer to prove compliance with the Contract independently of any tests which may already have been carried out at the

Manufacturer's Works. In particular, all pump performance tests made at the Manufacturer's Works shall be repeated.

If, in the opinion of the Engineer, the Plant does not comply with this specification, the defect shall be rectified at no cost to the Employer.

10.29. Instrumentation and Control

10.29.1. Design and Electromagnetic Compatibility

All circuits and equipment shall be designed in accordance with good engineering practices and particular care should be taken to ensure that no component shall exceed its maximum voltage/current/power ratings at any time, including during transient surges.

All instrumentation equipment shall be protected from interference emanating from radio frequency transmissions, either radiated or cable borne, such that it shall not cause malfunction of the system or damage to the components.

All equipment supplied shall not radiate any form of electromagnetic energy in amounts that might interfere with external equipment or instrumentation.

The latest standards on interference shall be followed and the principles of electromagnetic compatibility (EMC) applied to the design and application of the plant.

10.29.2. Interrelation with Other Sections

Requirements given in other sections shall be applicable whether relevant to equipment or materials specified in this Section.

Thus indicator gauges, metres, enclosures, panel construction, finish, components, wiring, terminations, cabling requirements and environmental operating conditions shall be in accordance with the relevant clauses of the Mechanical and Electrical Sections unless specifically amended in this Section.

10.29.3. Interrelation with other Contracts

Where the location, installation or connection of any components of instrumentation are arranged by the Engineer under other contracts, it shall be the responsibility of the Instrumentation Contractor to advise and provide all relevant information on such matters to the Engineer in order that the correct and proper performance of the Contractors instrumentation is not prevented or impaired.

10.29.4. Temperature and Humidity

All supplied equipment shall function without error and shall be constructed of such materials or so treated as to prevent the formation of mould, fungus or any corrosion over the ranges of temperature and relative humidity specified in the specific clauses for this site.

10.29.5. Enclosure Protection

Instrumentation and hardware mounted in the field shall be contained in suitable enclosures to provide ingress protection to BS EN 60529 rating IP54 indoors and IP65 outdoors as a minimum. Sensors installed below water level or liable to submersion shall be rated IP 68. Where items are fitted in a panel or other enclosure, they shall preserve the design IP rating of that enclosure.

10.29.6. Voltage and Frequency Tolerance

Equipment shall be capable of working from a supply whose voltage may vary ±15% and tolerate any transients that could be experienced in such an environment without programme corruption or system failure.

10.29.7. Instruments

Each instrument and sensor shall be selected considering all the relevant performance parameters for the principle of measurement adopted, its intended use and the particular process in question.

All instrument output signals shall be volt-free, clean contacts rated at 220V AC 2A for digital and 4-20mA continuous proportional linear signal for analogue. Pulsed outputs suitable for integration counter drives shall be 24V DC.

10.29.8. Inputs, Outputs and Signal Loops

Opto-isolation shall be provided on all input interfaces to card.

Digital signals shall be 24V DC with the power supply from either the associated power pack or the external instrument. Relays shall be used where more than one instrument including I/O are fed from a single signal.

Analogue signal shall be continuous linear scaled signals with a 4-20 mA operating range. Loops with instruments wired in series (e.g. panel mounted indicator and RTU input) shall have zener fitted across each subsequent instrument leg to ensure loop integrity.

10.29.9. Terminals

Signal terminals shall be the disconnect type. Power supply terminals shall be shrouded and clearly marked with the appropriate warning tags. LED's shall be provided for fault tracing, if not supplied on the I/O cards. LED's in either case must be clearly visible from the front, with only the enclosure door open.

For each incoming screened cable, a separate earth terminal shall be provided for screen termination to earth.

All equipment, isolators, terminals and cables shall be clearly marked. 20% spare terminals shall be provided.

10.29.10. Programming and Monitoring Unit

Hand-held portable devices shall be provided for the system allowing user configurable operation to enable the downloading or uploading of data or software and the local running of diagnostic software. For RTU plc's the device shall be fully compatible with the RTU and shall be supplied with:

- Software to enable the development of programmes and the subsequent downloading to the RTU.
- Software to enable full communications with the RTU and to:
- upload data or alter data in the RTU;
- access communications ports and I/O.
- Full page process mimic display capability.

10.29.11. Discrete Components

All discrete resistors, capacitors, switches, relays, diodes, transistors and other electronic devices shall comply with the BS 9000 series specification for components of assessed quality.

The Engineer's agreement must be sought before using components that are not certified, but it will remain the Contractor's responsibility to ensure that all components are suitable for the application.

Similar types of components shall be of the same manufacture and design wherever possible.

10.29.12. Integrated Circuits

All integrated circuits shall be of a proven design and shall be clearly marked with the original manufacturer's identity and device number.

10.29.13. Sub-Miniature Switches

Where DIL or other sub-miniature switches are used they shall be provided with a cover, or other means of protection, to prevent accidental switching during handling.

10.29.14. Printed Circuit Boards

Printed circuit boards shall be made of glass fibre with copper trackwork, all exposed copper being tinned prior to assembly, and the board and components cleared of flux before a thin layer of clear varnish is applied for environmental protection.

The board and its components shall be identified by references relating to the corresponding circuit diagram which shall be printed on the component side of each board. Where a number of boards are mounted in a rack system, the rack and boards shall be clearly marked to identify each board to its particular position.

10.29.15. Sockets and Connectors

The use of plug-in connectors for electronic equipment shall be kept to a minimum, and all circuit components including integrated circuit clips shall have soldered connections where this is permitted by the chip manufacturer.

Where sockets and connectors are incorporated in the design, they shall have self-cleaning, hard gold alloy plated, wiping action contact faces, and incorporate polarizing keys or similar means to prevent incorrect mating. Insulation displacement type connectors shall not be used.

All light current wiring having a cross-section of 1.0mm2 or less shall have tinned copper conductors.

10.29.16. Test Facilities

The electronic equipment is to include built-in test facilities to permit the detection and replacement of faulty modules without the use of oscilloscopes, signal generators, or other sophisticated test equipment.

10.29.17. Surge Protection

All telecommunication lines, data and signal cables and other items of equipment external to the building environment prone to damage resulting from induced surges due to lightning discharges, shall be fitted with lightning surge protection barrier devices at each end of the line to suppress and divert any transients likely to cause damage to the connected equipment.

All surge diverters/lightning arrestors fitted to telecommunication lines shall be of a design approved by the telecommunications authority.

Surge protection units shall be un-fused, solid state devices, designed to limit the transient over-voltages to mot more than twice the normal working voltage of the line. They shall have low in-line resistance and automatically return to normal operation after diverting a surge.

The units shall have provision for either DIN rail or individual panel mounting or direct bolted connection to a suitable copper earth bar.

The location of the units shall be arranged such that the earth connection shall be routed clear of the protected signal cables and have short, straight connections without sharp bends to the main earth

points, using copper conductors not less than 16mm2 csa and not greater than 5 metres in length to provide a low impedance path.

Surge suppression devices to provide protection from mains switching or other supply network disturbances shall be incorporated or fitted to all sensitive monitoring or control devices. They shall be designed to filter un-wanted transients and limit the 'let-through' voltage to less than twice the working mains voltage, between all conductors and each conductor and earth. Protection monitoring status indication shall be fitted

10.30. Instrumentation

10.30.1. General

Indicating instruments shall show the specified measured values in either electro-mechanical or electronic and analogue or digital form, as defined in the Specific Requirements.

Wherever possible, panel mounting indicating instruments shall be of matching size, appearance and orientation and suitably scaled, all in accordance with the general requirements for electrical panels.

10.30.2. ultrasonic Devices

Flow or level monitoring by non-contact ultrasonic measuring devices shall incorporate ambient temperature compensation and adjustable datum setting facilities. Where specified, the output shall be computed to give a flow reading for the given parameters and/or control of pumps.

Transducer

The sensor head shall be protected to IP68, mounted to provide an unhindered beam path, prevent unwanted reflections, within easy reach of maintenance personnel and, where possible, be clear of flood conditions. For sewer or foul pumping sumps, the units shall be certified intrinsically safe Ex (i) for use in hazardous areas.

Signal Converter

The converter shall be suitable for operation from the specified power supply and convert the signals received from the sensor head to a 4-20 mA signal proportional to the range specified, to be used as detailed in the Specific Requirements.

The converter shall comprise a base unit and a programming device, all in a polycarbonate enclosure to IP 65. Communication between the programmer and the signal converter shall be in such a manner that the IP rate is not prejudiced.

A minimum of 3½ digit liquid crystal display shall be used to indicate key programming features, settings and output conditions, including flow calculations to BS 3680 for flumes and weirs.

Accuracy of the signal converter shall be better than ±1% of reading and shall have the following programmable outputs:

- mA proportional to user definable engineering units.
- SPDT relay contact output closing upon failure of the signal converter,
- lost echo or multiple echoes.
- Off SPDT contact outputs with independently set trip points. These
- outputs shall be programmed to energise upon high/low levels, rate of change or to allow a number of pump sequencing operations. Contacts rated at 5A 240V ac, non-inductive.
- Serial ports RS 232 for down-loading data.

10.30.3. Electro-Magnetic Flow Meters

Electromagnetic Flow meters shall be sized and installed in accordance with the manufacturer's recommendations as approved by the Engineer, BS 5792 and BS 6739.

Flow meters shall be supplied with a calibration certificate. Electromagnetic flow meters shall be selected and sized to give a maximum velocity of between 1 and 7m/sec. The minimum velocity achieving the stated accuracy shall be not more than 0.1 m/sec.

The flow meters shall be of electromagnetic inductive type having a DC pulsed field with automatic zero error averaging and low power consumption. They shall have no moving or protruding parts nor cause any restriction in the flow path and be capable of setting adjustments without the need to stop the flow.

Each metering system shall comply with BS 5792 and comprise a flow sensor mounted in the pipework line and a signal converter, wither integrally mounted or remotely located preferably within the main control panel.

The system accuracy shall be a maximum at normal operating flow with an error not more than 1% of the reading. When operating in the lower 30% of the meter range, the accuracy shall be within ±3%.

Flow sensors - these shall comprise electrodes located in ammeter tube which shall be of watertight construction, suitable for operation without loss of accuracy when totally submerged to a depth of 3 metres.

The meter tubes shall be made from a non-magnetic material lined with an inert material suitable for the medium and fitted with flanges to suit the pipework system, the lining material being applied such that it extends from the bore of the tube to fully cover the raised face of the tube flanges.

The measuring electrodes shall be continuously cleaned by means which do not interrupt the process flow or the measurement. A sensing electrode shall also be provided to detect when the flow meter is not fully charged with liquid.

The flow meter body shall be effectively bonded by non-corrodible, tinned copper braid links at each end, to the adjacent pipework to ensure a good connection between the body and the metered liquid, an earthing flange being inserted where non-conducting pipework is employed.

<u>Signal Converter/Pulse Power Unit</u>

These units shall be suitable for operation from the flow sensor into output signals having the following features:

Single flow rate range adjuster suitable for the flow sensor.

Independent output signals shall be provided for each flow direction as follows:

- +5/0/-5 volts d.c. signal for telemetry purposes with magnitudes directly
- proportional to flow.
- 4-20 mA current signal, to be used for indication of flow, quantity, etc.
- 24V impulse for integration counter drive.
- Works presettable system response time.
- Output driven downscale to zero on receipt of a 'flow meter empty' signal from the liquid sensing electrode.

The transmitter shall have the following programmable outputs:

- mA, proportional to use definable engineering units.
- off multifunctional SPDT relays. Individually programmed to allow a number of sequencing operations, rate of change or high/low flow indication. Contacts rated at 5A 240V ac, non- inductive.
- Serial port RS 232 for down-loading data.

Flow Meter Cabling

Where remote mounted converters are specified, cables shall be provided, installed and terminated between the sensor and converter/pulse power unit for the following purposes.:

- flow signal;
- reference signal;
- coil supply;

Such cables and sealing glands shall be suitable for submersible operation of the sensor to the depth specified. The length of each cable shall be as specified.

Spool Piece: A flanged steel spool piece shall be provided of the same diameter and length as the respective flow meter and flanged for insertion in the pipe should it be necessary to remove the flow meter.

Isolating valves shall be provided on either side of the flow meter.

Differential Pressure Flow meters and Differential Pressure Switches

Flow meters of the differential pressure type shall be designed and installed in compliance with ISO 5167- 1 or an Approved Standard. Primary devices shall be insertion probe type or carrier-ring type orifice assemblies with stainless steel orifice plate, or venture tubes shall include two sets of gaskets and fixing bolts for each primary device. Gasket materials shall be appropriate to the metered fluid and service conditions. Full details of orifice or venturi tube calculations shall be supplied.

Orifices shall be square-edged and concentric. The upstream edges of orifices shall be sufficiently sharp that the reflection of a beam of light from the edge cannot be seen without magnification. Drain holes shall be provided. The diameter ratio shall be between 0.20 and 0.70. Orifice assemblies shall have identification tags showing the direction of flow, orifice diameter and position of drain hole. The identification tag shall be welded to the plat before the orifice is machined.

Insertion probe type installations shall follow the equipment manufacturer's recommendations. The probe shall be mounted to a standard sired ferrule or flange plate and include appropriate 3-way value block.

Differential pressure transmitters and switches shall have over-range protection up to 1.5 times the maximum line pressure.

Location of these devices should be such that no turbulence shall interfere with the measurement of pressure either side of the device.

Signal Converter

The sensor shall be of the inductive type giving an output of 4 -20 mA proportional and the flow rate and a totaliser. The sensor shall be protected to IP 66 and having the following characteristics:

- Accuracy: <±0,25% of FSD between 25 and 100% of the flow measured.
- Stability: 6 months period: ±0,25% of FSD
- Voltage supply: 200 Vac
- Sensitivity:0,005%/V at 50% flow and more

Differential pressure switches shall have contacts with differing "cut-in" and "cut-out" values. The nominal values at which differential pressure switches operate shall be fully adjustable over the whole range of the instrument and the set value shall be clearly indicated by means of a scale and pointer. Contacts of differential pressure switches shall be hermetically sealed.

10.30.4. Mechanical Flow Meters

Mechanical flow meter shall be volumetric, jet or in-line helical vane (Woltman) type to Standards ISO4064/BS 5728 EEC Specification with integral strainer. Meters shall be designed for minimum maintenance and shall incorporate best quality rotor bearings to ensure long working life.

Meter bodies shall be cast in spheroidal graphite iron to BS EN 1563. All internal parts shall be manufactured from non-corrodible materials.

Meters are for the measurement of potable water flow with a normal working temperature up to 30ºC and a maximum working pressure of 16 bar.

Meters shall be generally in accordance with the following Table:

Meter Size (mm)	Qmax: PEAK Instantaneous Flow (minutes only) (m^3/h)	Qn: MAXIMUM Continuous Flow At ±2% measuring Error (m^3/h)	Qmin: MINIMUM Flow at ±5% Measuring error (m^3/h)

15	3.0	1.5	0.036
20	5.0	2.5	0.050
25	7.0	3.5	0.082
32	10.0	4.5	0.127
40	20.0	6.5	0.182
50	80	40	0.55
80	200	120	0.70
100	250	180	1.20.
150	600	400	3.00
200	700	550	5.00
250	1200	750	10.00
300	1500	1000	12.00
400	3000	2000	25.00

Measurement mechanisms shall be removable from the meter body without the necessity to remove the meter from the main. Meters shall be equipped with a register indicating flow in metric units a sweep hand and six figure counter. Dummy cover plates to seal the meter after the mechanism removal shall be provided.

Tapers shall be provided, or non-standard bearings and propellers, if required, to obtain the specified degree of accuracy at the specified flow rates.

The meters shall be suitable for working pressures up to 16 bar unless otherwise stated.

An extension drive and extended head shall be fitted to meters as required. The drive shaft bearings and gears shall be designed for long life under continuous operation, and normal wear shall not significantly affect the accuracy of the meter.

Meters shall have a circular dial and rate of flow indicator registering flow in litres/sec. A flow totaliser having at least six digits shall be incorporated in the head. The totaliser shall have a capacity of at least one years flow at maximum flow rate. A multiplying factor in multiples of 10 may be used in conjunction with the totaliser if required, however, if this is the case, the factor shall be clearly marked alongside the register.

Meters shall be individually flow calibrated at the manufacturer’s works and shall be guaranteed to within 2% of true flow within the rated range of the meter. Each meter shall be supplied with a calibration certificate.

The spare parts shall include as a minimum spare gearing and bearings for each size of flow meter used.

ANNEX ON SEWER CONNECTION STRATEGY

1. PROJECT CONNECTION STRATEGY

Sewer Connection Strategy is proposed to be directly associated with the following stakeholders:

i. AWWDA
ii. Water Service Provider (WSP)
iii. County Government of Nairobi - Department of Planning
iv. County Departments of Public Health (PH)
v. National Environment Management Authority (NEMA)
vi. Plot Owners/Landlords/ Consumers
vii. MWSI
viii. Communities
ix. NGOs
x. CBOs
xi. Development partners

1.1 AWWDA General steps for the Connection Strategy

The strategy is proposed to be implemented through a 7 Step approach as described in the following sections. These include:

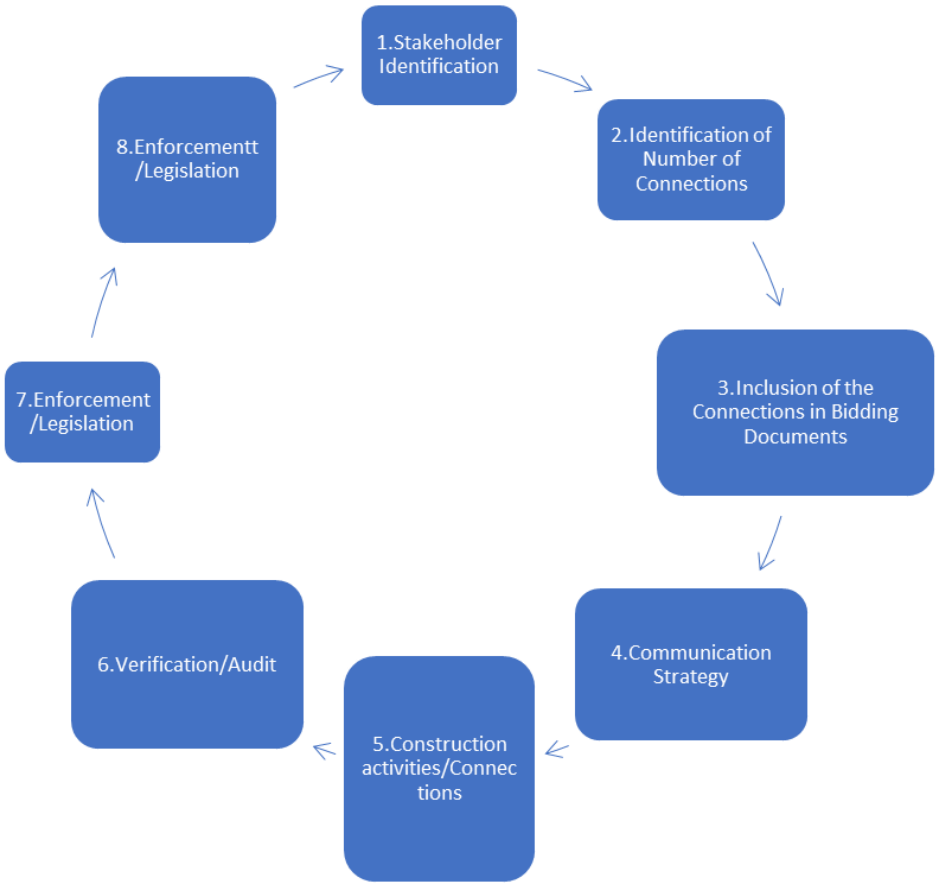


Figure 1: General Steps for connection

Detailed description of activities under each of the seven steps are as below.

1.1.1 Stakeholder Identification

Active stakeholder involvement at every stage is important. The five levels of participation are information, Consultation, Involvement, Collaboration and Empowerment. Among stakeholders - involved in Connection Strategy/Policy include the following;

i. Athi Water Works Development Agency (AWWDA)
ii. Water Service Provider (WSP)
iii. County Government Department of Planning
iv. County Departments of Public Health (PH)
v. National Environment Management Authority (NEMA)
vi. Resident Associations/Plot Owners/Landlords/ Consumers
vii. Private sector investors/development partners in the project areas including low-income areas private sanitation services providers

1.1.2 Identification of Numbers to be connected per phase/project.

The project area is identified jointly with the WSPs. The target number of Household connections envisaged is then proposed to be calculated as per the table below,

Target Area	Total 2019 Population(census)	Population within Project Area to be connected	Average No. of Persons / Household	Household sto b e connected,	Connectable Households (60%)	% of Households connectable	Actual No.of Household Connections
		A	B	C = A/B	D = C * 0.6	E	F = D * E

Assumptions;

- It has been assumed that only 60% of these households can be connected to the tertiary and secondary sewers due to their close proximity and accessibility. Additionally, some unfavorable factors such as ground terrain, topography, way leaves and the fact that some of the households have invested in septic tanks limit connectivity. (It is strongly advised that septic tanks be also connected to the sewer network)
- Out of the connectable Households (D above), only E% of the connections are likely to be implemented during the Construction Period. This E% is determined by the stakeholders among other factors such as available financing.
- Note;

  The designer to estimate the number of apartments to be connected per project by undertaking a reconnaissance survey to the project areas and referring to Census 2019 results on Distribution of Households and Tenure Status of Main Dwelling Unit by Area of Residence, County and Sub-County and any other relevant documents published by the government Bureau of Statistic.

  The project will provide an inspection chamber in properly planned areas with cadastral maps, clear land title demarcation and/or availability of land ownership documents. One inspection chamber can be utilized by more than one property depending on topography, location of property manholes and distance.

An apartment has several households with an average of up to 6 persons. The actual number of beneficiaries are therefore more than the number of inspection chambers hence need for accurate data gathering during implementation to determine number of households connected.

1.1.3 Inclusion of the target numbers in the bidding documents for all projects to be undertaken by AWWDA.

The envisaged numbers are designed and categorized as per the type of connections taking into consideration of the following categories;

Consumer Categorization Criteria		Category Description	How they will be affected in terms of connections
1.	Closeness to the Water & Sewer Lines	• Plot next to the Water/Sewer Line • Plot outside a 60m radius from the Sewer Line	• Costs-Consumers far from the sewer are likely to incur more connection costs than those near the sewer.
2.	Consumer Type	• Domestic • Institutions • Industrial • Commercial	The category of the consumers will determine the rate and costs for the connection and billing for the service.
3.	Socio-economic status.	• Informal Settlements • Low Income • Medium Income • High Income	• Property owners in areas with clear cadastral maps and land title demarcations shall be responsible for connections within the private property. Provision of an Inspection Chamber will be considered a complete connection and the utility will commence billing for the connection whether the property owner has connected to the chamber or not • Residents in the informal areas where they are no clear land demarcations, cadastral maps or ownership documents will be connected up to the communal sanitation facility within the project. Costs for the conversation of non-water borne facilities to water borne facilities will be included in the project
4.	Type of Sanitation Facilities	• Water Borne Sanitation System • On-site and offsite sanitation solutions • Others	• Connection methodology will be tailored for the different existing sanitation facilities.

Table 1: Categorization of Consumers

1.1.4 Communication Strategy (Sensitization)

The objective of the Sensitization Campaigns is to ensure that all key stakeholders are made aware of available water and sewerage infrastructure, procedures to be followed, roles of the stakeholders, benefits and importance to the general health and wellbeing of the populace.

Community Engagement and Sensitization is essential for successful implementation of the Connections Programme in the Project Area. AWWDA and respective WSP Community Liaison Teams are proposed to engage with communities from the onset of the Project to ensure that the community members are kept informed from the initial stage. This guarantees community buy-in to the project and safeguard the infrastructure during construction and after commissioning.

The Community Outreach consultant to be procured under the AFD projects will conduct sensitization activities prior to commencement of the works while under AFDB projects, the works supervision consultants shall undertake the sensitization activities as stipulated in their terms of references. The activities will be carried out in with close coordination of the AWWDA and the NCWSC project implementers.

Further, a household survey shall be conducted to determine the property type, number of households, property demarcation/availability of cadastral maps, the consumption levels of water, willingness to pay for water and sanitation services, attitudes towards water and sewer connections and other socio-economic parameters on the target areas. This assessment shall be incorporated as part of the connections program.

Global experience in the sector show that new systems need to be promoted effectively so that they are accepted by the community, operated and maintained properly. This generally requires an effective partnership between the utility and the community and enhanced awareness campaigns on

a) the socio-economic benefits of the water and sewerage systems,
b) legal provisions and risks if the property owners do not simply connect to the sewerage systems including the fact that the utility will continue to bill the property owner as long as the inspection chamber is built
c) the available options for the poor concerning provision of communal connections,
d) training and sensitization of the community-based organizations on proper management of the communal facilities
e) Implications associated with the community-based organization tasked with the management of the communal facility in the informal settlements not complying with the conditions set in the memorandum of understanding signed between the CBOs and the water utility NCWSC.

On the other hand, demand for sewer connection in slums is not generic and has to be created. Sewer connection uptake by low-income settlements in cities is always slow, and availability of connection prerequisites (Resources, materials, sanitation spots/latrines...etc.) largely lacking.

In this Strategy AWWDA/WSPs plan to address the critical step of household/ plot sewer connections by building a relationship between the Project Area residents and the respective WSP and providing Sanitation financing subsidies under the works contract for households that cannot afford the connection costs and lie in the informal settlements. This is not unusual, and experience shows that WSPs faces this challenge due to lack of active presence, conducive strategies, as well as inadequate policies to guide the connection process.

In terms of sewer connections, the aim of this initiative is to catalyze households in Project Areas to carry out latrine upgrading and apply for new sewer connections. This will mainly target

settlements where AWWDA/WSPs have established water networks and tertiary sewer network extensions.

The Community Engagement and Connections Promotion Activities are required to be carried out during the design and construction stage. This will also ensure that the target beneficiaries are sensitized and Applications for Consumer Connections are received and processed in good time before commencement of the actual connections.

The following activities are necessary to be carried out during the mobilization stage of the Works Contractor and continue during the Construction Stage:

i. Assessing the Willingness to Pay
ii. Community Mapping & GIS Referencing of Plots, existing disposal facilities (pit latrines, septic tanks etc.) and type of consumer connection required.
iii. Setting up a Local Site office
iv. Awareness Creation and Mobilization of Landlords/ Residents
v. Promotion of Connections Process
vi. Communications & Branding
vii. Local Sewer Network Operation & Maintenance Capacity Development

1.1.5 Construction Works and connections

To Increase water and sewer access and connectivity, AWWDA to work in close co- ordination with the WSPs to continuously expand the Water and Sewer Network in their areas of jurisdiction. For the project, the contractors will carry out works up to an inspection chamber adjacent to the plot boundary. Connections will only be done upon successful application by the property owners to the WSP. For project areas with proper cadastral maps, demarcations and land titles, connections within the private property will be undertaken by the property owner. Once an inspection chamber is provided, the utility will proceed and start billing for the connection in such planned areas whether the property owner has undertaken actual connection or not.

For project areas that lack cadastral maps, are unplanned and lack private land property ownership more specifically the informal settlements, the works within the property up to the communal sanitation block including conversation of pit latrines into water borne sanitation facilities will be undertaken by the project funds. Such sanitation facility shall be considered a public facility and handed over by the water company to an organized community-based organization for operation and maintenance in line with the memorandum of understanding.

AWWDA takes cognizance of the risk of customers not undertaking connections from the plot boundary to the house due to insufficient funds. To mitigate this risk and ensure full connection including activation to consumers is done prior to project closure it is proposed that for construction works within the property: -

- AWWDA with support of the design and supervision consultant and the Community Outreach Consultant shall, during design prepare last mile water and sanitation connections assessment report for designed/projected for the whole project area including Copy of Block Map/ Land Registry Index Map; Plot Numbers; Details of Plot Owners i.e. Name, Address and Phone Number; Type of consumers i.e., domestic, commercial, institutional or industrial; type structure; type of connections;
- AWWDA with support of the design and supervision consultants and the community outreach consultant will undertake a socio-economic survey of the residents within the project areas to determine willingness to pay, ability to pay and identify any vulnerable

community members within the project areas specifically the informal unplanned areas which would require homogeneous subsidy for connections up to the property

- Cost estimates based on market rate shall be prepared for the project areas including for materials required to ensure connection from the inspection chamber into the property
- Depending on the budgetary allocation for connections for the particular project area, the identified connections shall then be prioritized based on need, level of impact/beneficiaries, amount of sewerage flows and other considerations as prescribed by the last mile water and sanitation connections assessment report.
- The costs for construction work up to the inspection chamber shall be included as part of the construction works for all the formal areas.
- For the informal and unplanned settlements, the construction costs for the inspection chamber and the costs up to the active connection shall be included in the works contract. These costs shall be borne by the government as the unplanned settlements are wholly owned by the government and such facility would be utilized communally.
- AWWDA and Respective WSPs shall sensitize the customers on the provisions for household connections and the procedure to be followed including for options of full connection within the project. It is proposed that the project covers the cost of full connection in the selected households/communal facility in the informal settlements. The selected households will have a water account with NCWSC and charging for monthly bills shall commence after the connection is complete and management handing over MOU signed. The cost of this connections shall be treated as projects costs and hence considered grants as is the responsibility of the Government to provide service to the poor.
- Project reporting shall include household connection inventory including details such as Copy of Block Map/ Land Registry Index Map; Plot Numbers; Details of Plot Owners i.e., Name, Address and Phone Number; Type of consumers i.e., domestic, commercial, institutional or industrial; type of structure; type of connections

For water works, NCWSC will be responsible for installing customer water meters identified from the design stage and is to be procured under the works contracts. The contractors will install lockable chambers for the water meters.

1.1.5.1 Water Supply Connections

AWWDA & WSPs will carry out all Consumer Connection Works including Metering. Two types of Water Supply Connections will be carried out by WSPs:

1. Individual Household/Property Connection
2. Communal Yard Taps/Kiosks

The preferred mode of connection will be the Individual Household/Property Connection. Communal Yard Taps will be installed in areas characterized by multiple rooms in a plot, each room housing an individual household where it is not possible to install an individual connection to each individual room.

a) Individual Household/Property Connections

Individual Household / Property Connections will be provided in the Project Target Areas where plot owners have Title Deeds or can provide proof of ownership of the property. The main feature of this type of Water Connection is that one Connection is expected to serve one Household / Property.

The Scope of Works under the project required for this type of Connection includes:

- Supply and laying of 15mm HDPE pipes and associated fittings from a Secondary Water Distribution Main to the Plot
- Supply and installation of a Consumer Water Meter (Plastic Body type)

Internal Plumbing Works within the Plot / House are carried out by the owners under supervision of NCWSC and the project where applicable. However, the community outreach consultant and works supervision consultants for the AfDB projects will conduct social economic surveys. The connection works from the inspection chamber in the well planned areas will be carried out by the WSPs at the cost of the consumer upon application while those in the informal areas will be carried out by the works contractors. The project team will sensitize the plot owners to on the connection program.

b) Communal Yard Taps

This type of Water Connection will be installed to serve multiple low-income class households within a single plot.

Communal Yard Taps will be provided in areas with low income / temporary or semi- permanent housing in the selected areas. They are best suited for Informal Settlements characterized by multiple rooms in a plot, each room housing an individual household.

The main advantage of yard taps is that they offer a convenient access to good quality water for poor households that cannot afford individual connections. Water Charges for each individual house in the plot are usually incorporated by Landlords into the monthly rent.

The Scope of Works required for this type of Connection includes:

- Construction of Yard Tap on hardcore base including lockable brass tap and associated fittings
- Supply and laying of 15mm HDPE pipes and associated fittings from a Secondary Water Distribution Main to the Yard Tap/ existing water kiosk
- Supply and installation of a Consumer Water Meter (Plastic Body type)

The contractor will lay water pipelines to the communal water tap. A water meter shall be installed at the offtake from the water main to the water point. The communal water tap can be managed by any organized CBO's appointed by the water service provider.

The typical drawing for water connections is as below;

1.1.5.2 Sewerage Connection works

For sewerage works, a practical step by step sewer connection strategy to be adopted by WSPs is shown below;

The connections will depend on the Targeted Consumers Categories, types of Sewer Connections and the requisite Works for each type of connection. The types shall be categorized as;

i. Type 'A' – Connection of Existing Water Borne On-site Sanitation Facilities to the Public Sewer Network (for plots with septic tanks, cess pits etc.)

This type of sewer will be carried out in individual, institutional, commercial and industrial Plots which have existing water borne on-site sanitation and are adjacent to the proposed or existing Sewer lines i.e., within a radius of 60m

A typical Type 'A' connection is as shown on the attached drawing below.

ii. Type 'B' – Upgrading of Existing Pit Latrines to a Water Borne System (Pour Flush/ Cistern) and Connection to the Sewer Network (for Plots with Pit latrines)

This Type of Sewer Connection will be carried out in Plots without existing Pour Flush Toilets, but which have Pit latrines that are adjacent to the proposed or existing Sewer Lines i.e., within a radius of 60m.

A typical Type 'B' connection is as shown on the drawing below.

Household sewer connections works will be undertaken by the works Contractor. The contractor will install an Inspection Chamber adjacent to the Plot Boundary. The Scope of Works to be carried out by the Works Contractor comprises of:

- Construction of new 450mm x 600mm Inspection Chamber (IC) adjacent to the Plot Boundary
- Supply and Installation of 160mm diameter uPVC Class 41 Sewer Pipe to connect the new Inspection Chamber to the external Secondary Sewer.
- Connection from the consumer property to the new Inspection Chamber where applicable as described above under construction works within the property

The Project team will sensitize individual Plot Owners on the ongoing sewerage connection Works within their Plots. Gravity sewerage systems depend on water to provide conveyance of faecal matter and to ensure the system maintains self-cleansing velocity (i.e., a flow that will not allow particles to accumulate). It is not therefore possible for Plots that currently have Pit Latrines to be connected to sewer without first upgrading the systems to pour-flash. The Plot Owners will be sensitized to upgrade the facilities to Pour Flush Toilets that can then be connected to the Sewer System.

AWWDA and the appointed community outreach and supervision consultant will ensure the actual connections are undertaken and keep record of the numbers. Some of the details to be recorded include proportion of pit latrines / septic tanks / cess pits, density of residents / connections per km of sewer line, proportion of properties within the reach of the sewer line, geographical discrepancies and correlation with housing standards of each project area, etc.

<u>Sewerage Connection in the informal settlements</u>

For Households in informal settlements, different forms of sewered and non-sewered sanitation will be adopted. Some of the proposals include;

- Construction of condominium or simplified sewers
- Construction of Ablution blocks
- Corroboration with other stakeholders in the private sector to provide bio- sanitation facilities. The available sanitation technologies shall include but are not limited to bio digesters, integrated ablution blocks and container-based toilets, sewer connection, amongst others in the informal settlements

Further, AWWDA will also construct fecal sludge handling facilities to provide discharge points for sewerage emptier/exhausters for areas off the sewerage grid. AWWDA has identified 4 discharge points under the AfDB projects and will acquire land for this construction. AWWDA and NCWSC

will establish modalities and charges approved by the WASREB to be levied onto the discharging exhausters.

Bearing in mind the challenges of the informal settlements, AWWDA has engaged a consultant to undertake an inclusive sanitation strategy tailored to the IS. The grant financing is from the AfDB under the Nairobi Inclusive Sanitation Project Under the study, the consultant is required to review this strategy as well as come up with innovative financing models that are attractive to consumers who wish to undertake the private connections but are unable to raise the costs of connections.

The typical drawings for sewerage connections are as follows;

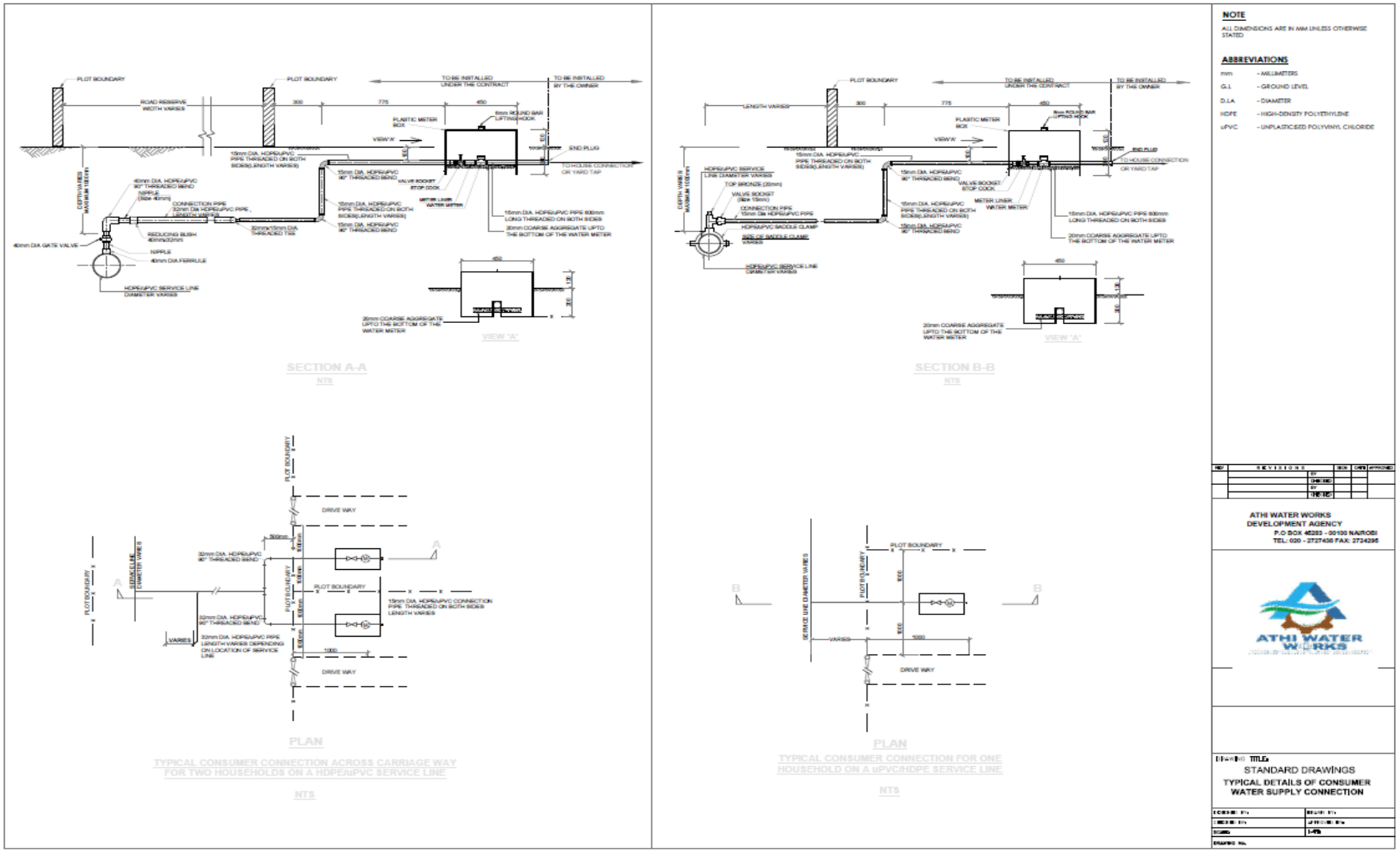


Figure 2: Typical Water Connection

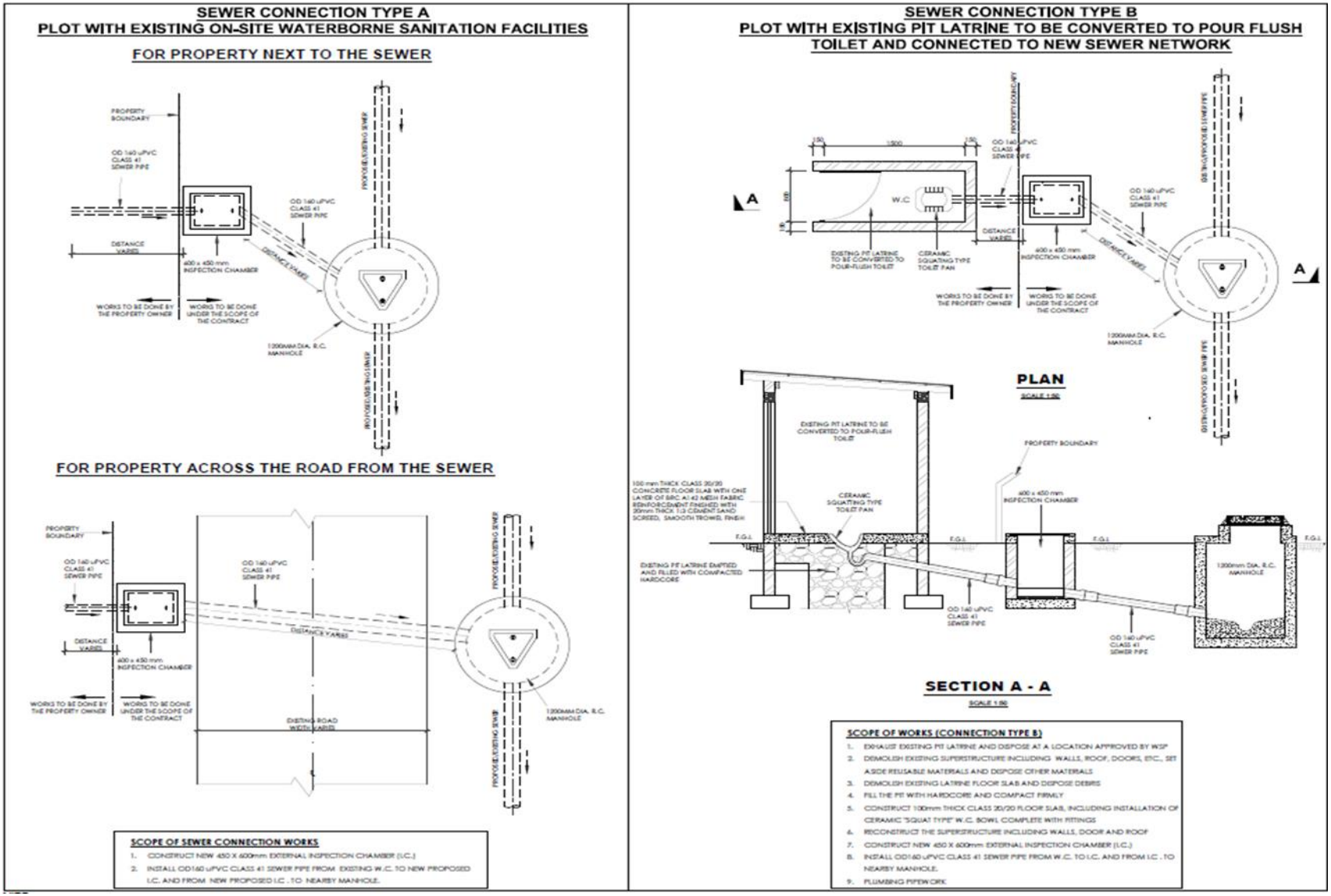


Figure 3: Typical Sewerage connection

1.1.6 Verification/Audit

After the laying of the new infrastructure, WSPs and WWDA will collect the following data to ascertain the number of connections.

- Copy of Block Map/ Land Registry Index Map
- Plot Numbers
- Details of Plot Owners i.e., Name, Address and Phone Number
- Type of consumers i.e., domestic, commercial, institutional or industrial
- Type of housing infrastructure i.e., single dwelling unit, apartments including number of dwelling units,
- Communal water and sanitation facility in the case of unplanned settlements including number of persons that can be served by such communal facility

1.1.7 Enforcement/Legislation

Data collected from the verification and Audit by WSPs above is forwarded to the Department of Public Health which issues a "Fourteen (14) days Statutory Notice" to the Plot Owners to Connect to the New Sewer. Failure to Comply, the Plot Owner is Prosecuted under CAP 242 of the Public Health Act.

Public Health Act -2012 -Drainage and Latrine Rules

Rules under Section 126

The Public Health Act - Drainage and Latrine Rules outlines the Policy on Sewer Construction, Connections, Type of allowed waste, Operations and Maintenance and the Power to the Local Authority in Enforcing the Rules. Of interest to the Sewer Connection Policy are rules described here below.

Rule 4: Local Authority to Enforce Drainage of Undrained Buildings

1. The Act Require that any building within 60m from a sewer should be connected to the Sewer. If the sewer is far from the building, the building can drain into a covered tank or any other receptacle or the authority can construct a sewer and recover the expenses as a civil debt apportioned amongst those connected to the sewer
2. Any person who fails to comply with the requirements of any notice served under this rule within the time specified shall be guilty of an offence, and the local Authority may, after the expiration of the time specified in the notice, do the work required, and may recover as a civil debt recoverable i.e., the expenses incurred by it in so doing from the owner.

Rule 8: Conversion of Latrines into Water-Closets

1. The Act provides that any building/ Plot with a non-water closet and is within 60m from any sewer belonging to the Local Authority and at a suitable level and with sufficient water supply, the local Authority may, by written notice addressed to the owner, require the owner within a reasonable time, to be specified in such notice, to convert the Sanitation Facility into a water borne system and to connect to the sewer

2. Any such owner who fails to comply with the requirements of any notice served under this Rule, and that within the time specified, shall be guilty of an offence, and the Local Authority may, after the expiration of the time specified in the notice, do the work required, and may recover as a civil debt recoverable i.e the expenses incurred by it in so doing from the owner.

Others Rules in the Act:

Rule 14: Penalty for unauthorized building over sewers or under streets.

Rule 15: Injurious matters not to be passed into sewers.

Rule 16: Power to prohibit passing of solid matter, steam, chemical refuse, etc. into sewers.

Rule 18: Power to make inspection chamber in manufacturing premises.

Rule 19: Rain-water pipes not to connect directly with a closed drain.

Rule 20: Notice to be given of intention to make a sewer connection.

Rule 21: Sewer connections not to be made without permission

1.2 AWWDA Connection Strategy Action Plan

Step	Action By	Description	Timeframe
Step 1: Stakeholder Identification	•Athi Water Works Development Agency (AWWDA) •Water Service Provider (WSP) •County Government Department of Planning County Departments of Public Health (PH) •National Environment Management Authority (NEMA) •Resident Associations/Plot Owners/Landlords/ Consumers •Private sector players in the project area including informal settlement •Community outreach consultant/supervising	The five levels of participation are • Information • Consultation, • Involvement, • Collaboration and • Strategy/Policy	Continuous

	consultants for project connections		
Step 2: Identification of Numbers to be connected per phase/project.	•WSPs •AWWDA •Community outreach consultant/design and supervising consultants project connections	The target number of Household will be identified by AWWDA, NCWSC, The community outreach consultant and the supervision consultant for the AFDB project. These designs shall the be included in the bidding documents as part of the scope of works.	6 Months for the initial report and updated continually
Step 3: Inclusion of the target numbers in the bidding documents for all projects to be undertaken by AWWDA.	•AWWDA •WSPs •Design and supervising consultants project connections	The envisaged numbers are designed and categorized as per the type of connections taking into consideration of the following categories; Closeness to the Water & Sewer Lines, Consumer Type, Affordability, Type of Sanitation Facilities	6 Months
Step 4: Communication Strategy (Sensitization)	•AWWDA •WSPs •County Governments •Community Outreach Consultant,	The objective of the Sensitization Campaigns is to ensure that all key stakeholders are made aware of available water and sewerage infrastructure, procedures to be followed, roles of the stakeholders, benefits and importance to the general health and wellbeing of the	Continuous

		populace.	
Step 5: Construction Works and connections	•AWWDA •WSPs •Property Owner •Contractor project connections •Supervision consultant project connections	To Increase water and sewer access and connectivity, AWWDA to work in close co-ordination with the WSPs to continuously expand the Water and Sewer Network in their areas of jurisdiction.	Construction period as per each contract.
Step 6. Verification/Audit	•AWWDA •WSP •Supervising consultant for project connections	WSPs Collects the following data with regard to the service area of the New Sewer (60m radius to the sewer). •Copy of Block Map/ Land Registry Index Map •Plot Numbers •Details of Plot Owners Name, Address and Phone Number •Type of consumer	Quarterly
Step 7. Enforcement/Legislation	•AWWDA	The Data collected in Step 6 is forwarded to the County Government (Department of Public Health) for enforcement through Public Health Act-CAP 242	After completion of the project

Table 2 Proposed Step by Step Connection Strategy Action Plan

2. RISK ANALYSIS MATRIX

Likelihood/Probability (P)	Negligible	Minor Impact	Moderate Impact	Critical	Catastrophic
Very Likely	5	10	15	20	25
Likely	4	8	12	16	20
Possible	3	6	9	12	15
Unlikely	2	4	6	8	10
Highly unlikely	1	2	3	4	5

Severity/Impact(S)

Risk Ratings

LOW	MEDIUM	HIGH
1 to 4	5 to 12	15 to 25

S/No.	Stage	Potential Risk	Consequences	Initial Risk Rating			Mitigation Measures	Assessment of Residual Risks (Control Measures in Place)			Responsible Person
				Probability(P)	Severity(S)	Initial Rating(PxS)		Probability(P)	Severity(S)	Initial Rating(PxS)	
1	Stakeholder Identification	• Political Interference in identification of stakeholders/target group • Lack of participation – County Government/Departments/NEMA	• Under-utilized system due to identification of wrong stakeholders • Lack of allocation of funds for complementary infrastructure and legislation on sanitation sector and enforcement. • Lack of necessary permits • Non reception of the project by stakeholders	5	4	20	1. Identification and assessment of potential household's data base to be derived from PIU (AWWDA, NCWSC, CONSULTANT) of existing consumers with water connections and no sewer connections as first priority in target areas. Needy areas with no water/sewer services list to be generated by PIU (AWWDA, NCWSC, CONSULTANT) as well. 2. Identification of all project stakeholder and ensure proper Involvement of other institutions/agencies from the onset through to the project implementation. within the water and sanitation sector within Nairobi County in the project	1	2	2	TBD
2	Identification of Number of Connections	• Potential Applicants are many or few • Categorization and eligibility of different types of consumers & Non-inclusion of all consumers due to topography	• Under budget/Over budget • Conflicts over number of connections required and responsibility of application/eligibility	3	4	12	1. Each project consultant to prepare a last mile water and sanitation connections assessment report for designed/projected connections for the whole project area including Copy of Block Map/ Land Registry Index Map; Plot Numbers; Details of Plot Owners i.e Name, Address and Phone Number; Type of consumers i.e., domestic,	1	2	2	TBD

							commercial, institutional or industrial; type of structure; type of connections; existing disposal systems, ability to pay for connection, subsidy required, proposed amortization for connection costs. 2. Prioritization criteria for eligible consumers to be developed by the supervision consultant.				
3	Inclusion of the Connections in Bidding Documents	• Lack of Adequate funding	• Under budget/Over budget	3	4	12	1. AWWDA to ensure adequate funds are available the project.	1	2	2	TBD
4	Sensitization Activities/Communication Strategy	• Unwillingness to connect due to existing disposal methods • Illiteracy • Lack of proper information	• Under-utilized system • Low Rate of Connections	4	3	12	Trainings/Community Outreach activities on the existence of the proposed infrastructure, benefits, connection/application procedure, eligibility and requirements.	1	2	2	TBD
5	Construction activities/Connections	• Health & Safety issues on site • Poor Workmanship • Inequitable connections for consumers • Interruptions of other services using the same proposed wayleaves(Public)	• Loss of lives & Accidents • Un sustainable infrastructure • Deserving consumers left out • Increase of project cost and inconvenience	5	5	25	1. Ensure Compliance with OSHA regulations 2. Ensure Quality Control of works and compliance with contract specifications 3. Auditing of the connection programs 4. Identification, Assessment of existing services and nature in the target areas, application for removal/interruption to service providers.	1	2	2	TBD
6	Verification/Audit of the Connections	• Corruption/Malpractices	• Connections targets and objectives not met.	4	4	16	Involvement of all stakeholders in the audit process.				TBD
7	Enforcement/Legislation	• Illegal Connections • Misuse of sewers	• Un accounted for connections – Loss of revenue • Destruction of sewer system infrastructure • Blockages • Dumping of solid waste in sewer. • Interruptions in service delivery	5	4	20	1. NCWSC to ensure regular inspections by the various sub regional offices within the target area to minimize illegal connections to the systems by termination or conversion of the connection to NCWSC system. 2. Sensitization of communities/property owners/customers on proper usage of the system	3	4	12	TBD

Specifications for Environmental, Social, Health and Safety Management (ESHS) of the Works

Throughout the present ESHS Specifications (hereinafter called "**the ESHS Specifications**"), a reference to Conditions of Contract, abbreviated by CC, means a reference to both the General Conditions of Contract and the Particular Conditions of Contract. Readers should apply due care, when being referred to a specific Clause or Sub-Clause, to:

- Read first the Clause or Sub-Clause text from the General Conditions of Contract;
- Then check whether this text has been amended by the Particular Conditions of Contract, and if so, to which extent.

As per CC Sub-Clause 1.5 – Priority of Documents, when interpreting the Contract, the terms of the Particular Conditions of Contract prevail over those found in the General Conditions of Contract.

Any term in these ESHS Specifications which is identical to a term in the Conditions of Contract shall have the same meaning as the one defined in the Conditions of Contract.

Any term in capital letters in these ESHS Specifications is defined in CC Sub-Clause 1.1 – Definitions.

Table of Contents

A. Environmental, Social, Health and Safety Management System

1 Responsibilities and Liabilities

1.1 In conjunction with his obligations defined under the Contract, the Contractor will plan, execute and document construction works pursuant to the Environment, Social, Health and Safety (ESHS) Specifications.

1.2 The Contractor is liable for all damages to natural resources caused by the execution of the Works or the methods used for execution, unless it is established that the execution or methods were necessary, according to the provisions of the Contract or an Engineer's instruction.

1.3 Under the Contract and as introduced by the ESHS Specifications, the term "Project Area" means:

a) The land where work will be carried out; or

b) The land necessary for the implantation of construction facilities (work camp, workshops, offices, storage areas, concrete production plants) and including special access roads; or

c) Quarries for aggregates, rock material and riprap; or

d) Borrow areas for sand and other selected material; or

e) Stockpiling areas for backfill material or other demolition rubble; or

f) Any other location, specifically designated in the Contract as a Project Area.

The term "Project Area" encompasses any individual Project Area or all Project Areas.

For the sake of clarity, Project Area is a different concept than Site under CC Sub-Clause 1.1.6.7.

Project Area defines an area within which the Contractor is to comply with environmental, social, health and safety obligations defined in the ESHS Specifications.

Site is the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and where right of access to, and possession of, is to be given by the Employer to the Contractor. The Employer is under no similar obligation for any area located outside the Site, even if within the Project Area, where access is at Contractor's risk.

In term of physical footprint, the CC Sub-Clause 1.1.6.7 Site is included in the Project Area. The Project Area is then of greater geographical extent than the Site.

1.4 The ESHS Specifications refer to the entire area of influence for the Works:

a) Protection of the natural environment (water, air, soil, vegetation, biological diversity) in areas within any Project Area and its surroundings, i.e. including but not limited to access roads, quarries, borrow areas, stockpiling of backfill material, camps or storage areas;

b) Health and safety conditions to be maintained for the Contractor's personnel and any other person present on the Project Areas, or along access routes;

c) Working practices and the protection of people and populations living near the Project Area, but exposed to the general disturbance caused by works.

1.5 Subcontractors:

The ESHS Specifications apply to the Contractor and unless explicitly agreed with the Engineer, all Subcontractors used for the execution of the Works. Pursuant to Sub-Clause 4.4 of the CC, the Contractor is fully liable for all actions, non-compliance and negligence by Subcontractors, their representatives, employees and workers, to the same degree as it would be held liable for its own actions, non-compliance or negligence or that of its own representatives, employees or workers.

1.6 Applicable regulations:

The Contractor must identify all regulations in relation to the protection of the environment (water, air, soils, noise, vegetation, fauna, flora, waste, groundwater) and, pursuant to Clauses 4 and 6 of the CC, the protection of people (labour law, indigenous populations, standards on occupational exposure, other). The Contractor must list all texts, standards and other regulatory limitations in its Worksite Environmental and Social Management Plan (Worksite - ESMP as specified in Sub-Clause 2.1 of the ESHS Specifications) and specify the means taken for compliance.

2 ESHS Planning Document

2.1 Worksite Environmental and Social Management Plan (Worksite - ESMP)

2.1.1 The Contractor prepares and ensures prior validation by the Engineer, implementation and regular update of a Worskite Area Environmental and Social Management Plan (Worksite - ESMP).

2.1.2 The Worksite - ESMP represents the unique reference document in which the Contractor defines in detail all organisational and technical provisions implemented to satisfy the obligations of the ESHS Specifications.

2.1.3 The Contractor defines in the Worksite - ESMP the number, the locations and the type of Project Area as defined in Sub-Clause 1.3 of the ESHS Specifications. For each of the identified Project Area, unless otherwise agreed by the Engineer, the Contractor establishes an Environmental Protection Plan (EPP). The EPP(s) are annexed to the Worksite - ESMP.

2.1.4 The Worksite - ESMP covers the entire period from the Contract Agreement signature date to the date of issue of the Performance Certificate by the Engineer.

2.1.5 Unless agreed otherwise by the Engineer, the Worksite - ESMP is written in the language of communication defined under Sub-Clause 1.4 of the CC.

2.1.6 The first draft version of the Worksite - ESMP is to be provided by the Contractor to the Engineer within 28 days from the date of execution of the Contract Agreement.

2.1.7 No physical work or activity shall commence on any Project Area until such time the Worksite - ESMP, and the annexed EPP corresponding to the Project Area, are approved by the Engineer.

2.1.8 During the execution of the Works, whenever instructed by the Engineer, the Worksite - ESMP will be updated by the Contractor and reissued to the Engineer. The revised version shall highlight the new elements incorporated in the document.

2.1.9 The Worksite - ESMP (and the EPP) is structured according to the plan specified in Appendix 1 to the ESHS Specifications.

3 Management of non-conformities

3.1 In application of Clause 5, non-conformities detected during inspections carried out by the Contractor or Engineer are subject to a process adapted to the severity of the situation. The non-conformities will be defined as deviations from the requirements of the applicable regulations, the ESHS Specifications, the ESMP, and the Worksite - ESMP. Non-conformities are divided into 4 categories as follows:

3.1.1 Notification of observation of minor non-conformities. The non-conformity results in a notification to the Contractor's Representative, followed-up by a signed notification of observation prepared by the Engineer. The multiplication of notifications of observation at the Project Area, or absence of corrective actions by the Contractor, can result in the severity of the non-conformity being raised to that of level 1.

3.1.2 Level 1 non-conformity: Non-conformities that present a moderate and non-immediate risk for health, environment, social or safety. The non-conformity is identified in writing to the Contractor and shall be resolved within five (5) days. The Contractor addresses to the Engineer the proof explaining how the non-conformity has been corrected. Further to an inspection and a favourable evaluation of effectiveness of the corrective action, the Engineer validates in writing the close-out for the non-conformity. In all cases where a non-conformity of level 1 is not resolved within one (1) month, the severity of the non-conformity is raised to level 2.

3.1.3 Level 2 non-conformities: applies to all non-conformities that represent a moderate and immediate risk or with significant consequences to health and/or the environment, social or safety. The same procedure as for level 1 non-conformities is applied. Corrective action shall be taken by the Contractor within three (3) days. All level 2 non-conformities which are not resolved within one (1) month, are raised to level 3.

3.1.4 Level 3 non-conformities: applies to all non-conformities that have resulted in damage to health or the environment, or which represent a high risk for health, safety, environmental or social hazards. The highest levels of the Contractor's and Engineer's hierarchies present in the Employer's country are

informed immediately and the Contractor has twenty-four (24) hours to bring the situation under control. Pursuant to Clause 14.7 of the CC, a level 3 non-conformity results in the suspension of interim payments until the non-conformity has been resolved. If the situation requires, and in pursuance to Clause 8.8 of the PC, the Engineer can order the suspension of work until the resolution of the non-conformity.

4 Resources allocated to environmental management

4.1 ESHS supervisors and Manager:

4.1.1 Pursuant to Sub-Clause 4.18 of the CC and in addition to the provisions of Sub-Clause 6.7 of the CC, the Contractor appoints one (or two depending on the case) Environment, Social, Health and Safety Manager(s) in charge of implementing the ESHS Specifications. Several experts may be assigned to fulfill this position. The manager(s) will be the Key ESHS Personnel identified in the bidding process, if any.

4.1.2 The ESHS Manager is permanently based at the Project Area for the full duration of the Works as of Contractor's mobilisation until Taking-Over Certificate is issued.

4.1.3 This manager holds the power within the Contractor's organisation to be able to suspend the Works if considered necessary in the event of level 2 or 3 non-conformities, and allocate all resources, personnel and equipment required to take any corrective action considered necessary.

4.1.4 The ESHS Manager speaks fluently the language of communication of the Contract, and the official language of the Employer's country, if the language of communication of the Contract is not the official language. The ESHS Manager will hold a relevant University degree or a significant experience of at least five (5) years in designing and monitoring the implementation of an environmental and social management plan for construction works.

4.1.5 ESHS supervisors are appointed in sufficient numbers and represent the ESHS Manager within work teams. Their role is to ensure that the Works are carried out pursuant to the ESHS Specifications and notify the ESHS Manager of any detected non-conformities.

4.2 Person in charge of relations with external stakeholders:

4.2.1 The Contractor appoints a person responsible for relations with external stakeholders: local communities, administrative authorities, religious and other representatives. If necessary, a team will be created.

4.2.2 Administrations and local authorities will be informed of the existence of this person as of the start of works and will be provided with contact details so as to be able to contact this person if a problem arises during the execution of works, or concerning the behaviour of the Contractor's Personnel, inside or outside the Project Area.

4.3 The team, including the ESHS supervisors and manager, and the person in charge of relations with external stakeholders, will be allocated the necessary resources to operate independently (travel, office equipment and communication).

5 Inspections

5.1 In addition to the ESHS Manager's own inspections, an ESHS inspection will be carried out on the facilities and Project Area on a weekly basis jointly with the Engineer.

5.2 A written report will be drafted for each weekly inspection, in a format approved by the Engineer, addressing non-conformities detected on the Project Area as specified in the ESHS Specifications.

5.3 Each non-conformity will be documented by a digital photograph with captions to provide a visual illustration, explicitly indicating the location, date of inspection and the non-conformity in question.

6 Reporting

6.1 As part of the Progress Report specified in Sub-Clause 4.21 of the CC, the Contractor submits an ESHS activity report summarising all ESHS initiatives implemented in relation to the execution of the Works during the reporting period to the Engineer on a monthly basis. The activity report is a separate document from the update of the Worksite - ESMP, which is updated at the intervals indicated in Sub-Clause 2.1.8 of the ESHS Specifications.

6.2 The ESHS activity report is written exclusively in the language of communication defined under Sub-Clause 1.4 of the CC.

6.3 Pursuant to Sub-Clause 4.21 of the CC, the ESHS activity report is submitted at the latest 7 working days after the last day of the month in question. The report contains the following information.

6.3.1 List of ESHS personnel present at the Site at the end of the month.

6.3.2 Construction works activities conducted during the month.

6.3.3 Inspections carried out (location and intervals).

6.3.4 Non-conformities detected during the month with descriptions of the root cause analysis and corrective actions taken.

6.3.5 Description of actions conducted and measures taken during the month to remedy non-conformities and to manage environmental, social, health and safety risks and impacts.

6.3.6 Description of stakeholder engagement activities undertaken with neighbouring populations, local authorities, governmental agencies.

6.3.7 Monitoring results for the following indicators:

a) Effluent quality (Sub-Clause 12.5 of the ESHS Specifications), if applicable;

b) Drinking-water quality, if applicable;

c) Hazardous and non-hazardous waste generation;

d) Air and noise emissions, if applicable;

e) Project Area state (Sub-Clause 20 of the ESHS Specifications);

f) Recruitment, number of positions and hours worked by local Contractor’s Personnel (Sub-Clause 39.3 of the ESHS Specifications);

g) Health & safety statistics: in pursuance to Clauses 4 and 6 of the CC, number of fatal accidents, lost-time accidents, number of accidents without lost-time, serious illness, frequency of accidents, and serious misconduct by Contractor's Personnel (record sheet attached as an appendix to the activity report, pursuant to Sub-Clause 7.7 of the ESHS Specifications); including root cause analysis and corrective actions taken.

6.3.8 Where appropriate, description of the formal or informal complaints (negative media attention, strikes or labour disputes, protests, complaints from communities, NGO or workers or formal notice from authorities, etc.) related to environmental, social, health and safety risks and impacts of the Works; including root cause analysis and corrective actions taken.

6.3.9 Report on training activities (topic, number and duration of sessions, number of participants).

6.3.10 Provisional environmental, social, health and safety actions for the coming months.

6.4 Notification of ESHS events:

6.4.1 The Engineer is informed within one hour of any accident, (i) involving serious bodily injury to a member of personnel, a visitor or any other third party, caused by the execution of the Works or the behaviour of the personnel of the Contractor, or (ii) any significant damage to private property, or (iii) any significant damage to the environment.

6.4.2 The Engineer is informed as soon as possible of any near-accident relating to the execution of the Works which, in slightly different conditions, could have led to bodily injury to people, or damage to private property or the environment.

7 Rules of Procedure

7.1 Rules of procedure are established by the Contractor for the Project Areas, addressing the following: safety rules, zero tolerance for substance abuse (refer to Clause 37), environmental sensitivity of areas around the Project Areas, the dangers of STDs with HIV/AIDS, gender issues (in particular sexual harassment) and respect for the beliefs and customs of the populations and community relations in general (drawing special attention to the risks of prostitution and human trafficking).

7.2 The rules are clearly displayed at the different Project Areas.

7.3 The rules confirm the Contractor's commitment to implementing the ESHS provisions provided for in the Contract.

7.4 New Contractor's Personnel and existing Contractor's Personnel are made aware and acknowledge their understanding of the rules of procedure and the associated provisions. Rules of procedure document are initialed by all Contractor's Personnel prior to the start of any physical work at any Project Area.

7.5 Pursuant to Clauses 6.9 and 6.11 of the CC, the rules of procedure include a list of acts considered as serious misconduct and which must result in dismissal from any Project Area by the Contractor, or by the Engineer if the Contractor is not acting in due course,

should a Contractor's Personnel repeatedly commit an offence of serious misconduct despite awareness of the rules of procedure, and this is without prejudice to any legal action by any public authority for non-compliance with applicable regulations:

a) Drunkenness during working hours;

b) Drug use;

c) Punishable statements or attitudes, and sexual and mental harassment in particular;

d) Violent behaviour;

e) Intentional damage to the assets and interests of others, or the environment;

f) Repeated negligence or imprudence leading to damage or prejudice to the environment, the population or properties, particularly breaching provisions intended to prevent the spreading of STD with HIV/AIDS;

g) Possession and/or consumption of meat or any other part of an endangered animal or plant as defined in the Washington convention (CITES) and national regulations.

7.6 Serious misconduct, such as organization of sex trade (pimping), committing pedophilia, rape, physical aggression, drug trafficking, deliberate and severe pollution, trading and/or trafficking in all or part of protected species, shall lead to immediate dismissal as of the first report of misconduct is detected, in application of the rules of procedure and labour laws.

7.7 The Contractor establishes a record for each case of serious misconduct, and a copy will be provided to the Contractor's Personnel in question, indicating all action taken to terminate the misconduct by the Contractor's Personnel in question and to bring the attention of other Contractor's Personnel to the type of incident detected. This record will be provided to the Engineer as an attachment to the ESHS activity report (see Sub-Clause 6.3 of the ESHS Specifications).

8 ESHS Training

8.1 The Contractor prepares a training and capacity building program for its Contractor's Personnel, as described in the Worksite - ESMP and documented each month in the ESHS activity report.

8.2 The Contractor also details in the training program the actions and ESHS training for Subcontractors and other members of the joint venture when applicable.

8.3 Training sessions are two-fold: introductory sessions for starting work at the Project Area, and technical training as required in relation to the execution of the Works.

8.3.1 Starting work sessions are organised for each Contractor's Personnel and shall cover as a minimum:

a) Rules of procedure;

b) Safety rules on Project Areas;

c) Protection of areas adjacent to Project Area;

d) Risks relating to sexually transmitted diseases (Sub-Clause 6.7 of the CC), prostitution, human trafficking, and sexual harassment;

e) Basic health: combating malaria (if prevalent) and waterborne diseases, improving hygiene;

f) Emergency response procedures or evacuation.

8.3.2 Technical training:

a) Training in the skills needed for tasks requiring a work permit (Clause 24 of the ESHS Specifications);

b) Training in first aid and transporting the injured in order to achieve the targets defined in Sub-Clause 29.1 of the ESHS Specifications on the number of first aid officers per Project Area and per team;

c) Ability to drive on rough ground.

8.4 The Contractor prepares an awareness program, where applicable, for local communities adapted to the main risks relating to the Works. This program will be included in the training program described in Sub-Clause 8.1 of the ESHS Specifications.

9 Standards

9.1 The Contractor complies with all norms, standards and discharge limit values defined in the national regulations of the Employer's country regulations and pursuant to Sub-Clause 1.6 of the ESHS Specifications.

9.2 The Contractor comply with norms, standards and discharge limit values recommended by the specialised international organisations affiliated to the United Nations, as described in Sub-Clause 9.3 below of the ESHS Specifications. In the event of discrepancies in between international standards and national regulations, the Contractor shall comply with the most stringent requirements.

9.3 The specialised international organisations affiliated to the United Nations referred to in Sub-Clause 9.2 of the ESHS Specifications include:

- World Bank, including the IFC and its Environmental, Health and Safety guidelines available from http://www.ifc.org/ehsguidelines.

For matters not addressed in the IFC above document, the most stringent of the norms, standards and discharge limit values of the following institutions shall apply:

- World Health Organization (WHO);
- International Labour Organization (ILO) (in particular in pursuance to Sub-Clauses 6.20, 6.21, 6.23 and 6.24 of the CC);
- International Maritime Organization (IMO).

B. Protection of the Environment

10 Protection of adjacent areas

10.1 Pursuant to Sub-Clause 4.18 of the CC, and unless instructed otherwise by the Engineer, the Contractor uses construction methods and means of protection in order to avoid or minimize

adverse effects that are incurred on vegetation, soils, groundwater and surface water, biodiversity, natural drainage and the water quality in areas within any Project Area and its surroundings for the entire duration of the Works.

10.2 Wetland areas include marshes, fens, mires or natural or artificial bodies of water, whether permanent or temporary, where water is stagnant or flowing, fresh, saline or briny, including seawater with a low-tide depth of six metres or less. Filling of all or part of a wetland area is not permitted, unless the Works are necessary according to the provisions of the Contract or the instructions of the Engineer.

10.3 With the exception of access roads, or unless instructed otherwise by the Engineer, the entire perimeter of land sites with a surface area of less than 2 hectares is physically demarcated with a fence or tape. For Project Area with a surface area of more than 2 hectares, the perimeter will be physically demarcated by a perimeter track, road, signs or any other means leaving no possible ambiguity as to the location of the Project Area perimeter.

10.4 Unless instructed otherwise by the Engineer, the Contractor defines the perimeter of the Project Area at a distance of at least:

a) 50 m from any permanent water course and outside of floodable areas;

b) 300 m from sensitive urban services and buildings (health centre, school centres, water supply for populations);

c) 200 m from any housing; and

d) 300 m from housing in the specific case of work requiring the use of explosives.

10.5 If the footprint of the Works do not respect the distances mentioned in the situations a) to d) of Sub-Clause 10.4 above of the ESHS Specifications, and unless agreed upon otherwise by the Engineer, the Contractor will contract a bailiff to make a sworn statement regarding the existence and conditions of residential buildings situated around the Site with a distance specified in paragraph b) to d) of Sub-Clause 10.4 of the ESHS Specifications. The bailiff's sworn statement is prepared and provided to the Engineer with the EPP.

11 Selection of borrow areas, backfill material stockpile sites and access road

11.1 The Contractor will submit to the Engineer for prior approval, within the framework of the EPP (provided in Clause 2.1.3), (i) the location of proposed borrow areas or areas to be excavated, (ii) proposed backfill material stockpile locations or zones designated for the rubble from demolition works.

11.2 The access routes to the Project Areas will be shown on a map and approved by the Engineer prior to the start of the corresponding Works.

12 Effluents

12.1 Effluents consist of liquid discharges, including infiltration, from Project Area, transporting a pollutant (dissolved, colloidal or particles).

12.2 A pollutant is a given chemical compound that is at a concentration that is greater than the limit values recognised for that compound according to Clause 9 of the ESHS Specifications.

12.3 If no recognised threshold exists pursuant to Sub-Clause 12.2 of the ESHS Specifications, the Contractor provides proof that the charges are harmless.

12.4 No effluent is discharged by the Contractor into water courses, soils, lakes or the marine environment without prior treatment and without monitoring of the treatment's performance to guarantee the absence of pollution.

12.5 The Contractor carries out or contracts the monitoring of the effluent quality pursuant to Sub-Clause 12.4 of the ESHS Specifications. In the first case, the Contractor provides the ESHS Manager with the means and skills to carry out in-situ monitoring and laboratory analysis of the performance indicators. In the second case, the Contractor establishes a contract with a specialised contractor, accredited with the Employer's country authorities for this activity.

12.6 The physical and chemical parameters of the effluent that are monitored are those that are listed in the applicable regulations according to the provisions of Clause 9 of the ESHS Specifications. The parameters have prior approval from the Engineer.

12.7 The Contractor will list, locate, and characterise (flow, expected quality, discharge frequency) all sources of effluents and outlets in the natural environment in the Environment Protection Plan(s).

12.8 The Contractor will submit to the Engineer an effluent monitoring report on a monthly basis, including documentation for the following for each effluent discharge point: (i) average flow rates of discharged effluents, (ii) discharge frequencies and durations over the month, and (iii) the physical and chemical quality of the effluent discharged, for the conformity parameters listed in Sub-Clause 12.1 above of the ESHS Specifications.

12.9 The special case of rainwater run-off:

12.9.1 Run off consists of the rainwater flow on the surface or the soil and other technical surfaces at Project Areas.

12.9.2 In the context of the Contract, run-off is considered as an effluent and will be treated in accordance with Sub-Clause 12.4 above, unless demonstrated otherwise, as documented and substantiated by the Contractor, and approved by the Engineer.

12.9.3 Particular attention will be given to all platforms with installed generators, hydrocarbon storage tanks, refuelling stations and concrete plants (cover, containment, settling, pH neutralization).

13 Atmospheric emissions and dust

13.1 Emissions refer to any discharge into the air of solid substances, aerosols, gases, radiation, or energy, whether point sources (e.g. incineration stack) or diffuse (e.g. fugitive dust emissions from road use by trucks).

13.2 The Contractor will use equipment and adopt construction and transport methods with atmospheric emissions which are not in excess of the threshold emission values recommended in the applicable regulations according to the provisions of Clause 9 of the ESHS Specifications.

13.3 The fleet of vehicles or equipment emitting combustion gases will be maintained at the intervals and according to the methods specified by the manufacturer.

13.4 The Contractor will document the maintenance records for its fleet of vehicles, machinery and equipment. The records will be in the language of communication defined under CC Sub-Clause 1.4, or any other language approved by the Engineer, and will be at the disposal of the Engineer.

13.5 On unpaved roads used by the vehicles and machinery of the Contractor:

13.5.1 The Contractor takes action to abate fugitive dust emissions generated by vehicles or mobile equipment in residential areas and on roads within the Project Area perimeter.

13.5.2 The Contractor will implement the necessary measures, as described in the Worksite - ESMP, to avoid or limit dust generation: dust removal, regular watering, reduction of Contractor's vehicles speed as specified in Sub-Clause 44.9 of the ESHS Specifications.

13.6 When storage, handling and transportation of bulk materials is made in the open air and exposed to the wind, the Contractor implements the necessary dust abatement measures, including one or several of the following techniques: vegetation of the surface, covering of the surface, humidification of the surface, covering the trucks, etc.

14 Noise & vibration

14.1 The Contractor uses equipment and adopts construction and transport methods so not to generate noise levels in excess of values recommended in the applicable regulations according to the provisions of Clause 9 of the ESHS Specifications.

14.2 Except as otherwise provided in the Contract or unless waived by the Engineer, high noise generating works (e.g. pile driving, blasting, rock clearing, drilling, percussion drilling) which may impact occupied receptor areas are carried out during normal working days, but prohibited at night. A receptor area is defined as an area used for nocturnal socioeconomic activities (e.g. accommodation camps, residential areas, hotels, health centres).

14.3 The use of heavy vehicles at night is specified in Sub-Clause 44.9 of the ESHS Specifications.

15 Waste

15.1 The Contractor is responsible for identifying, collecting, transporting and treating all waste produced on the Project Areas by its personnel, Subcontractors and visitors.

15.2 Waste management should be based on the following hierarchy: prevention of waste generations, reuse, recycling and disposal. The Contractor selects suppliers having a voluntary and documented policy to reduce the volume and weight of packaging, and to select recyclable or biodegradable packaging.

15.3 The Contractor establishes and maintains a waste register which is at the disposal of the Engineer. This register will record all waste management operations: production, collection, transport, treatment. The following aspects are documented in this register:

a) Type of waste, using the nomenclature specified in Sub-Clause 15.7 of the ESHS Specifications;

b) Waste quantities;

c) Name and address of the third party waste management facilities receiving waste or parties taking possession of the substances no longer considered as waste;

d) Name and address of waste transport contractors;

e) Planned waste treatment.

15.4 The Contractor files and maintains at the disposition of the Engineer the waste manifests for the collection, transport, treatment and/or elimination of waste.

15.5 The waste register is established and available as of the Contractors mobilisation to any Project Area. This register will be archived for at least 1 year after the Taking-Over Certificate for the Works is issued.

15.6 The Contractor implements specific waste management practices adapted to the level of danger for human health or the natural environment. Three waste categories are identified for Project Areas and in tracking documents:

a) Hazardous waste: any waste with one or several dangerous properties as listed in Appendix 2 to the ESHS Specifications;

b) Non-hazardous waste: any waste with no properties rendering it hazardous. Non-hazardous waste contaminated by hazardous material will be considered as hazardous waste, unless instructed otherwise by the Engineer;

c) Inert waste: any waste unaffected by any significant physical, chemical or biological modifications, which does not decompose, burn or produce any physical or chemical reaction, is not biodegradable and does not damage any substance with which it comes into contact in a manner likely to cause damage to the environment or human health.

15.7 The Contractor assesses, document and effectively implements any local recycling or re-use options for its waste.

15.8 Waste is categorised and stored separately prior to removal from the Project Areas, depending on the level of danger, phase (liquid, solid or gas), the waste management solution to be applied and its potential in terms of recycling or reuse.

15.9 Waste is collected from each Project Area at the same rate that it is produced and is placed in temporary locations meeting the following criteria:

a) Located at a distance of over 100 m from any natural sensitive area and over 500 m from any socioeconomic sensitive area (school, market, healthcare centre, water well

or catchment area), with the exception of waste storage area in camps;

b) Protected from moving machinery and vehicles, but easy to access for regular collection;

c) Located on a flat impervious surface to prevent infiltrations;

d) Under cover for non-inert waste;

e) Stored in containers of the appropriate size, tightness and level of resistance depending on the danger and phase (solid, liquid, gas) of the waste;

f) Liquid wastes storage is equipped with secondary retention with a volume at least equal to the greater of the following two values (i) 100% of the capacity of the largest reservoir and (ii) 50% of the overall capacity of the associated reservoirs;

g) Hazardous waste stored pursuant to Sub-Clause 26.8 of the ESHS Specifications.

15.10 Waste is removed from Project Areas and transported to recycling, treatment and waste management facilities on a regular basis. The frequency of removal, approved by the Engineer, guarantees:

a) No overflow from containers;

b) No unpleasant odour or emissions which are dangerous for human health;

c) No proliferation of insects, rodents, dogs or other animals which are harmful or dangerous for human health;

d) Regular cleaning of containers and surfaces on which they are located.

15.11 Unless otherwise specified in the Contract or instructed by the Engineer, waste incineration is prohibited on Project Areas. Two exceptions are medical waste and green waste, which unless instructed to the contrary by the Engineer, are managed pursuant to Clauses 15.15.1 and 16.1.3 of the ESHS Specifications.

The use of third party waste management services is subject to a documented prior audit of the treatment, storage and recycling facilities by the Contractor, to guarantee the conformity with the provisions of the ESHS Specifications on waste.

15.12 Pursuant to Sub-Clause 1.5 of the ESHS Specifications, the provisions applicable to the Contractor regarding waste management also apply to any third party waste management Subcontractor. The Engineer reserves its right to inspect third party waste management facilities and prohibit the Contractor from using the facilities if considered unacceptable.

15.13 The management of non-hazardous waste complies with the following conditions:

15.13.1 Inert waste is removed or treated on-site and can be disposed in a permanent or temporary landfill with unused backfill material. The location, capacity and environmental protection measures, particularly for water courses, implemented by the Contractor or any Subcontractor, will

comply with the provisions of the ESHS Specifications, and will be described in the EPP and validated by the Engineer.

15.13.2 Non-hazardous waste that cannot be recycled is disposed of to landfill, complying with the following criteria:

a) Walls and base sealed by a geo-membrane or a layer of compacted clay with a permeability 10^{-7} cm/s;

b) Drained for the recovery of leachates, which are routed to a lagoon aerobic/anaerobic treatment prior to discharge into the natural environment or collected in a temporary storage prior to regular collection and transfer to a treatment unit (septic tank or wastewater treatment plant);

c) Regularly compacted and covered by earth to limit odours and the proliferation of insects;

d) When the landfill has reached full capacity, vents are installed to evacuate gases, and the landfill covered by a geo-membrane with a minimum thickness of 1 mm, or a layer of compacted clay, and a top layer of 1.5 m of topsoil, which is revegetated.

Any other proposal must first be validated by the Engineer.

15.14 The Contractor's hazardous waste is managed by a specialised waste Subcontractor, accredited in the Employer's country for this activity.

15.15 In the absence of an existing waste management solution for hazardous waste satisfying the provisions of Sub-Clause 15.14 of the ESHS Specifications, the Contractor takes the following action:

15.15.1 Medical waste is incinerated in a specific facility constructed and accredited for this purpose. The Contractor will submit the technical specifications of the facility to the Engineer before importing or procuring the equipment.

15.15.2 Hydrocarbons, lubricants, paints, solvents and batteries are transported in drums to the capital city, or any other city where suitable waste management facilities are available. Sludge from settling tanks/ponds, septic tanks or oily water skimmers will also be managed in the same way.

15.15.3 Contaminated soils from construction/demolition and drilling muds will be treated, stabilised and disposed of to landfill. Prior approval is required from the Engineer regarding the method and site location. The Contractor obtains authorisation from the competent local authorities prior to any disposal to landfill.

15.15.4 Prior approval from the Engineer is required before implementing waste management solutions on any other hazardous waste.

15.15.5 Prior to the issue of the Taking-Over Certificate for the Works, the Contractor provides documentation on hazardous waste landfilled at other sites than accredited third party waste management facilities. The documentation includes a

plan showing the location of landfill sites. The document is provided to the competent local authorities whose jurisdiction covers the landfill sites.

16 Vegetation clearing

16.1 The Contractor describes in the Worskite - ESMP the planned methods and schedule for vegetation clearing. Specific agreement from the Engineer is obtained prior to any clearing works.

16.1.1 Vegetation clearing using chemicals is not permitted.

16.1.2 Vegetation clearing using bulldozer is not permitted in zones less than 30 m from areas designated as sensitive by the Engineer, where only manual clearing is authorised.

16.1.3 Unless otherwise specified in the Contract or if otherwise instructed by the Engineer, burning vegetation is not permitted. Green waste can be burnt with prior approval from the Engineer regarding the location, method and schedule.

16.2 Areas cleared prior to undertaking earthworks are shown on a plan with a minimum scale of 1/10,000. Plans are submitted to the Engineer for validation prior to starting clearing works.

16.3 The Contractor undertakes physical demarcation of zones to be cleared using a method approved by the Engineer.

16.4 Trees not to be cut down are identified in relation with the Engineer. Such trees are marked with paint and protected against clearing machinery using a method approved by the Engineer.

16.5 Clearing is undertaken without damage to adjacent non-cleared areas. Topsoil is stored within the cleared areas at the edge of the cleared zone. Clearing is undertaken working from the edge of the zone inwards.

16.6 Wood with economic value:

16.6.1 During clearing, the Contractor stockpiles separately: (i) tree trunks with a diameter at chest height greater than the size defined by the Engineer, and (ii) trunks with a smaller diameter, branches, leaves, stumps and roots.

16.6.2 Unless instructed otherwise by the Engineer when validating the plans of Sub-Clause 16.2 of the ESHS Specifications or unless specified otherwise in the Employer's country regulations, the trunks of trees exceeding the diameter defined by the Engineer are made available to the local communities, according to the methods defined with the Engineer.

17 Biodiversity

17.1 The Contractor shall ensure that all personnel are informed and aware of the importance to protect fauna and flora. Information and awareness training is documented.

17.2 The Contractor shall ensure that all personnel are informed and aware of wildlife encounters procedures. Information and awareness training is documented.

17.3 The Contractor shall define in the Worksite – ESMP the method with regards to fauna and flora management prior to clearing activities. This method must notably address the work schedule,

which sometimes can be adjusted to limit impacts on fauna and flora.

17.4 Where possible, areas shall be cleared from one side to another, or from the inside out, to prevent animals becoming trapped.

17.5 The Contractor personnel shall not approach, injure, hunt, capture, possess, feed, transport, rear or trade wild animals and/or collect eggs while working on the Project Areas.

17.6 The Contractor personnel shall not collect flora species while working on the Project Areas.

17.7 The Contractor shall report any sighting or finding of wounded or dead wildlife to the Engineer immediately.

17.8 The Contractor shall protect excavations to prevent injury to animals.

17.9 The Contractor shall release any trapped uninjured animals immediately.

17.10 The Contractor shall not disturb natural habitats outside the Project Areas.

17.11 The Contractor shall only use designated roads or paths and abide by speed limits.

17.12 The Contractor shall not start forest fires.

17.13 The Contractor shall not introduce Invasive Alien Species (IAS).

17.13.1 All construction machinery imported from overseas shall be inspected to detect IAS and washed before dispatching to the Project Areas.

17.13.2 If the presence of topsoil contaminated with IAS is detected, that topsoil shall only be stored or re-spread in the area from where it was removed.

17.13.3 When earthworks are carried out in IAS contaminated areas, vehicles shall be washed before moving them to other areas.

17.13.4 Where necessary, the Contractor shall develop IAS control procedures (e.g. physical removal, slashing, mulching, herbicides, etc.). Methods used to control or prevent such species shall not cause adverse impacts on the environment or communities.

17.13.5 To limit the risk of introducing marine invasive species, the Contractor shall control the ballast water and anti-fouling systems of vessels arriving from other bioregions in accordance with International Maritime Organization (IMO) conventions and guidelines.

18 Erosion and sediment transport

18.1 The Contractor plans earthworks and optimises the management of space to ensure that all cleared surfaces and areas exposed to soil erosion are minimised on all Project Areas.

18.2 Topsoil:

18.2.1 Unless indicated otherwise by the Engineer, the top 25 centimetres of the soil will be considered as topsoil.

18.2.2 Earthworks for the temporary occupation of the Project Area are preceded by the clearing of topsoil and the storage of this soil separately from the underlying sterile soil.

18.2.3 Topsoil is stored according to the provisions approved by the Engineer to enable reuse during Project Area rehabilitation.

18.2.4 The refurbishment must be done in accordance with the provisions of Clause 19.

18.3 Draining and treatment of rainwater run-off:

18.3.1 The gradient of Project Areas allows the collection and drainage of rainwater from the entire surface area to one or several discharge points. No pools of water are created.

18.3.2 Suspended solids in rainwater are removed using sediment traps / settling ponds. Rainwater from vehicle parking areas, machinery areas, workshops is subject to treatment with oily water separators.

18.3.3 Rainwater treatment units are sized, cleaned, maintained and accessible to ensure compliance with the effluent quality criteria defined in Sub-Clause 12.9 of the ESHS Specifications and to allow monitoring of performance.

18.4 Sediment control:

18.4.1 The Contractor installs sediment control barriers to slow the flow of water and control sediment transport at Project Areas with (i) a gradient of more than 20%, and (ii) where land is disturbed by the Works or where stockpiled mineral material are susceptible to erosion.

18.4.2 Sediment control barriers are installed on the slope or at the base of the slope to protect the natural drainage system from sediment accumulation at levels higher than the natural situation. These barriers comply with the following principles:

a) Made with geotextiles or straw bales or any other means pre-approved by the Engineer;

b) Deployed before the start of works and removal of topsoil. Barriers can be used for the physical demarcation of working areas;

c) Installed, cleaned, maintained and replaced according to manufacturer recommendations;

d) Drainage surface area does not exceed 1,000 m² per 30 m of barrier. The length of the slope behind the barrier is less than 30 m, and is not used for flows in excess of 30 l/s.

18.4.3 For the dredging of marine sediments, unless specified otherwise in the Contract, or instructed otherwise by the Engineer, and particularly if the working area is exposed to currents, the Contractor will install a geotextile silt curtain, or any other technique approved by the Engineer to control turbidity clouds.

18.5 Backfilling and stockpiling of backfill materials:

18.5.1 In the EPP of these temporary and permanent stockpiles, the Contractor defines the proposed arrangements (height, slope, drainage, revegetation, etc.) to guarantee stability and erosion resistance.

18.5.2 For permanent backfill material stockpiles, the stockpile is shaped and compacted to ensure long-term stability.

18.5.3 Temporary stockpiles likely to result in strong erosion (duration of storage, rainy season, presence of downstream issues, etc.) are protected against runoff erosion by (i) revegetation using fast growing grass species, either by direct seeding or by hydro-seeding, or (ii) using other natural anti-erosion cover with prior approval from the Engineer.

19 Site rehabilitation

19.1 Unless instructed otherwise by the Engineer, the Contractor will rehabilitate all Project Areas disturbed by the Works, prior to the provisional acceptance of the Works.

19.2 All buildings and free standing and underground structures (e.g. piping, underground tanks, sumps and basins) are removed pursuant to the provisions of Sub-Clause 4.23 of the CC. All waste and rubble is removed in accordance to the provisions of Clause 15 of the ESHS Specifications. After removal of buildings structures and rubble, the Contractor returns Project Areas to their original condition, according to the following provisions.

19.2.1 Land is adjusted to ensure that run-off water drains without eroding soil or stagnating in pools. Unless instructed otherwise by the Engineer, the gradients of restored sites (excluding backfill as defined in Sub-Clause 18.5 of the ESHS Specifications) must be as for the adjacent undisturbed land.

19.2.2 Rehabilitated Project Areas do not represent hazards for people. Areas near steep drops at quarries are indicated with permanent concrete signs. Holes are refilled. Sharp or unstable items are rendered inoffensive.

19.2.3 Unless specified otherwise in the Contract, or instructed otherwise by the Engineer, the Contractor undertakes revegetation of all Project Areas disturbed by the Works and bears the cost of such work.

19.2.4 Topsoil set aside during initial earthworks pursuant to Sub-Clause 18.2 of the ESHS Specifications, is evenly spread over cleared areas. The surface of compacted soils on Project Areas is loosened by scouring (using rakes or other acceptable methods).

19.2.5 The Contractor describes in the Worskite - ESMP the planned revegetation works to ensure sustainable Project Area rehabilitation: methods, plant species to be used and their origins, activity schedule based on a progressive taking over of Project Areas.

19.2.6 Prior approval by the Engineer is required regarding the origin of seeds and plants proposed by the Contractor. The species used for revegetation must be suitable for the local environmental conditions, and selected according to the

rehabilitation program: stabilisation of backfill, landscaping, drainage, prevention of erosion, etc.

19.2.7 Revegetation is undertaken throughout the duration of construction Works, and is not limited to the rehabilitation of Project Areas at completion of the Works.

20 Documentation on the Project Area condition

20.1 The Constructor documents changes in condition of all Project Areas from the start of Works until the Performance Certificate is issued. Documentation comprises dated and geo-referenced colour photographs taken from a constant angle and viewpoint.

20.2 The Project Area condition is documented as a minimum for the following stages:

a) Before any Project Area disturbance at the start of works;

b) On completion of Works, but prior to starting rehabilitation;

c) On completion of rehabilitation and revegetation, if necessary, but prior to the Taking-Over Certificate issuing;

d) After the end of the Defects Notification Period and prior to the Performance Certificate issuing.

20.3 The Contractor specifies in the Worskite – ESMP: (i) the list of viewpoints to be used, (ii) areas to be photographed, and (iii) methods used for taking and archiving photographs.

20.4 Adjacent areas (100 m from the perimeter of the Project Area) are included in photographic documentation.

20.5 Unless instructed otherwise by the Engineer, structures to be buried are photographed weekly until covered. As a minimum the structures are photographed twice for Works with duration of less than 7 days, and at least once a week for Works with a longer duration.

20.6 Photographs subject to the present Clause 20 are archived in digital format and provided to the Engineer on a monthly basis under the CC Sub-Clause 4.21 monthly progress report.

20.7 The nomenclature of electronic files for photographs explicitly indicates the Project Area, date and structure documented.

C. Health & Safety

21 Health and Safety Plan

21.1 In application of Clauses 4 and 6 of the CC, the Contractor describes in the Health and Safety Plan section of the Worskite - ESMP its organisation for managing health and safety (section 7 of Worksite – ESMP as described in Appendix 1 to the ESHS Specifications), pursuant to its Health and Safety Management System (HSMS).

21.2 Pursuant to Clause 6 of the CC, the plan identifies and specifies:

a) All health and safety risks relating to the execution of the Works, by also identifying gender-specific risks;

b) Prevention and protection measures to control risks related to the execution of the Works, by differentiating, where necessary, measures concerning the protection of women and men;

c) Human and material resources involved;

d) Works requiring work permits; and

e) Emergency plans to be implemented in the case of an accident.

21.3 In addition, this Health and Safety Plan describes how workers are trained in health and safety aspects.

21.4 The Contractor implements prevention, protection and monitoring measures, as described in the Health and Safety Plan.

22 Daily and weekly meetings

22.1 The Contractor organises as a minimum one health and safety meeting per Project Area per week (or at another frequency approved by the Engineer) with all the personnel assigned to the Project Area. This applies only to Project Areas where work is ongoing. At the meeting accidents and incidents that occurred in the previous week are discussed and feedback provided. Means of improvements are identified, documented and assessed to establish corrective actions. The Engineer is invited to participate at all health and safety meetings. Meeting reports are provided to the Engineer.

22.2 The Contractor organises daily (or at another frequency approved by the Engineer) health and safety meetings per team at all Project Areas, prior to the start of the daily work. The meeting establishes the health and safety risks associated with the day's tasks and activities, and means of prevention and protection to be implemented. Minutes of the meetings shall be recorded.

23 Equipment and operating standards

23.1 The facilities and equipment used by the Contractor are installed, maintained, revised, inspected and tested pursuant to the manufacturer's recommendations. The recommendations are available in the language of communication defined under CC Sub-Clause 1.4 (or any other language approved by the Engineer).

23.2 The Contractor lists and describes in the Health and Safety Plan the national and international standards, guidelines and industry codes of practice, applied during the execution of works.

24 Work permit

24.1 Unless otherwise provided in the Contract, or unless otherwise instructed by the Engineer, work requiring work permits are defined in the Health and Safety Plan. Work permits will be documented and saved.

24.2 The Contractor puts in place a work permit procedure to manage risks through the implementation of prevention and protection measures prior to the starting of work. This procedure is subject to validation by the Engineer.

25 Personal protective equipment

25.1 The Contractor ensures that all personnel, visitors or third parties entering a Project Area are equipped with Personal Protection Equipment (PPE) pursuant to the practices and standards specified in Clause 9.

25.2 The Contractor describes in the Health and Safety Plan the PPE to be used per Project Area and per activity.

25.3 Personnel and visitors to Project Areas are equipped with a safety helmet, safety shoes and a reflective jacket as a minimum.

25.4 Adequate quantities of PPE are available on the Project Areas. Storage conditions must be compatible with usage pursuant to the provisions of Sub-Clause 23.1 of the ESHS Specifications.

25.5 Contractor personnel are trained in how to use and care for PPE and the Engineer must be able to obtain the training reports.

26 Dangerous substances

26.1 A substance is considered dangerous if one or several of its properties render it dangerous, as defined in Appendix 2 to the ESHS Specifications. The Contractor identifies and manages dangerous substances planned for use on the Project Area in the manner described in the present Clause 26.

26.2 Details of risks and related prevention and protection measures are included in the Health and Safety Plan.

26.3 The assessment of the impact of the toxicity of dangerous substances on the reproductive functions of women and men must be taken into account.

26.4 The transport to the Project Area and use of dangerous substances requires prior authorisation from the Engineer.

26.5 The Contractor obtains all necessary authorisations and/or licenses for the storage and use of dangerous substances from local authorities. A copy of the authorisations is provided to the Engineer.

26.6 For each dangerous substance used, the Contractor will implement the recommendations described (i) in the Material Safety Data Sheets (MSDS), and (ii) by the Globally Harmonized System of Classification and Labelling of Chemicals established by the United Nations for hazardous chemicals.

26.7 Copies of MSDSs are kept on the Project Area, and made available to personnel. The Contractor's staff is aware of the health and safety risks related to hazardous materials. The Contractor provides the Engineer with copies of all MSDSs and training reports.

26.8 Storage of dangerous substances

26.8.1 Storage area are designed and equipped by the Contractor based on the chemical and physical properties of the substances, on the types of containers stored, the number of people requiring access, the ventilation requirements, the quantities of the substance used and potential chemical reaction with other substances (see Sub-Clause 26.8.5 of the ESHS Specifications).

26.8.2 Pursuant to Sub-Clause 15.6 of the ESHS Specifications, the Contractor anticipates and plans for the storage and management of hazardous waste.

26.8.3 Storage areas for dangerous substances are subject to strict rules, which are regularly checked by the ESHS Manager appointed pursuant to Sub-Clause 4.1.4 of the ESHS Specifications. The rules include the following as a minimum:

a) Access to the storage area is limited to trained and authorised individuals;

b) An inventory is maintained up-to-date;

c) MSDSs must be available for all stored dangerous substances, and the substances must be clearly labelled;

d) A strict and methodical storage system is implemented (storage plan posted, large or heavy packaging may not be stored at heights, equipment and tools may not be stored in the dangerous substance storage room);

e) Compliance with product expiry dates and implementation of a disposal procedure for substances which are not needed or which have expired;

f) Entrances, exits and access to emergency equipment are kept clear at all times.

26.8.4 Storage areas are clearly identified with warning signs at the entrance. The Contractor displays the storage plan (location of the different products, maximum inventory), a summary of labelling system and information on chemical incompatibilities.

26.8.5 Chemicals which could react together (leading to explosions, fire, projections or the emission of dangerous gases) are physically separated.

26.8.6 Products that react violently with water are stored so as to prevent contact with water, even in the event of flooding.

26.8.7 Inflammable products are stored separately in a dedicated area with adequate ventilation at all times.

26.8.8 Buildings used to store large quantities of dangerous substances are isolated from other buildings to avoid the spreading of fire. Such buildings are constructed using solid and non-combustible building materials, and are equipped with evacuation systems and the appropriate firefighting equipment. Access to the buildings is clear, allowing for rapid evacuation in the event of an accident. The electrical systems are reduced to the essential minimum, and access points are equipped with adequate lighting (300 lux).

26.8.9 All storage areas are equipped with secondary retentions. Each storage area acts as a general secondary retention. Suitable absorbents (neutralising and non-combustible) are available in the storage area to clean up any spills and leaks.

26.8.10 The Contractor maintains the storage area at a suitable temperature for storing dangerous substances at an appropriate level to avoid any deterioration of the containers.

27 Planning for emergency situation

27.1 The emergency plan required in application of Sub-Clause 21.2 of the ESHS Specifications covers the following emergency situations as a minimum:

a) Fire or explosion;

b) Structural failure;

c) Loss of the containment of dangerous substances;

d) Safety incident or malicious act;

e) Natural disasters.

27.2 The Contractor details the emergency plan in the Health and Safety Plan.

27.3 The Contractor ensures that all personnel are informed and aware of how to react in an emergency situation, and responsibilities are defined. Information and awareness training are documented, and available on all Project Areas.

27.4 The Contractor organises and documents emergency simulation exercises within 3 months of the physical start of the Works, and subsequently once every 12 months up to the issue of the Taking-Over Certificate. The Engineer is invited to participate in each of these exercises.

27.5 Fire extinguishers are made available in each building at clearly identified locations.

28 Medical check-ups

28.1 The Contractor organises medical check-ups for all Contractor's Personnel prior to the initial mobilisation to the Project Area to check aptitude for the work. Medical check-ups are adapted to the anticipated occupied positions and carried out pursuant to the recommendations of the International Labour Organization. Subsequent to the check-up, a written medical certificate is issued declaring the aptitude of the worker for the allocated tasks.

28.2 Hearing tests are conducted for the Contractor's personnel exposed to specific risks (such as noise levels above 80 dB(A), exposure to hazardous materials, etc.) in order to establish an initial state of health. Annual tests are carried out to monitor any changes and detect any deterioration.

28.3 The Engineer can request additional medical examinations for the Contractor's Personnel if considered necessary, and all associated costs shall be borne by the Contractor.

28.4 A medical examination is carried out on any Contractor's Personnel returning to work after leave caused by a work related accident. A written medical certificate is issued confirming the Contractor's Personnel's aptitude to return to work at the designated workstation.

28.5 The Contractor can produce a copy of its Contractor's Personnel's work aptitude certificates at the request of the Engineer or any competent authority.

28.6 Specific arrangements for tasks' assignments or workstations shall be made for pregnant Personnel.

29 First aid

29.1 The Contractor ensures that at least one first aid officer is present at all times during working hours per Project Area and per team of 10 to 50 workers present, and one extra first aid officer for each additional 100 workers.

29.2 The Project Area must be equipped with a communication system available immediately and primarily for the purposes of communication with the first aid services. Information on how to communicate with the first aid services is clearly indicated near the communications equipment.

30 Health care centre & medical personnel

30.1 For Project Areas with more than 35 workers present at any one time and where it is not possible to reach a hospital, medical clinic or the Contractor's health centre within a period of 45 minutes, by land and in normal conditions:

30.1.1 The Contractor sets up a health care centre at its own cost. This centre is:

a) Operational and easy to access all times;

b) Kept clean and in good condition;

c) Equipped with appropriate heating or air-conditioning;

d) Equipped with sanitary facilities and drinking water;

e) Equipped with instruments, equipment, medicines and material required to examine and treat injured or sick workers in emergency conditions;

f) Equipped with the supplies and furnishing required to allow medical personnel to provide first aid and fulfil their other functions.

30.1.2 A doctor is present on-site at all times, working full-time during normal day hours. The doctor is on-call when more than 20 workers are working simultaneously outside of normal day hours.

30.1.3 The doctor has the following profile:

a) At least 5 years' experience on large-scale construction works at sites located at a distance from a hospital;

b) Trained in infectious diseases, waterborne and epidemiological diseases prevalent in the Employer's country;

c) Able to lead training sessions on occupational health and first aid;

d) Trained in management and logistics for a remote health care centre;

e) Able to speak the same working language used by most members of personnel fluently (communication in emergency situations);

f) In good physical condition, able to access remote working areas.

30.1.4 The Contractor allocates a road or air vehicle for first aid purposes to the first aid station pursuant to standard NF EN 1789/2007.

30.1.5 The Contractor ensures the presence of at least one nurse to assist the doctor per team with 200 - 800 workers allocated, and one extra nurse for each additional 600 workers allocated to this team. Over and above 500 workers per team, the Contractor ensures the presence of an extra doctor for each additional 500 workers allocated to this team.

31 First aid kits

31.1 Each Project Area must be equipped with an adequate number of first aid kits to ensure that all workers can access these kits in approximately 5 minutes. Kits must be available at all times.

31.2 Each vehicle is equipped with a first aid kit.

31.3 First aid equipment complies with attached specifications.

32 Emergency medical evacuations

32.1 The Contractor establishes, and provides the Engineer within one month of the physical start of works a copy of an agreement with a specialised company for the handling of personnel in the event of a serious accident requiring an emergency medical evacuation, which cannot be organised using the first aid vehicle specified in Sub-Clause 30.1.4 of the ESHS Specifications without endangering the life of the patient.

32.2 The agreement includes a convention with a referring hospital where the member of personnel evacuated in emergency conditions will be treated.

32.3 The agreement covers the use of air transportation in order to evacuate the injured patient(s) to the referring hospital.

33 Access to health care

33.1 The Contractor guarantees access to health care as defined in Clause 30 for all personnel in necessary cases of accident or illness occurring during the execution of the Works, i.e.:

a) Medical check-ups: initial (recruitment), annual and upon returning to work after sick leave;

b) Screening, vaccinations and preventive healthcare;

c) General healthcare during the execution of the Works;

d) Medical assistance in the event of an accident and assistance for emergency evacuations.

33.2 Subcontractor's personnel, other contractors, the Employer or the Engineer, present at the Project Area, must never be refused medical assistance, under the pretext that they are not directly employed by the Contractor. The Contractor may however define a unit rate cost per medical act for personnel, other than its own Contractor's Personnel, display this rate in the healthcare centre and forward the information to the Engineer.

33.3 In the event of accident or serious illness, medical personnel must be trained, available and equipped with the necessary material, medicines and consumables to provide first aid for the patient, stabilise their condition, until the patient is:

a) Either treated or discharged; or

b) Hospitalized at the camp or in a larger hospital; or

c) Evacuated to a medical centre which is well equipped for intensive care, if necessary.

34 Health monitoring

34.1 The Contractor cannot recruit workers in poor health.

34.2 The initial pre-recruitment examination must confirm that applicants carry no infectious diseases and are physically able to carry out the tasks required for the position.

34.3 The detection of pregnancy during the initial pre-recruitment examination of female applicants shall not constitute grounds for declining recruitment, unless medical risk is proven.

34.4 The Contractor organises annual medical check-ups for its Contractor's Personnel and keeps up to date a medical record for each Contractor's Personnel. The presence of Contractor's Personnel for medical check-ups, treatment and hospitalisation is incorporated into the Contractor's planning.

34.5 The Contractor provides the Contractor's Personnel with prophylaxis and vaccinations against local diseases and vectors. In particular, the Contractor will promote the use of impregnated mosquito nets by its Contractor's Personnel in camps or off-site lodging, and distributes these nets appropriately.

34.6 The Health and Safety Plan includes a Contractor's Personnel health risk assessment based on exposure to specific risks (such as noise levels above 80dB(A), exposure to hazardous materials, etc.) and describes the medical monitoring implemented.

35 Sanitary repatriation

35.1 The Contractor is responsible for the sanitary repatriation of Contractor's Personnel in the event of a serious injury or illness. The Contractor will take out the necessary insurance to cover the cost of the sanitary repatriation of its Contractor's Personnel.

36 Hygiene, accommodation and food

36.1 Drinking water:

36.1.1 Pursuant to Sub-Clause 6.14 of the CC, the Contractor provides personnel with drinking water at all Project Areas. The quantity and quality of this water complies with the standards of the World Health Organization at supply points.

36.1.2 Unless the supply of drinking water is provided by a certified supplier, the quality of the drinking water provided to workers is tested at least at the start of the Works and then on a monthly basis. The protocol for taking and analysing samples is based on the recommendations of the World Health Organization. The results shall be documented and made available on the Project Areas.

36.2 Accommodation conditions:

36.2.1 The accommodation provided for non-resident Personnel in a camp or an alternative structure outside of the Project Areas, such as a hotel or rented house, will comply with the conditions of Sub-Clause 36.2 of the ESHS Specifications in pursuance of Sub-Clause 6.6 of the CC.

36.2.2 Unless specified otherwise in the Contract, or instructed otherwise by the Engineer, Personnel are housed in rooms. Rooms do not host more than 4 individuals, with no bunk beds, and with 0.5 m^3 of storage space available per person.

36.2.3 Rooms shall not be mixed: separate rooms must be made available for both men and women.

36.2.4 Rooms are lit and equipped with power sockets, beds and windows fitted with mosquito nets. Flooring is of a hard and impervious material.

36.2.5 The temperature in rooms and common areas shall be kept at an appropriate level during occupied hours.

36.2.6 Night-time noise levels to which personnel are exposed comply with the limits recommended by the World Health Organization.

36.2.7 The Contractor provides one drinking water tap per 10 Contractor's Personnel, one shower per 10 Contractor's Personnel as a minimum, one individual toilet for 15 Contractor's Personnel as a minimum, and one urinal per 25 Contractor's Personnel at accommodation camps. Separate showers, toilets and locker-rooms must be made available for women.

36.2.8 The Contractor constructs and maintains a shared leisure area in each camp and a sports field for use by Personnel.

36.3 Hygiene in shared areas:

36.3.1 Sanitary areas (showers, sinks, urinals, toilets) are cleaned and disinfected by the Contractor's cleaning service at least once every 24 hours. Cleaning operations are documented.

36.3.2 The canteen, kitchen and kitchen utensils are cleaned after each meal service.

36.3.3 The number and location of toilets on Project Areas shall be adapted to the number of employees and the configuration of the Project Areas (distance, isolated area, etc.). Separate toilets will be made available for women.

36.4 Food:

36.4.1 In application of Sub-Clause 6.13 of the CC and Sub-Clause 41.1 of the ESHS Specifications, the Contractor provides meals at a reasonable cost to its Contractor's Personnel in a canteen area and according to a procurement system which complies with the provisions of Sub-Clause 36.4 of the ESHS Specifications.

36.4.2 The Contractor defines and implements actions in order to guarantee (i) the quality and quantities of food stuffs, (ii) compliance with health rules when preparing meals, (iii) fitting out and servicing premises and equipment, both in the kitchen and food storage areas.

36.4.3 The Contractor inspects the cleanliness of food transport vehicles, temperature control and the cold chain, as well as best before dates, and takes the necessary corrective actions. The temperatures of chillers are regularly checked.

36.4.4 The Contractor checks that health requirements are met for food storage conditions in the kitchen or other locations, food cooking times and temperatures, and the conditions in which prepared products are left prior to consumption, to ensure no health risks. No food remains are to be reused.

36.4.5 The Contractor recruits trained canteen personnel and ensures that supervisors monitor compliance with sanitary instructions. The Contractor ensures that canteen personnel have means of ensuring compliance with health rules

(changing rooms, linen, hand washers, the condition of flooring and paint, and the existence of a cleaning plan).

36.5 The ESHS Manager carries out an audit on all Project Areas every 3 months, and documents the results, and includes the conditions of hygiene in which meals are prepared and food conserved. The results of this audit are provided to the Engineer.

36.6 The ESHS Manager regularly informs Contractor's Personnel on appropriate behaviour in terms of workplace hygiene. This information is documented and saved.

37 Substance abuse

37.1 Pursuant to Sub-Clause 6.16 of the CC, the use, possession, distribution or sale of illegal drugs, controlled substances (as per local regulations) and alcohol is totally prohibited on the Project Areas. The Contractor implements a zero tolerance policy for the consumption of these substances.

37.2 Any person suspected by the Engineer to be under the influence of alcohol or controlled substances on any Project Area is immediately suspended from his position by the Contractor, pending the results of medical tests.

D. Local Labour and Relations with Local Communities

38 Labour conditions

38.1 The Contractor should ensure decent labour conditions for workers and notably compliance with applicable law and regulations in the country of implementation of the contract, and with the fundamental conventions of the International Labour Organisation (ILO). This includes workers' rights related to wages, working hours, rest and leave, overtime, minimum age, regular payment, compensation and benefits. The Contractor should respect and facilitate workers' rights to organise and provide a grievance mechanism for all direct and indirect workers. The Contractor should implement non-discrimination and equal opportunity practices, and ensure prohibition of child or forced labour.

39 Local recruitment

39.1 Local recruitment is defined as the number of positions actually allocated to people residing in the region of the Works, which must be defined by the Contractor in its offer according to relevant criteria by giving priority to populations living in the area of influence or in the immediate proximity of the Project Area.

39.2 Pursuant to Sub-Clause 6.1 of the CC, the Contractor implements a voluntary local recruitment policy for its personnel for the duration of the Works and shall enforce this policy to its Subcontractors.

39.3 The Contractor demonstrates the effective implementation of this voluntary policy to the Engineer in its monthly activity report as defined in Sub-Clause 6.3 of the ESHS Specifications.

39.4 Pursuant to Clause 8 of the ESHS Specifications, the Contractor shall develop a training program. This training program must be open to women and men and be adapted to their level of education and needs of each group to occupy the positions proposed during the Works.

39.5 Local labour needs are estimated prior to the start of Works and described in the Worskite - ESMP with the following information:

a) Identification of positions that could be filled by local staff and the level of qualification required;

b) Definition of the planned procedure for the effective recruitment of these members of staff;

c) Establishment of mechanisms to ensure non-discrimination of women in accessing recruitment procedures. This mechanism must cover the definition of the positions, the methods of communication on the positions to be filled, etc.;

d) Deployment schedule for these positions;

e) Initial training to be provided by the Contractor for each job description.

39.6 In order to prevent outsiders from entering the Project Area, local recruitment at the Project Area, including at the entrance, is prohibited.

39.7 Local recruitment office:

39.7.1 Prior to the start of works, the Contractor establishes a local recruitment office in the district where the main Project Area is located, at a location pre-approved by the Engineer.

39.7.2 A representative of the Contractor is present in this office at least two mornings each week, from the start of the Works to a date pre-approved by the Engineer.

39.7.3 The representative provides information on job vacancies with the Contractor for the execution of the Works (required qualifications, duration, and location) and on the information to be provided in applications.

39.7.4 Lists of local candidates are drafted by the representative allocated to the office and forwarded to the Contractor's humans resources manager on a weekly basis.

39.8 The Contractor's Human Resources manager selects candidates listed by the local recruitment office based on requirements for the Works and the Contractor's recruitment procedures. A written contract between the Contractor and the local Contractor's Personnel is drafted, signed and archived by the Contractor.

39.9 If the Project Areas are located near to several different communities, the Human Resources manager ensures a fair distribution of local recruitment between the different communities, by giving priority to the people affected by the project.

39.10 The Human Resources manager will ensure that recruitment campaigns in local communities have been spread to women and that the latter have not been discriminated in recruitments.

39.11 Pursuant to Sub-Clause 6.22 of the CC, the Contractor maintains one record per local Contractor's Personnel indicating the hours worked per person allocated to the Works, the type of tasks carried out, the wages paid and any training taken. Records are available at the main Project Area at all times, so the Engineer and the authorised representatives of the government can assess the content.

40 Transport & accommodation

40.1 Unless specified otherwise in the Contract, or instructed otherwise by the Engineer, the Contractor provides or enables access to daily transport for Contractor's Personnel living more than 15 minutes' walk from the Project Area and more than one hour by land transport.

40.2 The transport is organised under conditions which comply with local regulations and which ensure the safety of the people transported.

40.3 The Contractor organises collective transport: pick-up times and locations are defined and services organised appropriately.

40.4 If the Project Area is moved during the working season and if the Contractor retains the local personnel trained at the start of the Works, the accommodation of the Contractor's Personnel is managed by the Contractor:

a) Within a mobile camp with the other non-local Contractor's Personnel; or

b) In villages located near to the mobile Project Area, in this case, each local Contractor's Personnel will receive a housing allowance in addition to his wages.

41 Meals

41.1 Food supplies for the meals of the Contractor personnel will exclude any meat obtained from hunting or poaching, with the exception of fish.

41.2 The Contractor provides at least two meals per day to local Contractor's Personnel pursuant to the hygiene conditions specified in Clause 36 of the ESHS Specifications, at reasonable price.

42 Damage to people and property

42.1 The Contractor shall not disturb or interfere with the inhabitants of local communities close to or in the Project Area, and shall respect their houses, cultures, animals, properties, customs and practices.

42.2 Pursuant to Sub-Clauses 4.14 and 17.1 of the CC, the Contractor is responsible for damages to people and property caused by the execution of the Works or the procedures used for execution.

42.3 Access to the Project Areas is prohibited to unauthorized persons. The Contractor is responsible for the security and access control of the Project Areas.

42.4 The Engineer is informed of any damage caused to people, or the property of individuals, other than the Contractor's personnel, within 6 hours of the event, regardless of the value of the prejudice.

42.5 Housing existing before the start of the Works, located within a minimum radius of 800 m around the perimeter of the quarries and within a minimum radius of 500 m around the other Project Areas that will be subject to blasting, will be examined by a bailiff unless agreed upon otherwise with the Engineer.

42.6 The bailiff's sworn statement is prepared and provided to the Engineer with the EPP.

42.7 Should any problems be detected due to the intensity of blasting, the Engineer is entitled to request that the Contractor carry out seismic measurements of the intensity of the vibrations induced

by the blasting, at variable distances from the blasting points, under the supervision of the Engineer, and at the cost of the Contractor.

43 Land acquisition and land take

43.1 Pursuant to Sub-Clause 7.8 of the CC, the Contractor will cover (i) occupancy indemnities for the extraction or use of construction materials and (ii) the cost of acquiring or temporarily occupying the necessary land to stockpile excess backfill material.

43.2 The Contractor provides compensation for any prejudice suffered by the owners and users of this land, if these users are not the same parties as the owners.

43.3 The Contractor demonstrates to the Engineer (i) who are the owner and the users, if different parties have been identified, and (ii) a written agreement governing the temporary occupancy or acquisition of this land has been negotiated and duly paid up to the two parties, if different.

44 Traffic

44.1 The Contractor defines a Traffic Management Plan in Worksite - ESMP (section 11 as defined in Appendix 1 to the ESHS Specifications).

44.2 The Traffic Management Plan:

a) includes the characteristics of its fleet of vehicles and site machinery; and

b) defines the itineraries used on a map for each route between the different Project Areas that must be validated by the Engineer.

44.3 The Contractor requests that the Employer obtain the authorisations of the competent administrative authorities if public roads are used. Any Engineer’s instruction to update the Traffic Management Plan shall be implemented.

44.4 Within one month of the physical start of Works, the Contractor informs the administrative authorities of areas crossed by the Contractor’s vehicles, of the itinerary and characteristics (frequency of passing, size and weight of trucks, materials carried) of the Contractor's fleet of vehicles.

44.5 If public roads are used, and unless approved otherwise by the Engineer, the Contractor mandates a bailiff to make a sworn report regarding the state of the road prior to use by the Contractor's vehicles. The report is annexed to the Traffic Management Plan.

44.6 The Contractor describes in the Traffic Management Plan the expected traffic created by its fleet of vehicles (frequency of trips between Project Areas, working hours, convoys).

44.7 The Contractor also describes the number and positioning of flagmen.

44.8 Unless specified otherwise in the Contract or instructed otherwise by the Engineer, heavy vehicles (i.e. with a GVWR of more than 3.5 tons) may not be used at night between 22:00 and 06:00.

44.9 Speed limits:

44.9.1 The Contractor takes action to limit and check the speed of all vehicles and machinery used to execute the Works.

44.9.2 The maximum speed of all machinery and vehicles of the Contractor comply with the lowest of the following: the speed limit defined according to the Employer's country regulations or the following limits.

b) 10 km/h within the Project Area;

c) 30 km/h in villages or hamlets, in towns, from 100 m before the first house;

d) 80 km/h on unpaved roads outside of towns, villages, hamlets and camps.

44.9.3 Pursuant to Sub-Clause 4.15 of the CC, and in coordination with the competent Employer's country authorities, the Contractor provides and installs signs for the fleet of vehicles along public roads, when public signs are inadequate.

44.9.4 The Contractor provides each of its drivers with a map at the appropriate scale of the roads authorised for the execution of the Works, clearly indicating the maximum speeds authorised, and ensures their understanding.

44.10 It is strictly prohibited to transport people, equipment or products other than those required for the Works and the management of Project Areas, on board any of the Contractor's vehicles. This provision also applies to the transport of live animals and meat obtained from hunting, fishing or poaching.

44.11 The trailers and skips used to carry materials which could be projected (sand, crushed material, aggregates, selected materials) are covered with a tarpaulin for the entire itinerary between two Project Areas.

44.12 The Contractor carries out regular inspections along the roads used by its fleet of vehicles to ensure compliance with the provisions of Clauses 44.8 to 44.11 of the ESHS Specifications. The Contractor records these inspections and the results and transmits a summary of checks carried out for the previous month to the Engineer on a monthly basis.

1 SPECIFICATIONS FOR PREVENTION OF GENDER-BASED VIOLENCE/SEXUAL ABUSE AND EXPLOITATION (SGBV)	Gender-Based Violence is an umbrella term for any harm that is perpetrated against a person as a result of gender power inequalities that exist among males and females. It refers to any violent act inflicted on a person primarily because of their gender. Gender-Based Violence is often a display of male power that manifests in various forms, including physical, economic, psychological, and sexual. It can also be a display of female power, especially where the man does not seem to conform to the standards of masculinity. It also includes unwanted behavior directed towards another person, which disrupts such person's work or reduces their quality of life. The commonest forms include bullying, physical abuse, shouting, domestic violence, threats, name-calling, stalking, isolation, and actual or threatened physical harm. Gender based violence also manifest in the form of Sexual Abuse, Sexual Exploitation and Abuse (SEA) or Sexual Harassment. While **Sexual Abuse** is the actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions; **Sexual assault** refers to a wide range of forms of non-consensual sexual conduct ranging from sexual coercion, attempted rape, rape, gang rape, marital rape and

	date rape. Sexual assault involves unwanted sexual experiences, sexual aggression and sexual abuse, ranging from non-consensual kissing to non-consensual sexual intercourse. It also refers to the use of objects (other than the sexual organs) to cause penetration. **Sexual exploitation and abuse (SEA)** refers to any actual or attempted abuse of a position of vulnerability, differential power, or trust for sexual purposes, including but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another. Sexual abuse refers to actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions. It is abuse of a sexual nature including acts such as rape, incest, fondling and indecent exposure. SEA therefore refers to unlawful forceful sexual or intercourse directed a beneficiary or member of the community (In the context of Bank-supported projects). **Sexual harassment** refers unwelcome sexual advances, requests for sex favors or other verbal or physical conduct of sexual nature. This manifests by way of words, acts, gestures or comments that would embarrass, humiliate, demean or compromise a reasonable person at whom such advances, requests or conduct are directed. It also refers to the imposition of sexual requirements in the context of a relationship of unequal power. Sexual harassment is the abuse of power and an assault of one's right to dignity, respect and freedom. The project may exacerbate the risk of GBV in both public and private spaces in a number of ways: • Influx of workers may increase the demand for sex work including risk of trafficking of women for the purposes of sex work or risk of forced early marriages in a community. Higher wages for workers in a community can increase transactional sex. • When land redistribution occurs e.g., due to resettlement for civil works, women may be extremely vulnerable to GBV. • Increased risk of violence can also be experienced when women are confronted with traveling long distances to access work opportunities or forced to travel at night. The contractor therefore shall develop and implement an appropriate system for prevention, mitigation and management the risks. The purpose of this is to prevent and mitigate risks against incidences of SGBV during implementation of the project. The SGBV shall focus on Sexual exploitation and abuse and workplace Sexual harassment since these are the types of SGBV most likely to occur on or be exacerbated by the project. The specific objectives will be: 1. To create awareness on SGBV focusing on SEA among members of the targeted communities and their leaders within the project areas 2. Sensitize the project workforce, their supervisors and other project persons involved in the project on SGBV focusing on SEA and SH. 3. Enhance the contractor's ability to implement measures to prevent and respond to GBV issues. 4. Establish GBV prevention and management good practices and systems in the project. The contractor shall undertake the following actions to address SEA/SH Risks: 1. Recruit a GBV consultant to support implementation of GBV activities;

	2. Map out GBV prevention and response actors in communities adjoining the project. This should incorporate an assessment of the capabilities of the service providers to provide quality survivor-centred services, including GBV case management, acting as a victim advocate, providing referral services to link to other services not provided by the organization itself; 3. Develop a SEA/SH Prevention and Response Action Plan including an Accountability and Response Framework as part of the Construction Environment and Social Management Plan (C-ESMP); 4. Make certain of the availability of an effective Grievance Redress Mechanism (GRM) with multiple channels to initiate a complaint. It should have specific procedures for SEA/SH, including confidential reporting with safe and ethical documenting of SEA/SH cases; 5. The contractor's staff shall sign the Codes of Conduct (CoC) and the contractor should i. Ensure requirements in CoCs are clearly understood by those signing; ii. Train project staff on the behavior obligations under the CoCs; iii. Disseminate CoCs and discuss with employees and local communities; iv. Create an appropriate Accountability and Response Framework. 6. Have project workers undergo training on SEA/SH. 7. Undertake community sensitization on SEA risks and project activities to get their feedback on safeguard issues. This should occur at the start and throughout the implementation of the project; 8. Implement appropriate project-level activities to reduce SEA/SH risks prior to construction works commencing such as: i. Have separate, safe and easily accessible facilities for women and men working on the site. Locker rooms and/or latrines should be located in separate areas, well-lit and include the ability to be locked from the inside. ii. Visibly display signs around the project site (if applicable) that signal to workers and the community that the project site is an area where SEA/SH is prohibited. iii. As appropriate, ensure public spaces around the project grounds are well-lit. 9. Undertake quarterly monitoring and evaluation of progress on SEA/SH prevention and response activities, including reassessment of risks as appropriate.

APPENDIX 1 – Contents of Worksite - ESMP

1. Environmental policy

- Declaration of ESHS policy signed by the managing director of the Contractor and clearly defining the commitment of the Contractor in terms of (i) ESHS management for its construction sites and (ii) compliance with the ESHS Specifications of the Contract.

2. Worksite -ESMP

- Target and content of the Worksite Environmental and Social Management Plan
- Preparation and updating schedule
- Quality assurance and validation

3. ESHS resources

- Human resources:
  - ESHS Manager
  - ESHS Supervisors
  - Person in charge of relations with stakeholders
  - Medical personnel
- Logistics & communications:
  - ESHS vehicles
  - IT stations
  - In situ noise, air and water measuring equipment
  - Analysis laboratory used
- Reporting:
  - Weekly inspections
  - Monthly
  - Accident / Incident

4. ESHS regulations

- Definition of standards for the applicable national ESHS regulations and the ESHS recommendations of institutions affiliated to the United Nations (WHO, ILO, IMO, IFC), applicable to the execution of works:
  - Discharge standards
  - Minimum wage
  - Day and/or night traffic restrictions
  - Other
- Definition of ESHS standards for the industry applied

5. ESHS operational inspection resources

- Site tracking procedure:
  - Frequency
  - Personnel
  - Assessment criteria
- Non-conformity handling and detection procedure:
  - Distribution information
  - Notification depending on the level of importance allocated to non-conformities
  - Tracking of the closing of the non-conformities
- Management of data on tracking and non-conformities:
  - Archiving
  - Use as a performance indicator

6. Project Areas

- Description of Project Areas (as per definition in Sub-Clause 1.3 of the ESHS Specifications):
  - Number
  - Location on a topographical map
  - Activities
  - Opening & closing schedule
  - Access
- Reference to the Appendix: an Environment Protection Plan (EPP) for each Project Area

7. Health and Safety Plan

- Identification and characterisation of health and safety risks, including the exposure of personnel to chemicals, biological hazards and radiation

		➢ Description of working methods to minimise hazards and control risks ➢ List of the types of work for which a work permit is required. ➢ Personal protection equipment. ➢ Presentation of the medical facilities at Project Areas: – Healthcare centre, medical equipment and allocation of medical staff – Medical acts that can be carried out on-site – Ambulance, communications – Referring hospital ➢ Evacuation procedure for medical emergencies. ➢ Description of the internal organisation and action to be taken in the event of an accident or incident.
8.	**Training plan**	➢ Basic training for non-qualified staff ➢ Health & safety training
9.	**Labour Conditions**	➢ Description of Human Resource Policy for construction works of direct and indirect workers
10.	**Local recruitment**	➢ Local labour requirements: – Job descriptions and the levels of qualifications required – Recruitment procedure and deployment schedule – Initial training to be provided by the Contractor for each job description ➢ Location and management of the local recruitment office(s)
11.	**Traffic Management Plan**	➢ Description of the fleet of vehicles/machinery used for the execution of the Works ➢ Deployment (Project Area & schedule) and maintenance sites for each vehicle and machine ➢ Mapping of itineraries, travel times, and areas where speeds are limited ➢ Dust suppression: – Mapping or road sections where dust reduction initiatives apply – Water points identified or to be created for refuelling tanker trucks – Capacity of the tanker trucks used and calculation of the number of trucks required – Width of the track to determine if one watering run or equivalent is adequate (narrow track) or if two runs are required (wide track) – Number of watering or equivalent operations proposed per day depending on the climate
12.	**Dangerous products**	➢ Inventory of dangerous products per Project Area and per period ➢ Transport and storage conditions and chemical incompatibility
13.	**Effluents**	➢ Characterisation of effluents discharged to the receiving environment ➢ Facilities for the treatment or pre-treatment of effluents ➢ Measures for reducing the sediment content of rainwater runoff ➢ Measures for monitoring the efficiency and performance of facilities for reducing sediment content of rainwater runoff ➢ Resources and methods for monitoring effluent and rainwater runoff quality
14.	**Noise and vibrations**	➢ Estimation of the frequencies, duration, days of the week and noise levels per Project Area
15.	**Waste**	➢ Inventory of waste per Project Area and per period ➢ Collection, intermediate storage, handling and treatment methods for ordinary or inert waste ➢ Storage and handling methods for dangerous waste
16.	**Clearing and revegetation**	➢ Methods & schedule for clearing vegetation and earthwork activities ➢ Methods, species and schedule for the revegetation of Project Areas disturbed by the Works
17.	**Biodiversity**	➢ Schedule for adequate fauna and flora management ➢ Measures for minimizing impact on fauna and flora species based on the Contracting Authority procedures ➢ Measures for monitoring the efficiency and performance of the plan in place ➢ Measures for limiting IAS ➢ Measures for monitoring the efficiency and performance of the plan in place

18. Prevention of erosion

- Location of zones suffering from erosion
- Methods and schedule for the implementation of anti-erosive actions, including topsoil storage

19. Documentation on the Project Area condition

- List and cover of viewpoints
- Imaging method
- Archiving photographs

20. Rehabilitation

- Method and schedule for Project Area rehabilitation

21. Appendices

- Environment Protection Plans (number and location specified in Section 6 “Project Areas” above):
  - Marking out of the Project Area perimeter on a map
  - Definition of zones for vegetation clearing, zones for the storage of usable timber, zones for burning of green waste
  - Definition of on-site activities: construction, storage areas, accommodation areas, offices, workshops, concrete making units
  - Layout of activity areas on the Project Area: construction works, production/operation areas, rehabilitation and closure
  - Zones for the storage of topsoil, spoil from earthworks, materials
  - Access routes and checkpoints
  - Project Area occupancy schedule
  - Organisation of Project Area preparation
  - Liquid discharge outlet points
  - Proposed sampling points for monitoring water quality
  - Atmospheric emission outlet points
  - Location of the storage site for dangerous products
  - Location and mapping of waste treatment facilities when handled by an external service provider
  - Any other information relating to the environmental management of the Project Area
- Emergency plan:
  - Description of facilities
  - Characterisation of hazards
  - Emergency situations
  - Organisation structure - roles and responsibilities
  - Emergency procedures
  - Human and material resources
  - Triggering of the plan
  - Reporting
- Bailiff’s sworn reports as specified in Sub-Clauses 10.5, 42.4 and 44.5 of the ESHS Specifications.

APPENDIX 2 – Properties rendering a product dangerous[1]

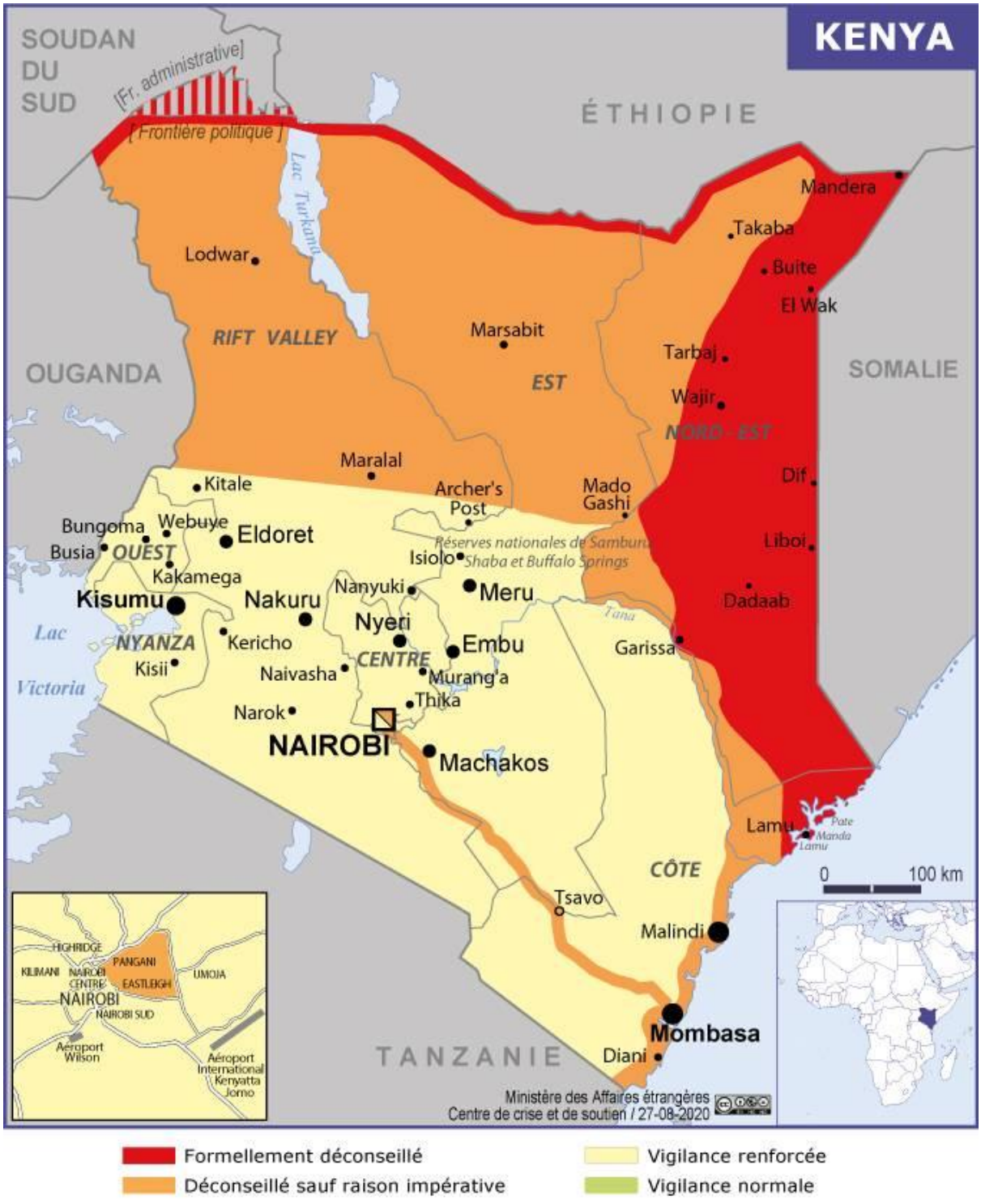
1.	**Explosive**	substances and preparations which could explode in the presence of a flame or which are more sensitive to impacts and friction than dinitrobenzene.
2.	**Combustive**	substances and preparations which, when in contact with other substances, particularly inflammable substances, undergo strongly exothermic reactions.
3.	**Easily inflammable**	substances and preparations (i) in liquid phase (including extremely inflammable liquids), with a flash point below 21°C, or which can heat up to the extent of spontaneous combustion in ambient air; or (ii) in solid phase, which can burst into flames easily in the brief presence of a source of inflammation and which will continue to burn after the removal of the source of inflammation or (iii) in gaseous phase, which are inflammable in air at normal pressure; or (iv) - which, when in contact with moist air or water, produce dangerous quantities of gases which are easily inflammable.
4.	**Inflammable**	liquid substances and preparations, with a flash point equal to or above 21°C and less than or equal to 55°C.
5.	**Irritant**	non-corrosive substances and preparations which, when in immediate, extended or repeated contact with the skin and mucosa, can cause inflammation.
6.	**Harmful**	substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can lead to risks of limited severity.
7.	**Toxic**	substances and preparations (including highly toxic substances and preparations), which, in case of inhaling, swallowing or cutaneous penetration, can lead to serious, acute or chronic risks, and even death.
8.	**Carcinogenic**	substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can lead to or increase the frequency of cancer.
9.	**Corrosive**	substances and preparations which, in case of contact with living tissues, can destroy the latter.
10.	**Infectious**	substances containing viable micro-organisms or their toxins, for which it is known or we have good reasons to believe that they cause disease in humans or other living organisms.
11.	**Harmful to reproduction function**	substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can induce or increase the frequency of undesirable non-hereditary effects in offspring or have a negative effect on reproductive functions and abilities.
12.	**Mutagenic**	substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can lead to hereditary genetic disorders or increase the frequency of these disorders.
13.	**React with water**	substances and preparations which, in case of contact with water, air or an acid, release a toxic or highly toxic gas.
14.	**Sensitising**	substances and preparations which, in case of inhaling or cutaneous penetration, can lead to a hypersensitisation, so that renewed exposure to the substance or preparation will cause characteristic harmful effects. This property can only be considered if test methods are available.
15.	**Ecotoxic**	substances and preparations with inherent or potential immediate or deferred risks for one or several environmental components.
16.	**Dangerous for the environment**	substances and preparations which are likely, after elimination, to lead to another substance, by any means, e.g. a lixiviation product, with one of the above characteristics.

[1] Source: French Environment Law (*Code de l'environnement*) / Articles R541-8

Security Specifications

1. Preamble

Part of the project area has been classified in areas labelled as orange or red by the French Ministry of Europe and Foreign Affairs *as per the map below.*



The key potential security risks include:

- Terrorism
- Common crime
- Project study and implentation routes in areas prone to common crime including robbery

The state Government of Kenya has however put in place sufficient police statison and security arrangements which maybe availlable to the Contractor if required.

The Contractor must therefore show the care it exercises to protect its employees who perform Works in the country. Therefore, it must identify the risks and, in light of this analysis, define prevention and protection resources, incorporating additional resources therein, which may be organisational, technical or human resources. These elements shall be described in a methodology, which for each of the headings below must address and describe what the Contractor has planned.

Disclaimers:

1 - Although the specified admissibility requirements endeavour to correlate with the potential risks to which the Contract may be exposed, they are intended to be used solely to evaluate Bid Documents in order to eliminate Bidders that do not meet a minimum set of requirements. They are in no event to be understood to constitute sufficient measures to ensure the security of persons and property in connection with the Contract. **The risk assessment and security measures to be defined in consequence thereof are the responsibility of the Contractor, who shall explain them in its security methodology.**

2 - **A methodology that fails to meet any one of the admissibility requirements set out in the sections below will be declared non-compliant and the Proposal of the Contractor will be rejected.**

2. Analysis of security issues and threats

The Contractor shall describe its view of the security environment and threats in the area where the Contract will be performed and/or the danger area, and present a security analysis for the relevant area and for the activities it will perform therein. It shall specify the method and references used to perform this analysis and describe the main threat scenarios that can be identified at the Proposal stage.

In addition, it shall at all times be able to share information learned from its country watch by its local organisation or head office.

Admissibility requirements:

- Document describing the method used to carry out this analysis;
- At least one identifiable reference source must be used;
- Identification and evaluation of security threats in relation to the contract;

3. General security organisation

The Contractor shall define the general security roles and responsibilities within its organisation and the allocation of the associated tasks for this Contract (including subcontractors and co-contractors), and shall designate a security reference person. It shall define the planned organisation and resources. In the event of a Joint Venture (JV), the leader shall designate a security officer as the JV's sole contact for this Contract.

Admissibility requirements:

- Description of the organisation;
- The Contractor (and each member in the case of a JV) shall provide the name of the company's internal security officer, who shall be responsible for defining and monitoring the measures implemented for the Contract.

4. Specific security measures planned

Based on its own security analysis and the main threat scenarios it may have identified, the Contractor shall plan specific and appropriate measures. These measures shall cover at least the following matters:

4.1 Security organisation

The Contractor shall describe its local security organisation in the location where the Services will be performed. In particular, it shall specify whether this organisation relies on internal resources, using its own resources already existing in the country, or whether it uses a local partner, a security services provider or a "Security Officer" dedicated to the Contract, or whether it relies on the country's State resources and whether it can request them directly. It shall describe the respective roles planned for each participant operating locally.

Admissibility requirements:

- Description of the organisation and resources mobilised in the country of the Contract;
- The Contractor (and each member in the case of a JV) shall provide the name of the person who will be its contact for all security issues in relation to the Contract. This person may be the same person identified in Article 3 above;
- In the event of a JV, describe the coordination and distribution of responsibilities among the members;

4.2 Travel within the country and to the relevant area

Depending on the security analysis, special measures may be required to ensure secure travel within the country. These means may include the use of aircraft of national companies or private aircraft, the use of passenger vehicles amongst others.

The Contractor shall describe the resources and measures planned to protect itself against security risks (crime, kidnapping, etc.) during these trips. These provisions may be technical, organisational or human. It shall distinguish between measures concerning protective actions and measures deemed forward-looking actions.

The Contractor shall describe the planned transport logistics, including human, technical and organisational resources and mechanisms for monitoring travel. It shall also define its requirements for maintenance management and rules of conduct.

Admissibility requirements:

- Description of modes of travel, the physical means of travel and the security measures planned in connection with such travel;
- Distribution of roles and measures planned for the Contractor itself, for external participants and those expected from the Client and local authorities, identifying each actor;

4.3 Accommodation during assignments

If the accommodation and security measures of the Contractor are not provided by the Client or the works company (in the case of construction project), the Contractor shall describe the type of accommodation and the measures planned to ensure the security of teams (security guards, physical means, etc.).

Admissibility requirements:

- Description of the accommodation selection criteria and security measures planned for each overnight stay;
- Provision of the names and addresses of hotels or accommodation venues planned for overnight stays

4.4 Communication

The Contractor shall implement a communication and exchange process between the various Contract participants, to ensure reporting of security events, and that preventive or corrective actions deemed necessary are properly carried out. It shall describe the means enabling it to ensure effective communication.

Admissibility requirements:

- Description of the planned means of communication and measures taken to ensure their reliability;

5. Information, awareness-raising and training before departure

The Contractor shall make arrangements to inform, raise awareness and train its employees prior to departure on assignment. These arrangements shall be in the form of formal communication actions. It shall describe the provisions specifically planned for this Contract, in the form of "service orders" or similar documents.

Admissibility requirements:

- Description of essential instructions provided to employees (welcoming, briefings, updating of instructions booklets, etc.);
- Provision of the list of emergency numbers (local numbers and service providers, repatriation, head office on-call security service) furnished for the Contract's assignments;

6. Alert management and crisis management

The Contractor shall prove that it has set up a crisis management process involving the local organisation and its head office. It shall describe the main procedures for triggering this process and its key operating procedures.

For this purpose, the Contractor shall describe the alert process, from the local organisation to its head office, and the interaction with the Client.

Admissibility requirements:

- Summary of the crisis management procedure dedicated to security, describing triggers, roles and responsibilities.