

9.2.8 CLEANING AND CEMENT MORTAR LINING

9.2.8.1 CONTROLS OF MATERIALS

9.2.8.1.1 Local Materials

Portland cement conforming to BS12 or other approved equivalent internationally accepted standards, and river sand are available locally and every endeavour should be made by the Contractor to use locally available materials for this work. However, if the Engineer is satisfied that non-availability of local materials is going to hinder the rate of progress desired under this Contract, he may request the Contractor to import such materials. Failure by the Engineer to make such request to the Contractor will not relieve the Contractor from his obligation to obtain such materials in time to complete the works *within the period specified in this contract.*

The Contractor before tendering should ascertain for himself that the local grades of cement and sand conform to all specifications and its availability. All expenses incurred for carrying out tests of locally available materials should be borne by the Contractor.

9.2.8.1.2 Approval of Materials

Only new materials shall be incorporated in the permanent works. All materials furnished by the Contractor shall be subject to the inspection and approval of the Engineer. No materials shall be delivered to the work without prior approval of the Engineer.

As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer data relating to materials and equipment he proposes to use for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the Specifications.

Facilities and labour for handling and inspection of all materials shall be furnished by the Contractor. If the Engineer required, either prior to beginning or during the progress of the work, the Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, stored, packed and shipped as directed at the Contractor's expense. Except as otherwise noted the Employer will make arrangements for and pay for the tests. If the materials fail to satisfy the Specifications, the Contractor shall bear the cost of the tests.

9.2.8.1.3 Handling and Storage of Materials

All materials to be incorporated in the work shall be handled and stored by the Contractor in a manner satisfactory to the Engineer.

Sand and cement shall be stored under a roof and off the ground and shall be kept completely dry at all times.

9.2.8.1.4 Cement for Cement-Mortar

Portland cement shall meet the requirements of BS 4072 or other approved equivalent internationally accepted standards, and shall if deemed necessary by the Engineer be passed through a 16 mesh screen before incorporation into the mortar.

9.2.8.1.5 Sand for Cement-Mortar

Sand shall be clean, shape, well-graded, with no organic impurities and shall meet the requirements of BS 882 graded in accordance with Table 4 -Sand or other equivalent internationally accepted standards. The sand shall contain no aggregate of size greater than one-third of the minimum lining thickness. The sand shall be washed by the application of clean water during the final sieving process.

A forty (40) kilogram sample of sand proposed for the work shall be delivered to the Engineer for sieve analysis prior to use in the work. Field mixing of sand shall not be permitted.

9.2.8.1.6 Water for Cleaning and Cement Mortar Lining

The Contractor may obtain water of potable quality for cleaning and cement mortar lining from the transmission or distribution systems with the approval of the Engineer. The Engineer will appoint authorised officers to supervise the opening and cleaning of valves for providing the necessary water from available points within reasonable distance. The Contractor shall pay for the water at the prevailing water rates of the Employer, provide the necessary men for opening and closing the valves as well as carrying out and providing hoses for any connection necessary for obtaining the water, all at his own expense.

9.2.8.2 CLEANING AND LINING

9.2.8.2.1 General

All work shall generally be in accordance with AWWA Standard Specification for Cement-Mortar Lining of Water Pipelines in Place, AWWA C602-83 or other approved equivalent internationally accepted standards as it applies unless otherwise specified herein.

The Contractor shall inspect any section of pipe prior to lining and ascertain its internal diameter and its suitability for successful operation of cleaning and cement-mortar lining. There will be no claim for delays. Bends or other restricting specials or physical parts or objects which could not be anticipated shall not be considered "obstructions" for the purpose of payment unless the Engineer certifies in writing that such bends, other restricting specials, or physical obstructions are not indicated on any drawings or other Employer's records of such mains included hereunder. Co-operation cocks will not be considered as obstructions. Multiple fittings within a distance of 5 metres will not be considered as more than one obstruction.

9.2.8.2.2 Cleaning and Lining to Follow Excavation

Cutting, scraping and lining operations shall closely follow access excavation, the extent of which must at all times comply with any requirements of the local Highway or Police Authority.

9.2.8.2.3 Cutting of Pipes

All cutting of pipes on mains to be reconditioned shall be carried out by the Contractor. Every cut shall be made with equipment and by a method approved by the Engineer. Every cut shall be such that the face is smooth and square to the axis of the pipe.

Ductile iron and Cast Iron pipes shall be cut with an approved mechanical pipe cutter and in conformity with the pipe manufacturers recommendations.

The edges of the cut, together with those parts of the pipe from which the coating has been removed shall be given two coats of bitumens paint and the internal lining repaired if damaged, to the approval of the Engineer.

When the cut pipe is to be inserted in a Push-fit joint, it shall be bevelled for 10mm at 30 degrees to the pipe axis to remove sharp or rough edges.

The use of an oxy-acetylene flame cutter will not be permitted in any circumstances.

The Engineer may instruct that the main be pieced-up using a new length of pipe rather than an off-cut from the existing main. In this situation the Employer will provide the necessary pipes and fittings for the piece-up free of charge, unless such new pipes or additional fittings are required as a result of the Contractor's negligence (then the Contractor will be charged for the cost of such by the Employer)

9.2.8.2.4 Cleaning of Pipelines

The Contractor shall supply all necessary equipments for the cleaning operation.

The pipe cleaning apparatus shall be water propelled or other approved type. Cleaning machine shall be of a type that has been used successfully for similar work over a period of at least 3 years. Tenderer shall designate the type (or types) of machine he proposes to use and shall present evidence that his Firm, using the proposed machine has satisfactorily performed work similar to the proposed work. All rust, tubercles, deposits, old coating, and other foreign materials shall be removed from the inside of the pipe, leaving the surface satisfactory for the application of cement mortar lining. Several passages of the cleaning machine through the pipe shall be made, if required, to provide the specified results. The metal surface shall be free from deposits or residue, which could prevent the bonding of the cement-mortar lining. If necessary, the interior of the pipe shall be washed or wiped clean. Where the hydraulic cleaning method fails to produce satisfactory results or where the device cannot be used, machine-operated wire brushes or other cleaning methods shall be required.

If the cleaner is cable propelled, the section being cleaned shall be flushed with water during the progress of the cleaning. Dry cleaning will not be permitted unless otherwise approved by the Engineer.

The Contractor shall flush out all laterals, hydrants, and service connections and shall take precautions to prevent obstructions caused by deposits of cleaning debris. He will be required to restore such connections to normal service condition at his own expense. Prior to cleaning, the Contractor shall at his own expense trace the line and decide on the most suitable entry and exit points.

9.2.8.2.5 Disposal of Washings

The Contractor shall dispose of cleaning water and the residue from cleaning the mains. He shall examine the locations where cuts are to be made and make adequate preparations to avoid the flooding of streets and adjacent structures or private property. Precautions shall be taken to prevent cleaning waste from being deposited in drains, sewers or waterways. Immediately following cleaning, the street and affected areas shall be hosed and swept clean, permanent staining of highway surfaces shall be avoided.

9.2.8.2.6 Inspection of Pipeline Before Lining

The Contractor shall notify the Engineer as soon as cleaning of a length of main is completed and the Engineer shall, without delay, examine the pipeline for any defects or evidence of leakage. Any defects or leakages shall be repaired at the expense of the Employer. Unless such defects or leakages have been caused by the Contractor, in which case those shall be repaired at the expense of the Contractor. The Contractor shall not line with cement-mortar any defective section until it has been inspected and repaired, unless otherwise directed by the Engineer.

For inspection of non-man entry pipelines Contractor shall provide with In Pipe Remote TV facilities. The Contractor shall also assist Engineer in identifying previously unknown fittings such as buried valves, tees, scours etc.

9.2.8.2.7 Cement Mortar Lining

As soon as practicable after a section of pipeline has been cleaned and approved by the Engineer cement mortar lining shall be applied to the interior of the pipeline.

The cement mortar lining shall be continuous, dense, and concentric with the pipe and of the specified thickness and finish without variation in quality.

The cement mortar mix for lining pipes and fittings shall contain not less than one part of cement to between one and half to two parts of sand by weight, thoroughly mixed with water to a consistency which will provide a dense and homogeneous lining. The exact proportion shall be determined by the characteristics of the sand used and shall be approved by the Engineer in advance. No mortar, which has attained its initial set or has been mixed for more than one hour shall be used. To improve the density, durability and surface smoothness a plasticiser complying with the requirements of BS 4887 Standard of Mortar Admixture or other approved equivalent internationally accepted standards may be used in the mix with the written approval by the Engineer.

The water cement ratio shall be maintained at a minimum and shall be carefully controlled at all times.

Prior to commencing work Contractor shall provide the Engineer with full details of his proposed cement mortar mix proportions.

9.2.8.2.8 Placing of Lining

The lining shall be placed by centrifugal method and the lining machine shall be of such design as to provide for the projection of the mortar against the walls of the pipe at high velocity. The machine shall be provided with trowelling arrangements for smoothing the surface finish of the applied mortar, unless the Engineer specifies an alternative finish. Nothing shall be allowed to come into contact with the finished surface until it has attained an adequate hardness. Lining shall be placed in vertical riser mains also.

The machine shall be of a type that has been used successfully for similar work over a period of at least 3 years. The Bidder shall designate the type (or types) of machine he proposes to use and shall present evidence that his firm, using the proposed machine has satisfactorily performed works similar to the proposed work.

The Contractor shall guarantee the finished work to be free from defective material and workmanship for a period of 1 year after the date of acceptance by Employer.

9.2.8.2.9 Thickness of Lining

The completed lining shall have an even finish complying with the following requirements:

Mains of diameter greater than or equal to 150mm.

Trowelled to finish with the following mean thickness:

150 mm to 300 mm = 5.0 mm

300 mm to 600 mm = 6.0 mm

Permitted deviation from mean thickness = ± 1.5 mm

Special attention shall be given to ensure smoothness and coverage at pipe joints.

Sections of pipe removed for access purposes and all fittings not lined during the mechanical lining process shall be separately lined with cement-mortar to the thickness prescribed in this Sub-section.

If any section of lining shows evidence of failure, undue irregularity, or inferior workmanship, requires excessive patching, or shows segregation or deficiency in cement content, the Contractor shall remove the faulty section, re-clean the pipe and re-line in accordance with these Specifications, the cost for same has to be borne by the Contractor.

9.2.8.2.10 Piecing-up and Curing

As soon as practicable following completion of the lining of a section of pipeline or of a day's run of the lining machine, the completed section shall be pieced-up by the Contractor to prevent circulation of air. As soon as practicable after placing of the lining, a sufficient amount of water shall be introduced into the section to create a moist atmosphere and keep the lining damp. There shall be no pressure applied on any section until the mortar lining has been in place for at least 24 hours, except for pressure induced by variations in the grade of the pipeline.

Where sections of cast iron pipes have been removed for access to the line, piecing-up shall utilize where possible undamaged, reclaimed and relined portions of the pipe removed. Any new piecing lengths will be provided by the Employer at the Contractor's expense if due to his negligence, such piecing lengths will require cleaning and relining.

Piecing up shall be by means of suitably protected Viking Johnson Couplings or similar couplings which shall be supplied and installed with external protection as specified, by the Contractor.

9.2.8.2.11 Protection of Lining

The Contractor shall take all necessary precautions to prevent injury or damage to the completed lining. Any damaged or defective works shall be repaired or replaced by the Contractor at his expense to the satisfaction of the Engineer.

9.2.8.2.12 Testing of Mains

All mains shall be tested in the presence of the Engineer to normal static pressure on completion of lining. Any leakages which have occurred between the commencement of scraping and completion of lining shall be the responsibility of the Contractor, except where causes can be attributed to excessive corrosion of the metal of which the main is composed.

Water tightness will be checked by standard pressure testing of the main. Prior to testing, the main will be subjected to normal working pressure to achieve stable conditions. The test pressure will be working pressure plus 5 bars. This will be maintained for 1 hour. The pump will be disconnected with no water being allowed to enter the pipe for a further 1 hour. At the end of this period the original pressure is restored by pumping.

Water loss is measured by measuring the additional quantity of water pumping into the pipeline to restore the original test pressure.

The quantity of water in litres should not exceed the allowable leakage given by the following formula.

The allowable pipeline leakage shall be less than 2.3 litres per 24 hours per mm-pipe diameter per km-length as presented by the formula below:

$$\frac{Q}{D \times L \times H} \times 24 < 2.3$$

Where:

- Q : Amount of leakage in litres
- D : Diameter of pipe in millimeters
- L : Length of pipeline in kilometers
- H : Duration of leakage test in hours

No disinfection work shall be commenced before testing of the mains has successfully been completed and approved by the Engineer.

9.2.8.2.13 Sample Cuts

For non-man-entry mains the Contractor will be required to make sample cuts to enable the Engineer to examine the quality of the completed lining. The Contractor will be required to pull through a "proving pig" of the required diameter. Sample cuts shall be made at an average rate of one cut per 500m lined provided always that in the event of any sample showing materials or workmanship not in accordance with the Contract then the Engineer will require the Contractor to make additional sample cuts on that length. In lieu of the above, the Engineer may require the inspections of the pipeline with Closed Circuit T.V. facilities.

9.2.8.2.14 Lining through Valves

The Contractor shall obtain the prior approval of the Engineer to any proposals he may have for lining through valves. Valve locations and tight bends should be used as far as possible as entry and exit points of lining.

9.2.8.2.15 Connections and Appurtenances

After placing the lining in mains, all valves, laterals, air valves, appurtenances, and service lines shall be cleared of mortar or other materials deposited during the lining operations. If service lines are cleared by means of compressed air applied at the service line meter connection, blow-back shall be done before initial set has occurred in the cement-mortar applied to the pipe. Compressed air pressure for blow-back operations shall be regulated to produce a clear service opening and prevent dislodging or blistering of cement-mortar lining in the main. Bonnets shall be removed from all gate valves and the Contractor shall examine and clean out the interior of the valve of any deposited detritus and cement-mortar, paying special attention to the valve seating.

9.2.8.2.16 Blockages of Services and Connections

If as a result of scraping and relining blockages (complete or partial) of any ferrule, service pipe, ball tap or other apparatus connected to the service should occur, then any necessary remedial works shall be carried out by the Contractor immediately the blockage is discovered.

Where admittance to consumer's premises is denied or impossible by virtue of absence and it is impossible to clear the connection following the lining the Contractor shall when directed by the Engineer make the necessary excavation at the main to restore the connection.

However, if in the opinion of the Engineer the necessary remedial works are not carried out with the required urgency the Employer's personnel will carry out the work with the fully cost of the work charged to the Contractor.

9.2.8.2.17 Cleaning and Disinfection of Pipelines

All reasonable precautions shall be taken by the Contractor and his employees to prevent contamination of the interior of the pipelines by water from excavations and otherwise. Upon completion

of the work, and before chlorinating, all fragments of the mortar and other debris shall be removed by the Contractor so that the pipeline is clean and ready for use in all respects pending the application of chlorine.

Sections between gate valves shall be completely filled with water, and chlorinated as soon as possible after the lining is completed.

Upon completion of all cleaning and lining operations in a Section of pipeline and after the work has been approved by the Engineer, the Contractor shall chlorinate the interior of the completed section in accordance with ANSI/ AWWA C601, "AWWA Standard for Disinfecting Water Mains" or other approved internationally accepted Standards. All materials, equipment, labour and chlorine shall be furnished by the Contractor at his own expense. The entire procedure of chlorinating the pipes shall be discussed in advance of the time the work is to be done, the methods employed shall be fully satisfactory to the Engineer as they relate to the Contract as a whole and to the operation of the distribution system.

In general, the procedure of chlorinating the main shall be to apply the chlorine in approved dosage through a tap in one end of the section while drawing water from or near the other end of the section, at which location the rate of flow may be approximated. The chlorine solution shall be allowed to remain in the pipe for at least 24 hours and the section shall be thoroughly flushed out before being placed in use. Special procedures may be outlined by the Engineer where the above outlined method is not practicable. The entire procedure of chlorinating the main shall be such as to prevent flows of water from a section exposed to possible contamination to a section of pipe, which has been completed, and chlorinated. Should such water from a contaminated section be allowed to enter a previously chlorinated section as a result of the Contractor's negligence or throughout necessity caused by failure of the Contractor to properly schedule this work, the section or sections of pipe thus affected shall be re-chlorinated at the Contractor's own expense. Any temporary connection to the mains or other facilities required to accomplish the chlorination as just described shall be at the Contractor's expense.

9.2.8.2.18 Swabbing of Mains

The Engineer may instruct that the mains that have been reconditioned be swabbed. Allowance must be made in the rates submitted for carrying out swabbing operations in conjunction with any disinfection operations.

The Contractor will be responsible for supplying the swabs and should allow for this in the rates submitted.

Soft grade swabs shall be used and shall have a diameter of 25% greater than the internal diameter for pipe sizes up to and including 300mm and 75mm greater for larger sizes.

9.2.8.2.19 Leakage

If any leaks occur in the water mains at locations where sections have been removed for access and later replaced by the Contractor, or if leaks occur at any other locations which are directly attributable to the operations of the Contractor in the cleaning and lining of mains, he shall, at his own expense, uncover and satisfactorily repair such leaks before the Contract is declared completed and is finally accepted.

9.2.8.3 MISCELLANEOUS

9.2.8.3.1 Temporary Services

a) General

Temporary interconnections and/or bypasses will be required during one single operation, for the following sizes of mains. The length of the bypass shall be agreed with the Engineer's Representative before an operation.

The information given above is only a guide to indicate the extent and nature of interconnection and/ or bypasses required to keep the interruption to services to minimum. This will not relieve the Contractor from his obligation to suggest and offer any alternative, which will be more economical, for the approval of the Engineer.

The Engineer's Representative will upon 24 hours notice from the Contractor, supervise the manipulation of the valves for draining or admitting water to the various sections of the mains. The emptying of any such section of water mains shall be the sole responsibility of the Contractor.

b) Scope of Work

The Contractor shall furnish all labour, materials, equipment and incidentals required to install and remove bypass and temporary service pipes of the size required from which connection shall be made to water consumers. The Contractor shall do all work of excavating for connections to service pipes or to trenches at streets which are not otherwise served. In certain cases, it may be possible to make connections, which will serve during the temporary period. The work of furnishing and installing services and other branches and maintaining and providing suitable safety precautions, and removal of the temporary services pipes shall be the responsibility of the Contractor.

c) Temporary Service Pipe

The temporary service pipe, connections, and branches shall be of the satisfactory quality and shall be fully adequate to withstand the pressures and all conditions of use.

d) Installation

Generally, temporary service pipe shall be laid in gutters. At driveways, pipe crossings shall be provided by cold patch cover or other approved method. At street intersections, pipe shall be laid in a shallow trench covered with temporary surfacing. Sanitary precautions shall be satisfactory to the Engineer. The installation shall be watertight. Care shall be exercised throughout to avoid any possible pollution of mains, house services, or the temporary service pipe. The interior of temporary service pipe shall be chlorinated in accordance with ANSI/ AWWA C601, "AWWA Standard for Disinfecting Water Mains", or other approved internationally accepted standards.

All service pipe shall be suitably valved and meet the approval of the Engineer.

The Contractor shall remove all meters, if any, and shall connect "blow-back" hoses to all services.

9.2.8.3.2 Decking

a) Scope of Work

The Contractor shall furnish, install, maintain, and remove decking over street openings where in the opinion of the Engineer, traffic requires unrestricted use of the street. At such locations, work may be suspended during period of heavy traffic to ensure public safety.

If decking is placed by the Contractor over any opening when not so ordered by the Engineer, all costs of decking at such locations, maintaining traffic, and safeguarding open excavation shall be deemed to have been included in the bid prices in the Tender for cleaning and lining water mains.

Before the decking and supporting systems are placed, the Contractor shall submit to the Engineer for approval a shop drawing showing detailed plans and the structure he proposes to use. The construction may be wood or steel. The decking and supports shall be of sufficient strength to carry a load of 14 kg per square cm over the entire deck area or 10 tonne on an axle with wheels 1,525 mm on centres without exceeding the allowable stress specified by the Department of Highways.

9.2.8.3.3 Gate Valves, Boxes, Hydrants And Miscellaneous Fittings

a) Scope of Work

The Contractor shall remove all existing gate valves, boxes and hydrants attached to the mains to be reconditioned and replace them with new gate valves, boxes and hydrants conforming to the requirements of the Specifications. The Contractor shall supply and install all gate valves, boxes, hydrants and miscellaneous fittings at locations shown on the drawings all at his own expense.

The Contractor shall supply and install all temporary gate valves required for cleaning and lining operations as well as for other operations required for completion of the work.

In the event that sideline valves leak, due to no fault of the Contractor, the Contractor shall when directed by the Engineer remove the defective valve and replace with a new valve supplied by the Employer. In the event that sideline valves leaks due to the fault of the Contractor, such valves should be replaced with new valves at the expense of the Contractor.

As soon as practicable, the Contractor shall transport the removed gate vales, boxes, hydrants and other miscellaneous fittings to the Employer's workshops in Colombo and he should therefore include allowance for this in his bid price.

c) Installation

All gate valves shall be set in a vertical position. The Contractor shall install the gate valves by taking as little of the water main out of service for as short a time as possible.

Each gate valve shall be accompanied by a cast iron valve box. Gate boxes shall be set plumb and centred over the operating nut, and shall be securely held in position during backfilling. The top shall be adjusted to the elevation of finished roadway or ground surface.

Hydrants shall be bedded on a firm foundation. Each hydrant shall be set in true vertical alignment and properly braced. If directed, the hydrants shall be tied to the pipe with suitable rods or clamps, galvanised, painted or otherwise rust proof treated. Concrete used for anchor blocks shall be no leaner than 1 part cement, 3 parts sand, and 6 parts coarse aggregate. Hydrant paint shall be touched up as required after installation.

Miscellaneous fittings shall be supplied and installed for all gate valves, gate boxes, and hydrants as required.

9.2.8.4 MEASUREMENT, PAYMENT AND GUARANTEES

9.2.8.4.1 *General Obligations of the Contractor*

General obligations of the Contractor shall be as set forth in the Contract Documents. Unless special payment is specifically provided in the payment paragraphs of the Specifications, all incidental work and expenses in connection with completion of work under the Contract will be considered a subsidiary obligation of the Contractor and all such costs shall be deemed to have been included in the appropriate item in the Tender in connection with which the costs are incurred.

9.2.8.4.2 *Payments for Cleaning and Cement Mortar Lining of Water Mains in Situ*

The pipe of the respective sizes actually cleaned, inspected lined with cement mortar in accordance with the Specifications, and accepted by the Engineer will be measured along the centreline of pipe without deduction for valves and fittings in the line.

Excavation and backfilling of test pits and trenches for pipe opening, temporary and permanent pavement, and all other work specified will be considered incidental to the cleaning and cement mortar lining of the water main and no separate measurement will be made therefore, unless otherwise provided herein.

Payment for cleaning and cement mortar lining of mains in place will be made for the quantity as above determined at the appropriate contract price per linear meter of pipeline in the Bill of Quantities, which price and payment shall be full compensation for furnishing all labour, equipment, materials for cleaning, dewatering, inspection, cement mortar lining, swabbing and disinfecting the pipe, for all related work specified, and all costs in connection therewith and incidental thereto for which separate payment is not provided under other items. The Contract price for payment may be reduced, if necessary, as outlined in Sub-section 9.2.8.4.8.

10% of the price per linear meter will be held unpaid until the completion of successful tests for roughness and water-tightness. This will be released as soon as testing is satisfactorily completed.

No direct payment will be made for any work required for clearing blockages of services and connections and all costs connected therewith shall be included in the unit prices agreed upon in the Contract. No claim shall be made for delays.

9.2.8.4.3 *Payment for Temporary Bypass Pipe*

The temporary service pipe actually furnished, installed, and removed by the Contractor will be measured for payment along the centreline of the pipe, including pipes and valves. Pipes smaller than 50 mm in diameter, which are provided for temporary services connections or other purposes will not be measured for payment. Pipes installed by the Contractor solely for his own convenience and use will not be measured for payment.

Payment for furnishing, installing and removing temporary service pipe of the size required will be made for the quantity as above determined at the Contract price per linear meter established for the appropriate size of pipe in the Contract, which price and payment shall be full compensation for furnishing all labour, equipment, and materials for installing the pipe, for all excavation, backfilling, replacing in private or public property disturbed by the Contractor's temporary service pipes with all valves, fittings and other facilities required in connection with the use of a temporary service pipe to permit de-watering of mains for the purpose of cleaning and cement mortar lining all as specified herein above.

9.2.8.4.4 *Payment for Decking*

One measurement only will be made for decking at each opening ordered to be covered by the Engineer, regardless of the number of times the decking may be placed and removed at such openings.

If decking is placed by the Contractor over an opening when not so ordered by the Engineer, all costs of decking at such locations, maintaining traffic, and safeguarding open excavation shall be deemed to have been included in the bid price for cleaning and cement mortar lining of water mains.

Payment for furnishing, installing, maintaining and removing decking over each street opening when specifically ordered in writing by the Engineer to be so protected will be made at the unit price each under the Item for decking established in the Bills of Quantities which price and payment shall be full compensation for furnishing all labour, equipment, and materials for installing, removing and replacing cover over the street opening. All additional costs and expenses incurred because of traffic conditions at the particular locations, and all else in connection therewith and incidental thereto for which separate payment is not included under other items shall also be deemed to have been included in the unit price quoted under the Item for decking in the Bill of Quantities by the Contractor.

9.2.8.4.5 *Payment for Installing Gate Valves and Boxes*

The number of gate valves and surface boxes (in construction hole) to be paid for will be the number of such size actually installed and accepted by the Engineer.

Payment for replacing sideline valves shall include excavation, cutting pipe, removing defective valves, installing new valve, surface box and protection tube replacing pipe, and all other incidental work required. No claim shall be made for delays because of leaking valves. Payment will be at the unit price established in the Contract for additional work.

Payment for installing gate valves and surface boxes shall be at the price quoted in the Contract. This price shall be full compensation for installing, setting, jointing, and adjusting boxes including provision

of spindle protection tube and all work required for or incidental to the satisfactory completion of the items.

9.2.8.4.6 Payment for Installing Hydrants

The number of hydrants to be paid for shall be the number of each actually installed and accepted by the Engineer.

Payment for replacing hydrants shall be at the price quoted in the Contract. This price shall be full compensation for installing, setting, jointing, painting and installing pipe where necessary to tie into the main in the street, and all work required for or incidental to the satisfactory completion of the item.

9.2.8.4.7 Payment for Extra Work

Measurement for additional work as described in the Contract, which becomes necessary by order or approval of the Engineer, will be the actual number of services rendered or Items actually furnished and installed to the satisfaction of the Engineer.

Payment for additional work accepted by the Engineer will be at the unit prices established in the Contract or at rates mutually agreed between the Engineer and the Contractor for items where rates are not available in the Contract.

9.2.8.4.8 Guarantee of Cement Mortar Lining

The Contractor shall guarantee all material and workmanship furnished under this Contract against deterioration and failure for a period of one year after final acceptance of the work. Any deteriorated cement mortar lining shall be repaired by patching or removal and replacement as may be deemed necessary by the Engineer. Repairs or replacement shall include removal of defective lining, cleaning of the pipes, cutting and repairing or replacing access openings, and all incidental work. Repair work shall be in conformity with these Specifications and at the sole expense of the Contractor.

The Contractor guarantees to restore all cleaned and cement mortar lined water mains to the following coefficient (C) Hazen- Williams formula, all based on nominal pipe diameters with proper allowance being made for bends and fittings in accordance with accepted practice:

<u>Nominal Pipe diameter</u>	<u>Guaranteed Coefficient</u> <u>"C" Hazen-Williams</u>
350-500 mm	120
300 mm	115
250 mm	110
200 mm	105
150 mm	100
100 mm	90

After the mains under this Contract have been cleaned and cement mortar lined, the Contractor will make a loss of head test witnessed by the Engineer's Representative to determine coefficient "C" in the Hazen-Williams formula at no cost to the Employer.

If in any section of cleaned and lined water mains, the coefficient "C" as determined by the loss of head tests fails to meet the guaranteed figure, the unit prices for cleaning and lining will be reduced as follows:

- a) If the "C" value drops by the five units or less below the guaranteed coefficient, there will be no reduction in price.
- b) If the drop in "C" value is more than five units but less than fifteen units below the guaranteed coefficient, the Contract prices shall be reduced one per (1%) per unit of "C" value.
- c) For a drop in excess of fifteen units below the guaranteed coefficient, the Engineer will decide whether a further reduction in payment of two percent (2%) per unit below fifteen unit will be made, or the cement mortar lining shall be removed and the water main properly cement mortar lined at no expense to the Employer.

For the purpose of establishing coefficient "C" on such mains where it is not practicable to carry out the loss of head test through the full extent of the cleaned and cement mortar lined main, the several sections thereof shall be tested and the weighted average "C" coefficient from tests of such portions shall be considered to be acceptable for the whole of the cleaned and cement mortar lined main.

The Contractor shall take approved necessary steps to attain the required coefficient before deductions, if any will be determined.

All tests for establishing the "C" coefficient for water mains cleaned and cement mortar lined under this Contract shall be completed prior to final acceptance of this job.

The standards to which the "C" tests will be carried out should be approved by the Engineer in advance. Charges for use of equipment shall be included in his bid price. Measurement should be near the ends of the tested lengths, first with the pipe full (Downstream valve closed) and with the pipe flowing. At least two runs of the test shall be made for each stretch of pipeline to demonstrate that the results are within 5% of each other.

9.2.9 SPECIAL PROVISIONS

9.2.9.1 GENERAL

The Contractor is required to carry out instructions set out below at no additional cost to the Employer. All costs relating to the following special provisions shall be deemed to have been included in the items provided in the Bill of Quantities.

9.2.9.2 WORK IN ROADS

Procedures for dealing with Road Authorities (RA) for entering into and for cutting roads for the purposes of pipe laying, junction connections, installation of chambers valves etc., and making connections to existing pipeline, backfilling and temporary reinstatement etc. are set out below:

1. The Contractor shall produce his proposed overall programme and sub-programmes for each road section for installation works in roads for discussion with the Engineer at the earliest possible time after award of Contract to show the date of start and completion of excavation laying temporary reinstatement, hydraulic pressure testing, backfilling, compaction and in each road for the following:
 - (i) Pipelines along roads.
 - (ii) Junction connections, installation of valves & chambers, tapping of existing lines.
 - (iii) Pipelines across roads (Road Crossings).

Note Programmes for this work shall allow for the time needed for prior approvals, trial pits, ordering, manufacture and supply and delivery of pipes and any special imported fittings. Connection to existing lines shall be programmed for early completion together with the transmission lines to supply the reservoirs.

2. When satisfied with the construction programme, the Engineer will present it to RA who may propose changes to the sequence according to their own road improvement programme if any. The Contractor shall allow for some disruption to his programme and he shall not be entitled to specific extra cost or extension of time that may arise as a result of RA's comments.
3. The Contractor shall produce a final programme for action incorporating any changes requested by the Engineer following discussions with the RA.
4. The Engineer shall agree with the RA the estimated permanent reinstatement costs for the roads programmed for entry and execute works within the two months according to the Contractor's agreed programme or such other period as may be found more practical or appropriate similar procedure with monthly or such other suitable period to keep sufficient work in hand thereafter.
5. When directed by the Engineer, the Contractor shall pay the RA the agreed estimated amount. The Contractor shall apply for permission to enter in to the defined roads following payment to the RA.

6. Road Crossings : Road Authority requirements are that Road Crossings may only be carried out at times of low traffic density such as at night, at weekends and during public holidays and Contractor must prepare his programme accordingly. Contractor must allow in his rates for his extra costs involved in such work outside normal working hours.
7. Compaction of the back filling to trenches shall exceed 90% of the maximum dry density or percentage specified in Section 9.1.1.3 on Modified Proctor Test. The Contractor shall allow all costs for test facilities and for ensuring correct moisture content to achieve the required minimum compaction. Compaction tests of trench backfill shall be carried out whenever directed and results shall be to the satisfaction of the Engineer.
8. Contractor is expected to use Asphalt Cutters and Pneumatic Tyre Wheeled Excavators for road work to minimise damages to the road wearing surface.

The Contractor shall make all the arrangements for any temporary work, scaffoldings etc., at his own cost, with the permission of the relevant authorities where required.

The Contractor is required to liaise closely with the Road Authorities (RA), whose responsible officers are:

- The Director Engineering Services
Roads Development Authority
Sethsiripaya,
Sri Jayawardanapura Kotte
Battaramulla.
Telephone No: 865721
- Chairman
Provincial Road Development Authority,
No. 50, Kitulwatta Road,
Colombo.8.
Telephone No: 681685

Superintendent Engineer (Roads)
Colombo Municipal Council,
Town Hall, Colombo 07
Telephone No : 585005

9.2.9.3 MAJOR ROAD CROSSINGS

Before commencement of work on any road crossing, the Contractor shall submit to the Engineer a method statement and obtain Engineer's prior approval. The method statement should include traffic by-pass arrangements (where required) and the safety measures proposed during day and night. The Contractor shall maintain sufficient unobstructed width of the carriage way at any given time and this width should not be less than 3 meter to permit single lane traffic.

The Contractor shall adequately protect all existing service mains through out the construction and he shall ensure that all existing services operate without interruption.

The Contractor shall provide adequate temporary supports to all existing service mains which are either exposed or partially exposed or otherwise weakened by the trench excavation..

9.2.9.4 WORKS WITHIN AREAS OF PRIVATE AND PUBLIC PROPERTY

The Contractor shall in no way encroach in to and/or disturb private and public property. The Contractor is to take special care to avoid unnecessary damage to private and public property and he shall pay the compensation for such damage as may in the opinion of the Engineer be due to the execution of the work in a careless or unworkmanlike manner. Should the Contractor require for any purpose additional land, he shall provide it at his own cost and shall forward to the Engineer a copy of the permits from the owner and occupier of such additional land before entering thereon.

Where the work involving pipelines is carried out through, between or under buildings or other structures, the gardens, orchards or cartilage of private houses and business premises or in other cases which in the opinion of the Engineer render it impracticable or unreasonable for a specified width to be obtained for the construction of the works Contractor shall be deemed to have made allowance in his tender for any extra expense which may be incurred in carrying out the work in the restricted width available.

The Contractor shall not disturb any monuments, property corners or survey markers without permission from the Engineer, and he shall bear the expense or resetting any monuments, property corners or survey markers which may be disturbed.

The Contractor shall be responsible for all damage to streets, railways, roads, highways, ditches, embankments, canals, bridges, culverts or other public or private property which may be caused by transporting equipment, materials, or men to or from the work. The Contractor shall make satisfactory and acceptable arrangements with the property owner over the damaged property concerning its repair or replacement.

Where the pipe line runs through the existing embankment the Contractor shall take additional precautions not to disturb the existing pipe line and existing earth bund. The existing bund should not be loaded with heavy machinery and Contractor shall protect the existing pipe line throughout the construction and ensure its uninterrupted operation. On completion of works the bund should be formed to lines and grades shown on the drawings.

9.2.9.5 PRESSURE AND LEAKAGE TESTS

(1) General

Prior to acceptance, pipelines, reservoirs, tanks and conduits shall be pressure or leakage tested by the Contractor in the presence of the Engineer. Pressure tests shall ensure the system as constructed is structurally adequate for the anticipated pressures.

The leakage tests as specified in BS 8007 shall ensure that leakage either out of or into the units is within the requirements of these specifications.

Potable water for testing shall be obtained by the Contractor from the Employer at the current water rate at the time of use. The Contractor shall transport the water to the sites as necessary at his cost.

The Contractor shall furnish all labour, equipment, fuel, oil, grease and power required for testing purposes. This shall be for the time necessary to indicate to the satisfaction of the Engineer that the work is in conformance with the specifications.

The Contractor shall furnish suitable temporary service connections, testing plugs or caps, pressure pumps, pipe connections, meters, pressure gauges, thrust supports and other equipment required to carry out tests. No water may be pumped into tanks, conduits or channels or tests commenced in any way, without the Engineer's approval.

(2) Pressure Tests for Pipelines

This is explained in Sub-section 9.1.4.3 of the General Specifications-Civil Works.

(3) Leakage Tests for Structures

Concrete tanks, conduits and channels shall be tested for leakage. Tests shall be done before the structure is backfilled and before any water proofing material, if required, is applied.

No leakage from the concrete tanks, conduits and channels will be allowed.

Concrete tanks, conduits and channels shall be tested individually in accordance with BS 8007. These shall be kept filled with water for twenty one days for the concrete to absorb water thoroughly. The leakage shall then be assessed based on any diminution of water level, accounting for any evaporation losses. Water levels will be recorded at 24-h intervals for a test period of 7 days. Drop in water levels should not exceed 10 mm for the test period.

The roof slabs of reservoirs shall be tested for leakage by impounding the slab by water to a depth not less than 25mm, and keeping it for a period of not less than 24 hours, and with visual inspection of the underside of the slab for any dampness or leakage. This impounding may be in small sections, if required.

If any test shows that there is a leakage of any tank, conduit or channel, the structure shall be emptied and carefully examined and all defects shall be repaired by grouting, cutting out or remaking

joints, as directed, or by any other approved method. Such tests shall be repeated until there is no leakage any more.

9.2.9.6 DISINFECTING

(1) General

Before being placed in service all works including pipes, reservoirs, conduits and channels, and all other appurtenances which are to be in contact with, contain or convey potable water are to be disinfected as herein specified. Disinfecting shall be done after completion and acceptance of the specified leakage and pressure tests. Definition of potable water is water after filtration at the treatment plant.

After completion of the specified tests, pipes, reservoirs, conduits, channels and appurtenances to be disinfected shall be thoroughly cleaned out. Cleaning may be by flushing, hose stream, brush or other proper means as may be required for successful removal of all foreign material. All oil, grease and foreign material, not removed with water shall be removed with appropriate solvents in such a manner as not to injure the concrete or other materials, or impart a harmful residue to the potable water system after completion.

The Contractor shall furnish all materials including disinfecting chemicals, labour, equipment and incidentals necessary to disinfect the work as herein specified. After completion of the disinfecting, the water shall be flushed, pumped, drained or otherwise removed from the works. Proper precaution must be taken to ensure that the resultant chlorine concentration in the water will not be harmful to fish, plants or crops. The Contractor shall make the necessary chlorine residual tests to ascertain, to the satisfaction of the Engineer, that the concentration is not excessive.

(2) Disinfecting of pipelines is described in Sub-section 9.1.4.4 of GENERAL SPECIFICATIONS-CIVIL WORKS.

(3) Disinfecting of Structures

All surfaces of concrete tanks and structures that will be in contact with potable water shall be disinfected. This includes all submerged concrete and metal surfaces such as concrete slabs, columns, roof, interior and exterior of pipes, and metal surfaces of equipment.

The disinfecting should be performed in the following sequence;

- 1) All debris should be removed from within tanks and structures. The floors should be swept to remove all loose dirt and debris.
- 2) All the surface should then be flushed with clean water to wash dirt and debris away to the satisfaction of the Engineer.
- 3) Cleaning shall be followed by the spray application of chlorine solution containing at least 200 mg/L of chlorine to the entire roof, walls, columns, mechanical equipment and floor surfaces starting with the roof and working down. The solution shall remain in contact with the surface

being disinfected at least thirty (30) minutes before the structure is filled with clean water. The materials and method used shall be subject to prior approval by the Engineer and the entire operation shall be under his direct supervision.

- 4) For the concrete made clear water storage structures, an amount of chlorine solution and clear water should then be added and filled in the storage structure in the manner to make chlorine contents to be approximately 10 mg/L and left for twenty-four (24) hours.
- 5) After twenty-four (24) hours, if the concentration of residual chlorine is higher than 5 mg/L, the water should be retained for several days to have alkalinity in the concrete structure dissolve off into the water. If the concentration of residual chlorine has dropped below 5 mg/L, drain water to clean up the interior surfaces, fill the 10 mg/L chlorine solution and repeat the procedures above until the residual chlorine is maintained above 5 mg/L.
- 6) When the procedures above show the successful result, water in the structures should be drained off. Then fill it with clear water containing chlorine of 2 mg/L and leave the reservoir out of use for twenty-four (24) hours.
- 7) If the residual chlorine is observed after twenty-four (24) hours and the reservoir water shows no abnormal smell, it is allowed to distribute the water for service. However, should there be substantial reduction in the residual chlorine or when the water has abnormal smell, repeat the third cycle of cleaning and disinfecting.

When chlorinated water is drained off, it might result in the smell of chlorine spreading over a wide area or kill fishes or water plants. The Contractor shall take special care to prevent such accidents by regulating the discharge flow and by neutralising the chlorine.

Special precautions shall be taken to protect workmen from injury due to chlorine gas and splashing chlorine solution. Suitable rubber suits, boots and masks shall be supplied to be worn by all those within the structures.

Special disinfecting procedures shall be used as directed by the Engineer where the above outlines methods are not practicable and where alternative methods will be required. For these situations the disinfecting method shall be conducted in a manner to ensure the required degree of disinfecting without endangering potable water systems or releasing a large quantity of heavily chlorinated water into a canal or drain. The Contractor shall provide all labour, materials, equipment, incidentals and make all taps for disinfecting. This disinfecting shall be under the immediate direction of the Engineer during all phases of the work.

9.2.9.7 INTERCONNECTIONS

The contractor should complete the interconnections between pipelines constructed and rehabilitated under this Contract and existing pipelines as shown on the Drawings.

- Prior to any connections, the contractor shall liaise with the Operations and Maintenance Division of NWSDB.

- The contractor shall prepare a method statement for major connections and shall obtain Engineers' prior approval.
- The Contractor shall carefully plan all pipe work, connections and any associated construction works before interruption to the existing water supply.
- The contractor shall ensure that all the necessary pipes, fittings, and equipment required for the works including those for an emergency situation are available before commencement of the works.
- The contractor is required to properly organize the works and carry out construction works in the most efficient manner and ensure that the period of interruption to the water supply is reduced to the minimum.

9.2.9.8 CONSTRUCTION OF APPROACH ROADS TO MALIGAKANDA RESERVOIR AND OFFICE BUILDING, ELLIE HOUSE RESERVOIR, AND GOTHATUWA GROUND RESERVOIR AND PUMP HOUSE

The Contractor is required to complete construction of all chambers, laying of pipelines and other utilities underneath the proposed road formation level before commencement of the road construction. The top soil of at least 150 mm and all material which are not considered of value by the Engineer shall be removed from the right of way and dispose of so as not to constitute an obstruction or a nuisance.

(2) Sub Base

The right of way surface of the roadway shall be well cleaned, free from mud and site material properly shaped and compacted. The surface shall be filled by a sub base with compacted earth or gravel with California Bearing Ratio (CBR) not less than 20. The compacted thickness shall be 300 mm minimum. The sub base material shall be spread in layers for compaction using 8 –10 ton smooth wheeled roller.

(3) Base Course

A base course shall be compacted and formed to a thickness of 75 mm using two layers of 50 mm aggregate spread evenly with 19 mm choker stone to ensure that the stones are well embedded in the surface interstices of the base course. While the rolling is being done, the surface shall be wetted and lightly brushed so as to ensure that the finer aggregate including fines are worked into the services.

(4) Bitumen Application

The hot bitumen application shall be applied when the surface is dry. The binder shall be 80-100 penetration grade bitumen heated to 175° C and shall be applied using a mechanical sprayer or hand sprayer or by other means approved by the Engineer.

The rate of application shall be 1.5 to 2.0 litre per sq.m. and 0.75 – 1.0 liter per sq. m. for first and second coat applications respectively.

The binding material shall be immediately blinded with sand or any other approved material at the rate of 8 cu.m. for 1000 sq. m.. Rolling of the surface shall be carried out if directed by the Engineer.

(5) Drains

The lined drains shall be constructed with concrete as shown on the drawings and as directed by the Engineer.

(6) Quality

The quality of road works shall be exercised in accordance with the standard specifications of the Road Development Authority.

9.2.9.9 DEMOLITION OF BUILDINGS AT MALIGAKANDA

The demolition and construction sequence to follow at Maligakanda is as follows:

- (1) Demolish Court House
- (2) Construct New Office Building
- (3) Demolish buildings in Maligakanda New Reservoir area
- (4) Construct Maligakanda New Reservoir
- (5) Rehabilitate Existing Reservoir

All demolition work shall be carried out strictly in accordance with BS Code of Practice for demolition (BS6187: 1982) or the latest edition.

Demolition work shall be carried out in 2 stages, (1) and (3) above. In stage (1), the old court house is need to be demolished prior to construction of new office building. In stage (3), the remaining buildings, about nine in numbers shall be demolished prior to construction of Maligakanda New Reservoir.

Before demolition work commences, disconnect 4 inch and 6 inch pipelines feeding two bowser filling points and either disconnect or deviate any other services that are in the proposed area for demolition of structures.

Demolition work has to be carried out in a very restricted space. Two large water storage reservoirs, a court complex, schools and residential houses are located in the vicinity. The methodologies adopted for demolition shall suit the present environment.

The Contractor shall obtain prior approval from the Engineer for his methodology, engagement of manpower , machinery and equipment to be used, scaffolding system, safety measures and methods adopted for noise and dust control.

9.2.9.10 CONSTRUCTION OF MALIGAKANDA NEW OFFICE BUILDING

The construction of the above building shall be carried out conforming to specifications for building works Sri Lanka (ICTAD Publication, Volume 1 1985), unless otherwise noted.

The contractor shall divert all the existing services, demolished old court house building marked as No. 1 building and remove 22 trees as shown in the drawing No. MK/G-02.

9.2.9.10.1 Concrete for the foundation structure.

Soil at the building site has a high sulphate content and is considered aggressive towards concrete. The construction shall use special concrete for foundation as follows:

- Grade 35 Ordinary Portland Cement to BS 12 mixed with 25 % pulverized fly ash (pfa).
- The cement content of the concrete shall be not less than 380 kg/m³
- maximum free water cement ratio shall be 0.45.

9.2.9.10.2 Aluminium Doors, Windows, Frames and Partitions

The drawings submitted are only a schematic presentation of the Aluminium Doors & windows. Shop drawings showing details of composite profiles for frames and sashes (with Aluminium profile to be done by the fabricator for approval prior to Manufacturer profile reference Nos.) shall be provided prior to Fabrication.,

Authentication & Certification

All components of the Door /Window System / Assembly shall be from a reputed firm manufacturing Aluminium Glassed window and Doors. All component parts of the Window/Door System offered shall be compatible with one another and be tropicalised and as recommended by such reputed manufacturer.

All Bidders shall provide adequate proof and confirmation in writing so as to satisfy the Engineer that their offer conforms with specification herein.

Where the Engineers are dissatisfied with the proof provided that may reject such offers or request for adequate and more specific proof from the manufacturer or principal as the case may warrant in order to obtain a durable and reliable and safe product for their client.

Samples

Sample sections of all mullions, transoms complete with gaskets weather stripping bedding, screws, anchors and all components that comprise the various types of door/window assemblies shall be submitted to the Engineer with the Tender so as to enable him to examine the quality offered.

Shop Drawings

Before delivery, submit shop drawings for Aluminium doors, windows, Partitions and frames. Shop Drawings shall indicate elevation of units, full size sections, thickness of metal. Fastening methods of installation and anchorage, size and spacing of anchors, method of glazing and replacement of glass, location of operating hardware, mullion details, method and materials of weather stripping method of attaching screws, details of installation connections with other related work and schedules showing locations of each unit.

Approval of Shop drawings and samples, by the Engineer do not in any way relieve the supplier of responsibility for the acceptability of the finished installation in perfect working order free from defects of any sort.

At least four weeks shall be allowed after receipt by the Engineer for the examination of shop drawings and adequate time shall be allowed for any required amendments. Duplicate copies of the final approved shop drawings shall then be sent to the Engineer before any work is commenced.

9.2.9.10.3 *The Mineral Fibre Acoustic Ceiling*

The mineral fibre ceiling tiles shall be installed on a suspended "T" bar system as specified below.

The mineral fibre ceiling manufacturer shall offer a 10 year warranty against visible deformity of the ceiling tile for conditions up to 90% Relative Humidity and 104°F temperature. The surface pattern of the tile shall be sand finished. The thickness shall be minimum 16 mm with a trim edge. The tiles shall fit into a grid system of size 600 mm x 600 mm.

The ceiling shall be suspended using galvanized "T" bar grid system at 600 mm x 600 mm centres. The main tee bar shall be 38 mm high and 24 mm wide. The intermediate tee shall be 24 mm height and 24 mm wide.

The "T" bar and the ceiling tiles shall be manufactured by the same manufacturer and the entire system shall be covered under a 10-15 year comprehensive warranty.

The "T" bar system shall incorporate a fire break and shall be suspended from the soffit above using adjusting clips and hanger rod of min 3 mm dia.

The framework shall be installed level to the satisfaction of the Architect. The mineral fibre ceiling tiles samples & samples of main tee bars, intermediate tees & hanger rods & adjusting clips shall be forwarded to the Engineer for his approval.

9.2.9.10.4 *Cast Insitu Terrazo Floor Finishes*

Terrazo floor finishes 75 mm thick shall be according to the ICTAD specification for the Building Works - 1985 Publication No. SCA/4 (Volume 1)

Cement : Black Portland cement conforming to BS 12

Facing aggregates : The aggregates shall consist of good quality marble in black, white and brown colors. Aggregate size shall be No. 2 and No. 3 as specified in the Table 11.1 of ICTAD Specification for building works -1985. Aggregate shall be washed before use.

Dividing Strips : Dividing strips shall be 2 mm thick 25 mm wide Aluminium. Thickness of the top Terrazo layer shall be 8 mm. Sample panels shall be forwarded to the Engineer for his approval.

9.2.9.10.5 Potable Water Supply System

(a) Pumping Units

Two submersible type centrifugal pumping units complete with all mechanical & electrical accessories shall be supplied and installed in the Ground Sump for pumping of cold water from ground sump to overhead tanks, as indicated in the drawings. (Pumping equipment literature should be forwarded for approval by Engineer before supply & installation of pumps)

(b) Pumping sets shall satisfy the following requirements.

Pumps

Type of pumps: Pumps units shall be of submersible, centrifugal type close coupled with submersible type motor, complete with suitable suction strainer. The pump shall be required to handle potable water of average temperature of 25-35 deg. C and pH of 6.5 to 8.0.

Capacity

Each pumping unit shall be to the following requirements.

Delivery Head	Capacity (liters per minute)
18m	170

Speed

Maximum speed 2900 rpm.

Type of installation: Delivery flanges of the pumps shall be coupled with the duck foot bends installed at the bottom of the ground sump.

(c) Materials of Construction and Features

1. The impeller shall be of Bronze or Cast Iron, precision machined for maximum hydraulic efficiency and dynamically balanced for minimum vibration.
2. Pump housing should be of cast iron of ample thickness smoothed on inside and other surfaces and painted with a rubber paint.
3. The pump shaft, shaft sleeve, nuts and bolts and screws and washers shall be of stainless steel.
4. The mechanical shaft seal shall be of the heavy duty type to have a long trouble free life.
5. The bearing shall be adequately sized and self-lubricating to ensure continuous smooth and vibration free operation.

(d) Motor

The motor shall be suitable for submersible type installation and shall be of the totally enclosed, water cooled type with main dimensions according to IEC and DIN standard and operating on 400 V 50Hz, 3 Phase, AC supply.

The motor should be directly coupled to the pump and shall be enclosed in a rugged quality cast iron housing. The surface of the housing shall be primed with PVC epoxy and painted with rubber paint.

The speed of the motor shall not exceed 2900 rpm and the winding shall be of class 'F' insulation. Enclosure Class IP68 with a maximum ambient temperature of 40° C.

The starter shall be full voltage, across the line type, capable of withstanding voltage variations up to 10% of the nominal voltage (400 V) without overheating the windings.

(e) Accessories

The pumping sets shall contain the following minimum accessories.

1. Submersible type motor cables of sufficient length from the ground sump to electrical starter panel.
2. A stainless steel lifting chain to lift the pump from the ground sump for maintenance purposes.
3. Manufacturers recommended spares for five years trouble free operation, not limiting to the following spares.

Impellers	-	02 Nos.
Mech. Shaft seals	-	02 sets (01 set for each pump)
Cable entry seal	-	02 sets
Motor bearing	-	02 sets

9.2.9.10.6 Hose Reel Fire Protection System

(a) Scope

A brief description of the work could be given as follows:

- Supply & installation of fire pumps inclusive of the control power panel, piping, valves, etc.
- Supply & installation of hose reel riser, house reels with all the components as per drawings and specifications.
- Supply & installation of portable fire Extinguishers at the locations shown on drawings.
- Testing & commissioning of the system

(b) General

Two electrically operated automatic pumps comprising a main and stand by for the hose reel riser system shall be supplied and installed. The inlet side of all the pumps shall be connected to main inlet header pipe. The inlet header shall be connected to the tank via valves.

Fire hose reels shall be installed at each level in the locations shown in the drawings. The hose reels shall be 1 " (25mm) 30m length connected to the hose reel system by flanges of medium duty galvanized steel pipe to BS 1387.

Hose reel riser pipe work within the building shall be medium duty galvanized steel pipes conform to BS 1387.

The distribution pipe net work shall be kept pressurized at all times.

The pipes shall run concealed in ceiling voids where available and in the ducts provided.

The hose – reels shall be housed in fire cabinets located as indicated in the drawings.

The work shall conform to BS 5306: Part 1 except where otherwise required by this Specification.

(c) Standards

The installation shall comply with the following regulations:

British Standard Specifications

BS 5306: Part 1	- Hydrant Systems, Hose Reels and foam inlets
: Part 3	- Portable Fire Extinguishers
BS 5041: Part 1	- Specification for landing valves for wet risers
: Part 3	- Inlet breaching for dry risers
: Part 5	- Boxes for foam inlets and dry risers
BS 5274	- Fire hose reels (water) for fixed installation

(d) Other Requirements

- All the materials shall be new without any defects and to be approved by the engineer.
- All the approvals required to be obtained prior to the installation.
- All builders' work required with respect to plinths and foundations, opening on walls and floors and any additional provisions required shall be included in the scope of Work.

(e) Design Conditions

(e 1) Fire Protection System

- Water quantity at upper most hose reel connection - 0.5 liters / second
- Minimum pressure required at hose reel nozzle - 1.5 bar

(f) System Description

(f 1) Fire Sump

The water sump is situated at the location shown in the drawing.

Water supply for the fire protection system will be drawn from the water sump. The tank is continuously fed from the Main Water Supply Network. The lower part of the tank with a capacity of about 4 m³ will be reserved for Fire Protection System while the upper part of the tank will feed service water system of the building. The pumps shall be located in a pump house as shown in the drawings.

(f2) Fire Pump Inlet Manifold

The suction side of the pumps shall be connected to a common inlet manifold which will be connected to water sump via underground pipe line, puddle flange at the side wall of the sump and foot valve.

(f3) Fire Pumps

The contractor shall supply, install and hand over in good working condition the main, and standby pumps complete with vales, gauges and fittings. The pumps and accessories shall be installed at the pump house.

Electrically powered vertical / horizontal direct driven, duty and standby pumps shall be installed. To reduce pressure pulsation in the pipe, all delivery lines shall be fitted with cushioning chambers.

All pumps shall be capable of being started and stopped manually by an auto – manual selector switch in the pump control panel.

The main and standby pump shall be capable of delivering individually 60 l/ min at a total head sufficient to maintain the minimum specified pressure at hose reel nozzle.

Motor shall be designed for operation on 3 Phase, 50 Hz 400 V supply system and shall be of the totally enclosed, fan-cooled types protected to P 54 installation shall to Class E Motor shall be continuously rated and shall comply with the appropriated parts of BS 5000. Each fire pump shall be connected to inlet (section) manifold line for the water pump. The delivery pipes of the main and standby pipes shall be connected to a common manifold with valves gauges and pressure tank before joining the riser main.

The pumping set shall be completed with inlet pipe, delivery manifolds, isolating valves, and non-return valves. Test-cocks, flow switch, pressure switch and frame mounted control panel, all fitted on a combination bedplate. Pumps shall be of the back pull-out design for ease of maintenance.

The control panel, which shall be dust and damp proof to IP 65 shall incorporate all the necessary switches, isolators, starters, indicator lamps, fuses, relays and wiring for automatic operation right up to the pump motors and controls in the manifolds. Protection against running dry shall be provided.

High rupturing capacity fuses shall be provided and they shall be capable of,

- (a) Protecting the cable connecting to the motor,
- (b) Carrying the stalled current of the motor for a period of not less than 75 % of the period during which such a current would cause the motor windings to fail.

All electrical equipment shall be fully tropicalised and suitable for use in ambient temperature up to 40 deg C and relative humidity varying between 70 % and 90 % over any 24 hours period. The

control cubicle shall be protected against entry of dust, vermin and insect. Where control or main circuits are protected by fuses, two complete sets of spare fuses shall be supplied in a fuse holder provided for that purpose within the cubicle.

The control panel shall incorporate the following alarm / status indications

- (a) A fall in water pressure in the system which is intended to initiate the automatic starting of the pump set
- (b) The starting of a pump
- (c) The failure of the power supply to the pump sets on any phase

Voltage free contacts shall be wired and terminated in a connector block within the pump control panel and clearly identified.

(g) Fire Cabinets

Fire cabinets shall be located as indicated in the drawings. They shall be fabricated out of 1 mm thick steel sheet and protected with a coat of epoxy based sine chromate enamel Red paint. The doors shall have wired glass panel and shall be hung on piano hinges to be operable through 180° swing. The door shall also be fitted with a break glass type cubicle and the key shall be kept in it.

The size of each cabinet shall be made to accommodate the 01 no. Hose Reel (swivel type with shut off valve, (1) 25mm diameter, and 30m length

The doors should bear the words " FIRE HOSE REEL " in Red letters at least 50mm high on a White background. In addition all the provisions should be made as required in BS 5306 Part 1 or equivalent,

(h) Fire Hose Reel

Swing type fire hose reels, 25 mm dia. (1") 30m length shall be provided with shut off valves and spray nozzles.

Hose reels shall be provided internally at each fire cabinet as shown in the drawings.

Hose reel shall be of the recessed pattern swing type (according to location and as scheduled) complete with 30m of 25mm (Internet diameter) non-collapsible, non- kink reel hose and nylon spray / jet / shut-out nozzle.

All water passage shall be in non-ferrous corrosion resistant materials.

The side plates of the hose reel shall be of pressed steel and metal work shall be finished in stove-enameled signal red.

To facility ease of installation and maintenance, a gate valve and union shall be fitted between the rising main and the hose reel.

Reels shall be capable of being run out of the reel, through the hose guide where fitted, in any generally conform to BS 5274 (1985).

The hose shall comply with the requirements for type A (design working pressure of 15 bar) hose specified in BS 3169.

Each length of hose shall be durably marked at the nozzle end and at intervals not exceeding 10m, with the following information:

- (a) Manufacturer's name or identification
- (b) The number of the specified BS with the type letter suffix e.g. BS 3169 / A
- (c) The nominal bore size, eg. 20mm
- (d) Month and year of manufacture e.g. 10/ 95
- (e) The design and working pressure

This information may be conveniently printed in the following manner.

MR / BS 3169 / A 20mm / 01/95/15 bar

Hose reel brackets shall be firmly fixed to the wall so that casual knocks received during normal use of the building and the stresses incurred during use for fire – fighting will not prevent the unimpeded use of the hose reel.

(i) Control Valve and Pressure Gauges

All main control valves other than those in fire cabinets shall be of cast iron or bronze, sluice type, of approved quality.

Pressure gauges shall be provided wherever necessary in addition to the position shown on drawings.

All valves shall be new, of approved.

All valves shall be placed in accessible positions for operation and repairs. The connections between each valve and adjacent piping or equipment shall be made either with a flange (65 mm dia and above) or an union (upto 50 mm dia)

The valves and glands shall be provided with a means for attaching a strap so that the hand wheel may be secured in any desired position to prevent unauthorized use.

A purpose – made strap of leather or reinforced plastic material not less than 12 mm wide non less than 2 mm thick and a small non ferrous padlock to secure the two ends of the strap shall be supplied with cache valve.

Alternative means of securing the valves against unauthorized use may be offered.

Straight pattern valves shall be of the full – way gate type.

The bodies of valves up to and including 50 mm diameter shall be of cast gunmetal or bronze. Bodies of valves 65 mm diameter and above shall be of cast iron. Casting shall be of good quality, clean and smooth and free from scale or falls.

The system drain valves shall be 50 mm diameter, key operated type with hose unions fitted to the discharged end.

(j) Pressure Gauges

Pressure gauges 50 mm dia. Maximum, shall be installed in the following locations:

- (a) Pump set manifold
- (b) Top-most point of wet riser

The gauges shall be provided with a device to dampen pulsations and the fitting of the gauges shall be such that it may be removed and re-fitted without shutting

Down the line.

(k) Air Vents

Automatic air vents shall be used at the top of the riser.

It shall have gunmetal or brass bodies, non-ferrous or stainless steel floats and guides and non-corrodible valves and seats. An air outlet tapped to accept a drain line shall be provided. A manual test cock shall be fitted to the automatic air vent so that it is possible to check the automatic vent fail.

The automatic vent shall be isolated from the system with a gate valve to permit cleaning and repair if necessary.

Air release pipes shall be run to discharge at the nearest visible point to be agreed with the Engineer and where maintenance personal can regularly check for leakage.

(l) Pipes

Pipes shall be steel conform to BS1387, medium gauge and galvanized.

All pipes and fittings shall be new, of approved manufacture and the right grades. Each length of pipe shall thoroughly cleaned and blown out to remove all scale and dirt before erection. Rusting pipes and fittings and piping and fittings of classes other than specified will be rejected. A corrosion preservative coating of bitumen-tar or equivalent shall be applied at the surface of all underground pipes prior to lying of pipes.

(m) Pipe Supports

Pipe work shall be supported so as to permit free movement due to expansion and contraction. Pipe work supports shall be arranged as near a possible to joints and changes in direction, and each support shall take its due proportion of the load. The spacing of the supports shall be in conformity with the recommendations of the grooved coupling manufacturer but shall not exceed the centers given below. Where there are two or more pipes, the spacing shall be based on the centers required by the smallest bore pipe work.

Vertical rising pip network shall be supported at the base to withstand the total weight of the riser. Branches from riser shall not be used as a means of support for the riser. Brackets screwed to walls shall be secured by expanding plugs or other purpose designed fixing devices to suit the material of the wall (e.g. Brick, concrete, hollow block etc), Wooden or plastic plugs will not be permitted

Pipe work of 65-mm size and above subject expansion and hung from supports shall be suspended on swivel hangers unless otherwise agreed with the Engineer.

For horizontal pipelines, angers shall be off split-ring adjustable type hung from supports shall suspended be on swivel hangers unless otherwise agreed with the Engineer.

For horizontal pipelines, hangars shall be off-split-ring adjustable type hung on mild steel rods. Caliper hooks may not be used. Where pipelines run along walls, columns or ceilings, brackets may be used.

A support shall be installed not more than 600 mm from each change of direction.

Special care shall be taken when making piping connections to equipment (e.g. Pump set) to ensure that the connections are properly aligned and that no stresses and sprains are imposed on the equipment.

(n) Pipe Work

The design and installation of the hose-reel system shall be closely correlated with all other services being provided in the building.

All fittings shall, as far as practicable, be the same size as the pipes connected to them. Bushed outlets will only be accepted if the required outlet size of a fitting is not standard manufacture.

All changes in the direction of run piping shall be made with standards Ben; springs or long turn fittings. Elbows may be used with the concurrence of the Engineer where space restorations do not permit the use of easy bends.

Pipes shall be removed after cutting and shall be thoroughly cleaned before erection. Open ends left during the progress of work shall be temporarily closed with purpose made metal or plastic plugs of caps, or blank metal flanges.

No pipe shall be installed so as to cause unusual noise from the flow therein under normal operation.

Joints shall not be made in thickness of any wall floor or ceiling or in any inaccessible space, and paperwork shall not be embedded in the strict of floor unless otherwise instructed by the Engineer. Where paperwork passes through walls, floors or ceilings, sleeves shall be provided. Paperwork passing through floors shall be provided with 3-mm mild steel plates fastened securely to the sleeve. Sleeves shall be formed from pipes of suitable larger diameter and the space between paperwork and sleeves shall be plugged with an approved sealant, which will not cause hindrance to pipe expansion and contraction and will not run.

All piping shall generally be run parallel to the axes of the building, concealed in the walls ceilings and ducting where possible, arranged to conform to the architectural and structural

All fitting such as bends, tees, elbows, reducers, etc. shall be heavy duty quality.

Requirements and to suit the necessities of clearance for the work of other trades. The clearance between pipe work and the wall and any other fixtures shall be not less than 25 mm.

The pipe work shall be graded to ensure venting draining.

Reinforced molded bellows expansion joints with integral flanges shall be incorporated into the suction line between the pump set and the pump to prevent the transmission of vibration to the sump connection. The joints shall adequately restrained and supported in accordance with the manufacturer's recommendations.

9.2.9.10.7 Portable Fire Extinguishers

Four portable fire extinguishers shall be installed in each floor.

- * 02 Nos. 9 liter water / CO₂ fire extinguisher and 02 Nos. 2 kg CO₂ fire extinguisher fixed on to the wall, shall be installed at cache and every floor, as directed by the Engineer.

Portable fire extinguishers shall be of the re-chargeable, metal-bodied type containing an extinguisher agent expelled by the action of internal pressure. They shall be manufactured to BS 5423 and approved by the Fire Service Department of Sri Lanka. The extinguishers shall be color Coded to BS for

easy identification and shall be fitted with a visual “ discharged “ indicator to prevent accidental use of an empty cylinder.

The extinguisher shall be operated by piercing, opening and / or bricking a sealing device and thus releasing the contents. The method of operation shall be readily apparent. It shall not be necessary for any movement of the actuating mechanism or mechanism to be repeated in order to initiate discharge of the extinguisher.

All portable Fire Extinguishers shall comply with BS codes extinguishing medium shall be released by means of a controlled partial discharge.

All extinguishers marked with clear instructions of the extinguishers to be provided shall be in accordance with the specifications.

(a) Mounting

All internal extinguishers shall be wall mounted and attached in a manner affording quick release from the supporting bracket. Extinguishers shall be installed so that the top of the extinguisher is not more than 1.5m above the floor and in no case shall the clearance between the bottom of the extinguishers and the floor is less than 0.1m. The extinguishers shall be positioned so that the instruction faces outward.

9.2.9.10.8 Finishes of Fire Protection System

The pump sets, hose reels and similar manufactured item of plant and equipment shall be completely primed and finished in the manufacturer's works. Any deterioration or damage to manufacturer's finishes during storage and installation. Shall be made good by the contractor at his own expense, to the satisfaction of the Engineer.

The surface of all ferrous metal work including pipe work brackets, hangers, steel work etc. which are not protected by galvanizing, works applied primer or protective paint shall be cleaned to remove all grease and rust and then given one liberal coat of anti corrosive red lead primer and finished with coats of approved quality signal red enamel.

Those parts of the installation required to be left unpainted (eg. Brass work) shall be so left. Direction of flow shall be adequately indicated on all pipe work.

9.2.9.10.9 Commissioning and Testing of Fire Protection System

The Fire Protection System shall be commissioned and tested generally as specified in various sections of this Specification and in particular, according to BS 5306: Part 1-5 and as herein specified.

The water system shall be thoroughly flushed out and hydraulically pressure tested there after, to a pressure of 07 bar measured at the inlet for a period of at least 30 minutes. During this period, an inception of the system shall be applied to the riser.

Demonstrate the ability of the standby pump to come into service automatically and maintain the required outputs.

The Fire protection System and its performance must satisfy the requirements of the local Fire Authority and the requirements of all other interested Authorities and the contractor shall include for separate approval test, inspections etc. as may be required by such Authorities, and any fees in connection with these requirements.

On satisfactory completion of the tests, the system shall be restored to its normal operating state unless otherwise instructed by the Engineer.

9.2.9.10.10 Manual Call Point Fire Alarm System (Electrical)

1. A manually operated electrical fire alarm system with release-button call points should be installed throughout the building.
2. Call and operating points should be so distributed that a person need not travel more than 30m to raise the alarm.
3. Each manual call points shall be accessible, unobstructed, visible and of the same general type.
4. The call points should be placed on walls at about 1.30m above floor level, in conspicuous positions on escape routes.
5. The alarm sound level should be at least 65dB, and should be continuous and same in all parts of the building.
6. The delay between operation of a call point and the sounding of the alarm should not exceed 3 seconds
7. Standby supply should be provided from secondary batteries with automatic charges
8. The power supply cables and the cables to alarm sounders must continue to function in a fire (prolonged operation in a fire)
9. Central and indicator panel should at all times be accessible from within the building
10. Addressable pull station (call points) shall contain electronics that communicate the station's status (alarm, normal) to the control panel over two wires which should also provide power to the pull station. The address should be set on each station. The stations shall be manufactured from high impact red Lexan or equivalent. Lettering shall be raised and painted white. The station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks.
11. The front of station to be hinged to a back plate assembly and should be opened with a key to reset the station. The key shall be common with the control panels, Stations which use allen wrenches or special tools to reset, shall not be accepted. The station shall consist of high impact Lexan or equivalent, red in color.
12. The addressable manual station shall be capable of field programming of its address location on an addressable signaling line circuit.
13. There shall be no limit to the no. of stations, detectors or zone adopter modules which may be activated or in alarm simultaneously.
14. The addressable manual call stations should be UL listed and the audible and/ or visible alarm components should be designed as per BS5839 Part 1-1980.

9.2.9.11 CONSTRUCTION OF MALIGAKANDA GROUND RESERVOIRS AND ELLIE HOUSE RESERVOIR

9.2.9.11.1 *Special Cement for Foundations at Maligakanda*

The cement used to produce concrete for the foundation structure shall be Portland Cement complying to BS 12 mixed with 25 % pulverized fly ash (pfa). The cement content of the concrete shall be not less than 380 kg/m³ and the maximum free water cement ratio shall be 0.45.

9.2.9.11.2 *Post Tensioning at Maligakanda New Reservoir*

The concrete for the perimeter post-tensioned wall should be Grade 40 as per BS 5328 and for the other parts of the structure it should be grade 35A.

The post-tensioning shall be carried out as specified in Section 9.2.7. The anchoring of cables should preferably be with 'split-wedge and barrel-type' and the tensioning operation should be completed in two stages. First apply 50 % of the force on all cables in the order given and then the balance 50 % on all cables in the same order. For a system with tensioning and anchoring of four wires simultaneously the jack should have a safe pulling capacity not less than 25.0 Tonnes.

After the walls and floor slabs have been constructed the contractor shall fill the tank with water to the normal top water level to achieve initial settlement. Displacements should be monitored for a 30 day period while carrying out the leakage test. Construction of columns, roof slabs and final connections to the inlet and outlet of the tank shall be after initial settlement.

9.2.9.11.3 *Construction of Ellie House Reservoir*

(a) Special cement required in concrete foundations

The cement used to produce concrete for the foundation of structures at Ellie House shall be Portland Cement complying to BS 12. The cement content of the concrete shall be not less than 360 kg/m³ and the maximum free water cement ratio shall be 0.45.

(b) Protection of existing structures and property

The Contractor will be held fully responsible for any damage utilities, properties, buildings, homes or structures adjacent to or in the genuine area of the work, through settlement of ground, vibration or shock resulting from any cause relating to the work carried out under this Contract. Make good and repair such damage shall be at his own expense.

(c) Control of Vibrations

1. Control vibration levels to prevent damage to concrete work during construction, existing structures, equipment and utilities.
2. Control use of vibration producing construction techniques or equipment so that the ground adjacent to concrete has a resultant peak particle velocity (P.P.V) not exceeding the following limits.

Age of Concrete (hours)	Maximum Permissible Resultant
Less than 4	50
4 to 60	10
Over 60	50

3. Schedule and execute placing of concrete so that, for concrete 4 to 24 hours old, a minimum distance of 40 m between the source of vibration and the concrete is maintained.

(d) Special measures for demolition

A detailed sequence of demolition and construction is given in the relevant drawings (Dwg. Nos EH/GR/G-01 to G-06).

The main criteria in demolition and construction shall be to keep a part of the existing reservoir (southern cell –RS) in operation while keeping the northern cell (RN) in operation.

The arrangement for temporary support of the roof & walls during demolition to be designed by the Contractor and shall be submitted to the Engineer for approval.

(e) Construction Sequence

Suggested Construction Sequence is detailed on the Drawings and summarized as follows:

Stage 1 – Prepare for demolition of southern reservoir (RS) and office building

Stage 2 – Demolition of RS and office building

Stage 3 – Construct New reservoir one (NR1), valve house (VH) and chlorination facility

Stage 4 – Transfer distribution mains to VH

Stage 5 –Demolition of RN

Stage 6 – Construct New Reservoir – Middle Cell and North Cell

Stage 7 – Construct New Inlet Channels

Stage 8 – Restore Inlet / Outlet Buildings and Site Works

9.2.9.11.4 Protective Coating Inside the Reservoirs and Towers

All new concrete surfaces in water retaining structures including columns and baffle walls in contact with potable water such as water sumps, water reservoirs and water towers) shall be coated with elastomeric cementitious coating approved by the Water Research Council (WRC) of UK for the use with potable water.

The protective coating shall be a two-component polymer modified elastomeric cementitious compound.

The product should be able to mix on site using a slow speed drill fitted with a mixing paddle and then applied to the substrate using brush, towel or spray.

The mixed density shall be not less than 1800 kg/m³

It should have excellent bond to concrete specially bonding to green or damp concrete.

It should be suitable for soft water of “Langelier Saturation Index” of – 2.6 and pH value of 6.6 to 9.0.

The cured coating after immersion, shall be capable of withstanding cracked substrate cyclic movement from 0300-0 microns at 15-35 deg. C for 6000 cycles without failure.

It should have the capability to resist a positive water pressure of 7 bar and a negative water pressure of 3 bar when tested to DIN 108.

The coating shall be applied in two coats with a total minimum coverage of 3.6 g/m²)

It should have an abrasion resistance - water Index 1 or more (ASTM D 4060)

9.2.9.12 REHABILITATION OF THE ROOF STRUCTURE OF THE EXISTING RESERVOIR AT MALIGAKANDA

9.2.9.12.1 Rehabilitation of the Roof Structure

The drawings shall not be scaled. The contractor, prior to start with rehabilitation works, shall verify dimensions and all information in connection with the existing structure at site and satisfy himself. He also should get prior approval of the engineer for methodology, program, and the entire operation of rehabilitation works.

The main rehabilitation works in brief, is as listed below. As a precautionary measure to safeguard the existing post-tensioned concrete beams and rc column, which support them within the reservoir, the walls and the reservoir base, the contractor shall erect a temporary platform under the existing steel girders of the “barrel vault” roof. Since the steel tie rods which should provide horizontal support for the “barrel vaults” are severely corroded/or damaged it is necessary to provide temporary horizontal ties system prior to removing the roof.

- Existing reinforced concrete (rc) “barrel vault” roof structure should be cut into pieces with the help of a high pressure water jet, electrically or mechanically operated diamond tipped circular saw or an approved equipment, and be carefully removed part by part.
- The existing steel girders which support the barrel vault roof, should be cut into pieces with the help of an oxy-acetylene flame or an electric saw or any approved equivalent and carefully removed part by part. It is necessary to provide lateral supports to the existing cast iron columns when removing the existing steel girders.
- The existing cast iron columns and bases which support the roof structure should be carefully removed.

- The perimeter concrete wall should be cut with the help of a high pressure water jet or a diamond tipped circular saw, to 50-75 mm below the bottom level of the proposed new rc roof slab and carefully be removed roughened the exposed surface and finished with topping concrete with approved bonding agent.
- Since there are post-tensioned beams and their supports within the reservoir, the contractor shall be careful if necessary to erect a tower crane or heavy equipment within the reservoir to facilitate demolition or construction work.
- The contractor may erect a motorized gantry to span between existing reservoir walls with centre support on the existing base of the reservoir and the cut pieces may be brought to a place reachable to a tower crane erected outside the perimeter earth fill.
- The earth fill around the existing perimeter mass concrete wall of the reservoir should be made to a constant slope by filling the depressions with fresh soil, the filling should be carried out manually and tamping should be done with the help of a manual tamper, so that there will be no vibrations passed on to the existing structure. Prior to filling operation, the top soil should be removed. the filled area should be finished with turfing with approved grass.
- The existing toe drain along the perimeter of the reservoir should be cleaned and repaired where necessary, to have a constant gradient for the water to flow into the nearest manhole.
- No heavy constructions equipment shall be allowed on the existing embankment, specially when the reservoir is empty and the roof structure is removed.
- The possible tracks for a tower crane to facilitate removal of debris is as shown

9.2.9.12.2 Rehabilitation of the Intake Structure

- Slab at Level 1

Remove the existing slab (on grade) completely. Compact the sub base and reconstruct a new rc slab as shown.

- Slab at Level 11

Remove the existing steel chequered plate floor completely. Erect new steel sections as shown. Construct a steel grill type floor (unfactured super load 5 kN/m²) spanning on and secured on to the new steel beam sections.

- Existing steel weir and it's supports.

Clean the existing steel weir by sand blast to BS 7079-Sa 2.5 or by any other approved equivalent method. Carryout all necessary works to repair it and protect all exposed steel works with two stage epoxy coating.

- Existing "Barrel Vault" type roof slab & steps.

Remove completely and construct a new rc slab. Construct concrete benching, water proofing and heat insulation.

- Construct a steel step ladder from the reservoir new roof to the level II of the Intake Structure. Construct steel ladders from Level I to the Level II of the Intake Structure, from reservoir new roof to the Intake Structure new roof. Erect all necessary piping works and arrange new rain water drainage from Intake new roof. Erect a new door in place of old door as shown on drawings.

- All structured steel (except weir) shall be hot dip galvanized.

9.2.9.13 SPECIAL REQUIREMENTS FOR YARD PIPING – MALIGAKANDA AND ELLIE HOUSE

9.2.9.13.1 Maligakanda

The outlet system of the two existing reservoirs is already complex and the valves are located over a wide area. The addition of the third reservoir with a conventional outlet system will worsen this situation.

To avoid this, it is proposed to direct all reservoir by-passes and outlets through a valve house. Facilities are provided within the valve house to isolate reservoirs and distribution outlets.

The following work on yard piping are proposed.

(a) Connection to the existing supply scheme

Maligakanda Reservoir sits receives water from three transmission mains namely, old 30" New 30" from Ambatale pump house and old 20" from Labugama. The old Maligakanda Reservoir has two inlets, one on the western side and the other on the eastern side. The existing circular reservoir receives water from 30" by-pass, which is connected to Borella 30". The 27" by-pass on the other side is connected to 20" outlet of the old reservoir. The other by-pass system of the Labugama inlet side is connected to 20" washout and Borella 30". The inlet and by-pass system will be changed in the following manner to improve supply to existing circular reservoir and new Maligakanda reservoir.

- Remove existing inlet on the eastern side of the Old Maligakanda Reservoir and end cap.
- Provide inlet to the New Maligakanda Reservoir from 30" by-pass on the southern side.
- Continue 27" by-pass on the western side of the Old Maligakanda Reservoir and join it to 30" by-pass on the southern side in order to complete the by-pass arrangement around Old Maligakanda Reservoir and connect the joint by-pass to valve house.
- Disconnect the other by-pass arrangement taken off from Labugama inlet.

(b) Modification to the existing outlet scheme

Old Maligakanda Reservoir has three outlets of 30", 20" and 40". Out of these three, only 40" outlet will be connected to the valve house, while 30" and 20" will be end capped inside the reservoir.

A tee will be fixed on 30" outlet of the circular reservoir to divert flow through the valve house. A 30" valve will be installed immediately downstream of the tee. This valve will be kept permanently closed to ensure that the flow from this circular reservoir is sent through the valve house.

The outlet of New Maligakanda Reservoir will be connected to the valve house.

(c) Reservoir bypass

The by-pass around the old Maligakanda Reservoir will be completed and connected to the valve house discharge header in order to directly connect the transmission system to the outlet system. This enables to by-pass any one of the three reservoirs, any two of the three reservoirs or all three reservoirs at any given time.

(d) Flow metering and level sensing

All existing flow meters will be retained at their current locations except the meter on Mount Mary 10". This outlet lies under New Maligakanda Reservoir and needs removal. This 10" main will be reconnected to the valve house and the flow measuring arrangement will be shifted to the new location. New flow meters will be installed on 800 DI outlets of the New Maligakanda Reservoir and 300 DI proposed main to Dematagoda.

The level sensing arrangement for the two existing reservoirs will remain. New level sensing arrangement will be installed in New Maligakanda Reservoir.

The new work basically consists of DI pipes whereas the existing system consists of cast iron and steel pipes. When pipes of different materials are connected together, stepped coupling are proposed to join the two ends. 20" CI / 500 DI stepped coupling means that one end of the stepped coupling shall mate with 20" cast iron and the other end with 500 mm DI. The Contractor shall take measurements at site and furnish the data to the manufacturers when they demand for additional information.

As the valve house and the piping system are located in a close proximity, it will be beneficial to the Contractor to set out the lines and decide on the invert levels before finalizing on the alignment. It is also beneficial to keep the entire trench routes open to make the final adjustments in the alignment and levels in order to make a proper connection. Thrust blocks have to be provided at all bends and all new pipe laying have to be tested to the required test pressure as indicated in the technical specification.

9.2.9.13.2 Ellie House

The existing Ellie House reservoir is planned to be removed part by part to make way for the new reservoir. The procedure for the demolition of the existing reservoir and the construction of the new reservoir is described in the relevant sections. It is equally important to carry out the yard piping in an orderly manner so that the services provided to the consumer is least affected during the transition period. The sequence of yard piping, time of disconnection and reconnection, compatibility of new pipes and fitting with the existing pipes and fittings shall be confirmed in close consultation with the Employer and the Engineer.

To minimize trench excavation, the outlet pipes from the valve house have been kept in common trenches.

900 DI to Walls Lane, 600 DI to Fort, 300 DI to Kotahena and 500 DI for future extension have been kept close to each other for ease of excavation and pipe laying. These four pipes pass underneath the existing washout/overflow tunnel. Every care should be taken during the construction stage to protect the tunnel from collapse, as its continued existence is needed until the commissioning of the new reservoir

and the yard piping system. Contractor shall not use open excavation methods around the tunnel and shall use thrust boring or similar method instead to install pipes under the tunnel.

500 DI to Muthuwella and 500 DI to Mattakkuliya are also placed in a common trench.

All these outlet pipes cross existing pipelines on many occasions. After setting out the pipeline routes, the Contractor shall expose all the pipelines and shall determine their invert levels and outside diameters. The plans and longitudinal sections given in the drawings shall be used only as a guidance and the actual plans and longitudinal sections shall be decided by the Contractor depending on the levels and sizes of existing pipelines. Every care shall be taken not to disturb any of the existing pipelines during construction. When the new outlet pipes originating from the valve house are connected to the existing outlets, every effort should be made to make the point of connection lower than the main header of the valve house. It is also important to maintain a downward slope from the valve house to the point of connection.

9.2.9.14 GOTHATUWA-KOLONNAWA PUMP HOUSE

a. Connection to Gothatuwa-Kolonnawa Pump House

The Contractor shall carefully dig trial holes by hand to locate the exact position and also to determine the exact diameter of the existing pipe lines. All pipes and specials required for the connections shall then be verified, and any difference to that indicated on the drawings/BOQ shall be notified to the Engineer. All pipe work, connections and construction of the associated valve chambers and modifications required shall then be carefully planned before interruption to the existing water supply is permitted. The Contractor shall ensure that all the necessary pipes, fittings and equipment required for the work, including those for any emergency situation, are available, before commencement of the works.

The works shall be so organised that the period of shut down of the existing mains shall not exceed 12 hours. All works involving disruption to the existing water supply shall be co-ordinated so that the maximum amount of work can be executed within the period of shut down.

The Contractor shall submit to the Engineer for the prior approval, construction schedule together with a method statement that he intends to follow during the construction.

(b) Diversion of existing service lines,

The Contractor shall divert the existing services as shown on the Drawing. The Contractor's rate should include removal of existing pipes, cables, accessories, manholes etc., and making good all affected surfaces, supplying and laying of new pipes, cables and accessories (where necessary) construction of manholes gulleys etc., integrating into a new system and all other items of work necessary to make the services fully operational.

The contractor shall make necessary arrangements to carry out the water connection with the minimum disruption to the water supply and also obtain prior approval from the Engineer for the water main connection to the pump house.

9.2.9.15 GOTHATUWA TRANSMISSION MAIN

Route of Gothatuwa Transmission Main passes through narrow stretches of roads and there are two transmission mains along part of the stretches, originating from Ambatale Water Treatment Plant, namely Dehiwela transmission main (CI Pipe, 1000 mm diameter) and Kolonnawa Transmission Main (DI pipe, 600 mm). Both mains are laid on left and right sides of Himbutana Road approximately between Ch-300 and Ch-625 (Bank Junction) and the proposed main will be laid in between those two mains. After the Bank Junction along Himbutana Road, existing Kolonnawa Transmission Main is on the right side of the road and the Gothatuwa Transmission Main will be laid on the left side of the road. There are also underground telecom cables with manholes and existing water distribution mains throughout these routes for which as-built drawings are not available. Distribution main shall also be laid along part of this route in a common trench. The Contractor shall confirm and establish the Gothatuwa Transmission Main route by digging trial holes and obtain approval of the Engineer prior to excavation and laying of pipe line.

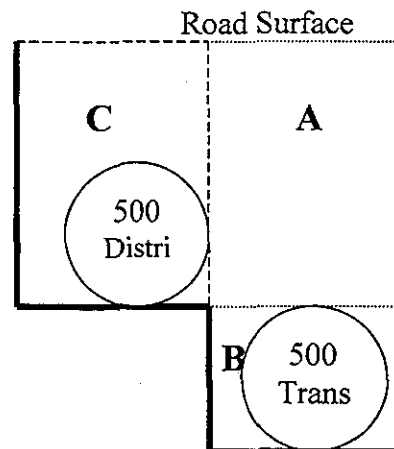
(1) Pipe Trench and Backfilling

Since, distribution main will also be laid in between Ch-566 and Ch-4,042, a common trench is for transmission main and distribution main is shown on the Drawings. Pipelines will be staggered both vertically and horizontally with distribution main at a shallower depth than transmission main. Minimum cover to the finished ground level shall be maintained for both pipes. Lengths included are as follows.

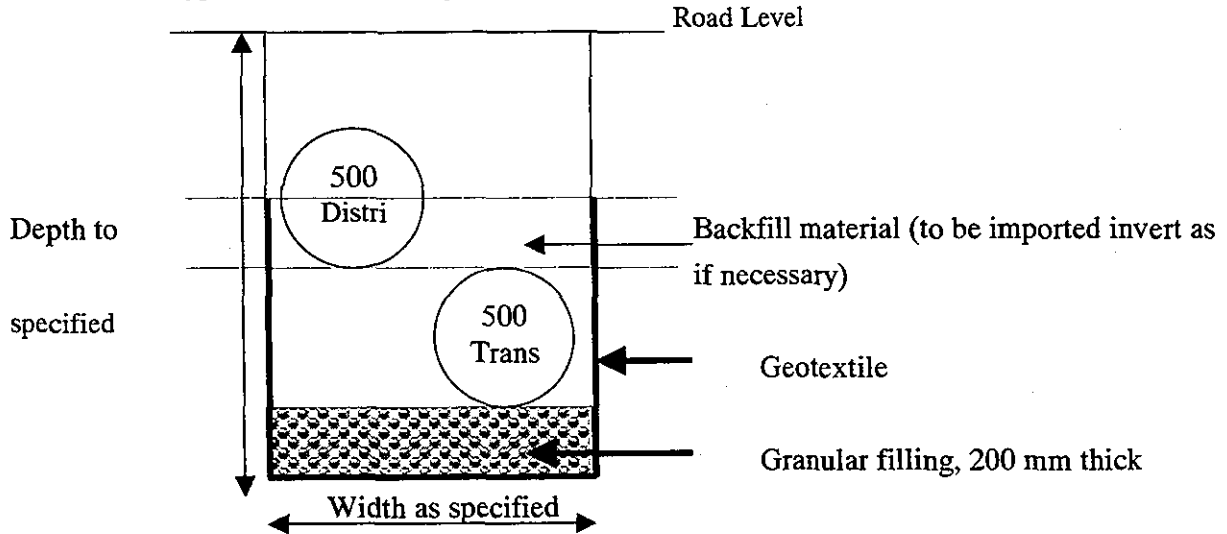
- 300 mm dia DI pipeline, L=1,719 m, Ch-566 to Ch-2285 with 800 mm dia transmission main
- 500 mm dia DI pipeline, L=1,757 m, Ch-2285 to Ch-4042 with 500 mm dia transmission main

The procedure to be followed when laying pipelines in common trench are as follows:

- Excavate areas A and B
- Lay Transmission main
- Backfill B (up to crown of pipe)
- Excavate C
- Lay distribution pipe
- Back fill A and C
- Reinststate Road



Soft ground is expected between Ch-2,700 and Ch-3,360 (660 m long stretch) along Fever Hospital Road, where invert level of the transmission main will be below 3.00 m MSL. The pipeline shall be provided with modified type of Class C bedding over this stretch as shown in the drawings.



(3) Access to Ambatale WTP

At any time during construction of transmission main, the following conditions shall be met.

- Access to Ambatale WTP has to be maintained either through Himbutana Road from Low Level Road or thorough Angoda Road and Himbutana Road.
- Pedestrian movement shall be allowed through the working area with adequate safety precautions.

9.2.9.16 GOTHATUWA GROUND RESERVOIR AND PUMP HOUSE

Excavation Works :

Excavation works shall be carried out with slopes not exceeding 1 (horizontal) in 2.5 (vertical) in areas where no buildings and structures exist. Near the neighboring building where Gabion wall construction shown in the drawings, vertical cut allowed, provided that the exposed edge shall not be left for more than 10 days and the Gabion wall constructed immediately after the excavation completed. In areas where water seepage is high and there is a chance of collapsing the excavated edges of earth, similar Gabion wall construction shall be carried out to prevent the same. Sufficient dewatering facilities shall be arranged to remove the ground water during the construction of foundation & walls.

9.2.9.17 GOTHATUWA NEW WATER TOWER

Any excavation for the water tower foundation shall be carried out only after completion of backfilling work of the pump house walls.

9.2.9.18 DISTRIBUTION MAINS IN KOTIKAWATTA AND MULLERIYAWA AREA

9.2.9.18.1 Protection of Existing Utilities

Underground telecommunication cables and PVC water mains exist on all roads where pipe laying is to be carried out. There are also several existing transmission mains in this area.

9.2.9.18.2 Major Road Crossings

Major road crossings are given below

- On Low Level Road
 - At Junction of Sri Perakum Mawatha / Ranabima Mawatha
 - At Junction of Angoda Road/Siri Sumana Mawatha
 - At Junction of Kotikawatte Road/Kohilawatta Road
 - At Junction of Meegoda Kolonnawa Road/Katupellella Road

There are four major transmission mains along Low Level Road serving Colombo and distribution mains shall be laid across these transmission mains at the junctions listed above. Contractor shall take utmost care while laying distribution mains across these so as to not to disturb these mains. Pipeline plan and profile for crossings shall be established through test pits and shall be submitted for approval of Engineer. Laying of distribution mains across these junctions shall be carried prior to pipe laying along roads on both sides of the above road junctions.

9.2.9.18.3 Laying of Pipes in Water Logged Areas

The Contractor shall make necessary measures to protect against floating of pipes while laying pipes in water logged areas. Special bedding types as shown on the Drawings shall be provided where ground conditions are poor or when directed by the Engineer.

9.2.9.18.4 Crossing of Transmission Mains

There are several transmission mains from Labugama, Kalatuwawa and Ambatale WTP's passing through Kotikawatte and Mulleriyawa areas. They are,

- Jubilee Transmission Main (1,100 mm DI) from Ambatale WTP along Udumulla Road
- Dehiwela Transmission Main (1,000 mm CI) from Ambatale WTP along Himbutana Road / Udumulla Road
- Kolonnawa Transmission Main (600 mm DI) from Ambatale WTP along Himbutana Road / Pethiagoda Road / Kumara Mawatha and Delgahawatta Road
- Four transmission mains from Labugama WTP / Kalatuwawa WTP, Old 30", New 30", Old 20" and Duplicate 20" along Low Level Road
- Ellie House Transmission main (600 mm DI) from Ambatale WTP along Old Avissawella Road

The Contractor shall locate these transmission mains at proposed crossings and shall take utmost care while laying distribution mains across these so as to not to disturb these mains. Pipeline plan and profile for crossings shall be established through test pits and shall be submitted for approval of Engineer. Laying of distribution mains across these junctions shall be carried prior to pipe laying on both sides of the crossing.

9.2.9.18.5 Culvert Crossings and Canal Crossings

The Contractor shall furnish all labour, equipment and materials and perform all incidental work required to install canal crossings and culvert crossings as shown on the drawings, or as specified or as otherwise directed by the Engineer.

The Contractor shall dig test pits, before the pipe crossing the canal is installed, near the bridge and/or the bank of the canal. If it appears that underground structures and/or utilities are not in the same locations as indicated on the Drawings, which may cause changes in the pipe routing and position of form of pipe support structures and other related work, then the Contractor shall prepare drawings showing details of the change and submit them to the Engineer for approval. The Contractor shall follow the directions of the Engineer without argument. Any damage resulting from not following the said direction, including the costs in changing the method of construction of the approach pipe laying, shall be borne by the Contractor.

Concrete thrust blocks shall be constructed at fittings or bends where indicated on the Drawings or as directed by the Engineer.

Two major canal crossings are at:

- (a) Delgahawatta Road Bridge Site
- (b) Angoda Road Bridge Site

9.2.9.18.6 Interconnections to Existing Pipe Lines

(a) Scope of Work

There are 42 interconnections to the existing distribution network and 20 junctions as shown on Drawing No. KMU/DM/C-68.

The Contractor shall supply all labour, material, tools and equipment to connect the proposed new pipes to the existing pipes in accordance with the drawings and specifications, and as may be directed by the Engineer.

(b) Submittals

At the point connecting to existing pipe, the Contractor shall excavate and inspect the pipe or valves to determine the material type and make measurements. Following measurements the hole shall be backfilled and the surface temporarily restored with asphalt pavement.

Based on the field data the Contractor shall prepare and submit shop drawings showing the method proposed for making the connection. Field data shall be clearly indicated on the shop drawings.

Generally the connections will be made dry unless a wet tap is specified. The Contractor shall coordinate his pipe laying and testing work with the connection work so that interruption of service to consumers is minimized.

As a part of the shop drawings the Contractor shall submit a plan for shutting down existing pipe so that connections can be made dry. The Contractor shall determine the locations of all valves required to be shut down and check the valves to be sure that they are operational. The Engineer will provide assistance in developing this plan.

(c) Execution

Connection to the existing pipe shall be made by means as specified on the drawings. The Contractor shall clean up the inside of the existing pipe prior to the connection work. The Contractor shall be fully responsible for testing and disinfection of this existing pipe from the point of connection to the extent which has been affected by the connection work as instructed by the Engineer.

Prior to any connection work, the Contractor shall notify the Engineer of his intention to commence the particular work. No connection work shall be commenced unless an approval by the Engineer has been given in writing.

(d) Testing

All connections to existing mains including valves shall be installed prior to the hydrostatic test of the water main.

Test pressure for distribution mains in Kotikawatte-Mulleriyawa Area is 7.5 bars. Hydrostatic tests shall be carried out with the interconnection at closed position.

9.2.9.18.7 Provisions for Future Extensions

A provisional sum is included in BOQ for installation of tee and blind flange as instructed by Engineer.

9.2.9.18.8 Commissioning of System and Closing of Transmission Main Tappings

Commissioning of new supply shall be carried out once the proposed pipe network is completed and tested, and Gothatuwa-Kolonnawa Pump House, Gothatuwa Transmission Main, Gothatuwa Ground Reservoir and Pump House and Gothatuwa New Water Tower are ready for commissioning. The Contractor shall liaise with NWSDB and prepare a methodology statement for commissioning of system and closing of transmission main tappings and submit to the Engineer for approval. The Contractor shall take every effort to minimize the duration of disruption of water supply.

Closure of the existing transmission tapplings shall be done one by one by the Contractor while commissioning the supply from the new system based on the following rule.

- ***As much as possible current pressures and direction of flow shall be maintained***
 - Interconnection to the existing system shall be opened near the location where the existing transmission tapping is closed.
 - Interconnection around areas where there is insufficient pressure shall be opened to the required pressure.
 - Wherever pressure is insufficient opening of interconnection shall be carried out for example at N297 and at N846
 - Opening of other interconnection shall be carried out when increase of pressure is required for a particular area

List of Existing Transmission Main Tappings

- ① Dehiwela Transmission Main, at the washout along Udumulla Road near Bank Junction
 - 160 mm transmission/distribution main to supply along Himbutana Road and to fill the existing sump opposite Fever Hospital
 - 160 mm distribution main to supply along Himbutana Road up to Maligagodella Road
 - 90 mm distribution main to supply along Udumulla Road
- ② Dehiwela Transmission Main, at the exit of S-tower
 - 225 mm distribution main to supply along Old Avissawela Road
 - 160 mm distribution main to supply along Low Level Road
- ③ Kolonnawa Transmission Main, at the junction of Kotikawatte Road and Delgahawatta Road through the tee
 - 160 mm distribution main to supply towards south along Kotikawatte Road,
- ④ Transmission Main from Labugama, at the Kohilawatta Junction through the washout
 - 90 mm distribution main to supply along Low Level road and along Kotikawatte Road,
- ⑤ Transmission Main Kolonnawa Tower to Weragoda Water Tower (250 mm CI) near Wellampitiya Bridge, through a tee
 - 160 mm distribution main to supply along Low Level road and along Katupelella Road
- ⑥ Distribution Main from Moragasmulla Water Tower through Madinnagoda Bridge
 - 90 mm distribution main to supply along M.D.H. Jayawardena Mawatha
- ⑦ Distribution Main from Towns East Project
 - through southern part of Udumulla Road
 - through Galwalahena Road
 - through Angoda Road at Aggona Junction
 - along Koswatta Road
- ⑧ Transmission Main from Labugama near Angoda Junction
 - 200 mm CI main to supply Angoda Mental Hospital
- ⑨ Transmission Main from Kolonnawa Tower to Harbour, through a tee
 - 90 mm distribution main to supply parts of Sedawatta area

Following major steps shall be adopted for closing of transmission main tapplings and commissioning the new system.

- (1) Conduct leakage and pressure testing all facilities and disinfect.
- (2) Inform public in affected areas on the transition.

- (3) Test and operate transmission system.
- (4) Test and operate Gothatuwa Pump House
- (5) Fill Gothatuwa Ground Reservoir and Gothatuwa New Water Tower.
- (6) Stop pumping to the existing Tower from the existing pump station in front of Fever Hospital.
- (7) Isolate the existing tower by closing valves on the outlet to the existing distribution main and by keeping the isolation valve between existing and new tower closed.

Proceed to (8)

(Disconnection of sump and existing pump house and alteration of pipelines as outlined in sub-section 9.2.9.17.9 can be carried out after this step)

- (8) Close the existing tapping at Dehiwela Transmission Main and at existing Kolonnawa Main.
- (9) Gradually open interconnections at N1071, N1003 and at N354 until supply is satisfactory.

Proceed to closure of next transmission main tapping

- (10) Close the valve at the exit of S-tower (Dehiwela Transmission Main) on 225mm distribution main supplying Old Avissawela Road and 160 mm distribution main supplying Low Level Road and gradually open interconnections at N768, N1127 and N1227. If necessary, open N892, N1137 and N750 until supply is satisfactory. Before opening N892, close tapping on Labugama Transmission Main supplying Angoda Mental Hospital. Similarly, close tapping on pipeline on Kolonnawa Tower to harbour before opening N750.

Proceed to closure of next transmission main tapping

- (11) Close valve at washout from Labugama Main at Kohilawatta Junction and gradually open the interconnection at N601.

Proceed to closure of next transmission main tapping

- (12) Close valve at the tapping on pipeline from Kolonnawa Tower to Weragoda Tower (250 mm CI) and gradually open the interconnection at N407.

Proceed to closure of next transmission main tapping

- (13) Close valve of pipeline at Bridge along M. D. H. Jayawardena Mawatha from Weragoda Tower and gradually open interconnection at N63.

Proceed to closure of next transmission main tapping

- (14) Isolate Towns East water supply by closing valves on
 - Udumulla Road and gradually opening interconnection at N 1014
 - Galwalahena Road and gradually opening interconnection at N1019
 - Angoda Road at Aggona Junction and gradually opening interconnection at N837
- (15) Open interconnections at N297, N846 and any other interconnection to increase pressure, if necessary.

9.2.9.18.9 Disconnection of Existing Sump and Pump House

The Contractor shall disconnect existing sump and pump house following satisfactory completion of Step (7) as outlined in Sub-section 9.2.17.8 i.e. after tapping on Dehiwela Transmission Main and existing Kolonnawa Transmission mains are closed and the new tower is successfully put on service, as shown on Dwg. No. KMU/DM/C-75. Existing tower shall also be isolated to facilitate the alteration of piping and shall be put on service on completion.

9.2.9.19 REHABILITATION / REINFORCEMENT OF MEDIUM & LARGE DIAMETER PIPE NETWORK IN CMC AREA

Detailed survey need to be carried out to develop the exact profiles of the existing pipe lines and other utility services underground and also soil characteristics. For this purpose, the Contractor shall carry out necessary field investigations to satisfy himself as to the nature of soil and the location of underground services.

The Contractor shall furnish all labour, equipment and materials and perform all incidental work required to carry out temporary and permanent road reinstatement according to SECTION 9.2.10 ROAD WORKS IN CMC ROADS.

9.2.9.19.1 *Reinforcement of Medium and Large Diameter Mains*

(a) 500 mm Diameter DI Pipe.along Port Access Road

The Port Access road is owned by the Ports Authority. The pipe laying shall be carried out along this road with the minimum inconvenience to the Ports Authority. The route of the pipe line is shown in Drawing No. RML/DM/RF-18 & 19. The Contractor should adhere to the following conditions laid down by the Ports Authority.

The Contractor shall ensure minimum disturbance to the embankment which is part of the road structure. It is essential that trenching, laying of pipe, filling with compacted backfill and surface dressing shall be completed within a minimum time interval so that undermining of the compacted soil due to rain etc. should be avoided.

The Contractor shall ensure that there is no leakage of water into the embankment at all times during construction as the leakage will have disastrous effects on the structure of the road.

The Contractor shall plan and execute the construction in such a manner to satisfy the above conditions and shall carry out pipe laying and backfilling in manageable spans within a day.

(b) Laying of 450 mm Diameter Pipe along Prince of Wales Avenue in Common Trench for Reinforcement Main and for Replacement of Small Diameter Distribution

The two pipelines 450 mm and 150 mm diameter shall be laid in a common trench between Ch 2700 and Ch 3360 (660 meter long stretch) as shown on the Drawings.

(c) Pipe Laying along Prince of Wales Avenue and Stace Road

The above roads being link roads to Colombo City are highly congested and heavy traffic is expected daily. The Contractor is advised to carry out night work to minimise inconvenience to the public.

9.2.9.19.2 Canal Crossing and Culvert Crossings

The Contractor shall furnish all labour, equipment and materials and perform all incidental work required to install canal crossings and culvert crossings as shown on the drawings, or as specified or as otherwise directed by the Engineer.

(a) General Conditions

The Contractor shall dig test pits, before the pipe crossing the canal is installed, near the bridge and/or the bank of the canal. If it appears that underground structures and/or utilities are not in the same locations as indicated on the Drawings, which may cause changes in the pipe routing and position of form of pipe support structures and other related work, then the Contractor shall prepare drawings showing details of the change and submit them to the Engineer for approval. The Contractor shall follow the directions of the Engineer without argument. Any damage resulting from not following the said direction, including the costs in changing the method of construction of the approach pipe laying, shall be borne by the Contractor.

Concrete thrust blocks shall be constructed at fittings or bends where indicated on the Drawings or as directed by the Engineer.

(b) Construction

The Contractor shall submit to the Engineer for approval his proposed method and details of the construction. Approval of such details shall not relieve the contractor from the responsibilities under the Contract.

The Contractor shall take extreme care to protect bridges, surrounding structures and utilities from damage. Vehicular and pedestrian traffic shall be maintained at all times, as well as utility services. Costs or charges resulting from damage thereto shall be borne by the Contractor.

Where pipe trenching is not practical or where pipes are to be installed in the swampy areas, the Contractor shall support these pipes with proper concrete structures. The installed pipe shall be levelled as shown on the Drawings and an air valve shall be installed at the highest point of the pipe, or at the end point of the pipe or at the tail water end as shown on the Drawings.

Where crossings at outside of the culvert under the invert level, necessary trench cut off walls and Rubble pitching shall be provided.

9.2.9.19.3 Connections to Existing Mains

(a) Scope of Work

The Contractor shall supply all labour, material, tools and equipment to connect the proposed new pipes to the existing pipes which have been constructed in other contract in accordance with the drawings and specifications, and as may be directed by the Engineer.

(b) Submittals

At the point connecting to existing pipe, the Contractor shall excavate and inspect the pipe or valves to determine the material type and make measurements. Following measurements the hole shall be backfilled and the surface temporarily restored with asphalt pavement.

Based on the field data the Contractor shall prepare and submit shop drawings showings the method proposed for making the connection. Field data shall be clearly indicated on the shop drawings.

Generally the connections will be made dry unless a wet tap is specified. The Contractor shall coordinate his pipe laying and testing work with the connection work so that interruption of service to consumers is minimized.

As a part of the shop drawings the Contractor shall submit a plan for shutting down existing pipe so that connections can be made dry. The Contractor shall determine the locations of all valves required to be shut down and check the valves to be sure that they are operational. The Engineer will provide assistance in developing this plan.

(c) Execution

Connection to the existing pipe shall be made by means as specified on the drawings. The Contractor shall clean up the inside of the existing pipe prior to the connection work. The Contractor shall be fully responsible for testing and disinfection of this existing pipe from the point of connection to the extent which has been affected by the connection work as instructed by the Engineer.

Prior to any connection work, the Contractor shall notify the Engineer of his intention to commence the particular work. No connection work shall be commenced unless an approval by the Engineer has been given in writing.

(d) Testing

All connections to existing mains or valves shall be installed prior to the hydrostatic test of the water main, and they shall be tested with the pressure of the water main.

9.2.9.19.4 Rehabilitation of Medium and Large Diameter Mains

Rehabilitation of medium and large diameter mains shall be carried according SECTION 9.2.8 CLEANING AND CEMENT MORTAR LINING and as shown on the Drawings.

9.2.9.20 REHABILITATION AND REPLACEMENT OF SMALL DIAMETER DISTRIBUTION MAINS IN CB1 AREA

(a) Scope of Work

Rehabilitation of small diameter mains as shown on the Drawings shall be carried according SECTION 9.2.8 CLEANING AND CEMENT MORTAR LINING.

Replacement of small diameter mains as shown on the Drawings shall be carried out by the Contractor.

Detailed survey need to be carried out to develop the exact profiles of the existing pipe lines and other utility services underground and also soil characteristics. For this purpose, the Contractor shall carry out necessary field investigations to satisfy himself as to the nature of soil and the location of underground services.

The Contractor shall furnish all labour, equipment and materials and perform all incidental work required to carry out temporary and permanent road reinstatement according to SECTION 9.2.10 ROAD WORKS IN CMC ROADS.

(b) Route

Before commencement of any construction work, the Contractor shall carry out a topographical survey and locate the existing underground utility services. After the preparation of shop drawings and obtaining Engineer's approval, the Contractor shall arrange for road closures, detour arrangements and inform Police, public and transport agencies

The existing small diameter pipe line to be replaced are shown in the respective drawings and it is recommended that the pipes to be laid in parallel to the existing pipes and as closer as possible to the existing line, wherever possible.

The Contractor should note that the roads where these pipelines are to be laid are in congested areas in Colombo.

(c) Pipe Trench Pipe Bedding and Backfilling

Imported material shall be used for backfilling and compaction shall be carried out as per specification.

(d) Railway Crossings and Bridge Crossings

The railway crossing shall be carried out as per the specifications and as given in standard drawing.

The locations where the pipelines cross the single line railway lines and pipe sizes are;

Dematagoda Road	-	(300 DI Pipe)
Saranapala Himi Mw.	-	(300 DI Pipe)

Blumendhal Road	-	(500 DI pipe)
Price of Wales Mw.	-	(450 DI pipe)

(e) Connection to Existing Mains

Connections to existing mains as shown on the Drawings shall be carried out according to Sub-section 9.2.8.18.3.