

**CLIFFERNA GROUP WATER SCHEME
NETWORK UPGRADE**

VOLUME A2

SPECIFICATION FOR CIVIL ENGINEERING WORKS



2026

Conditions of Contract

The Conditions of contract shall be 'Short Public Works Contract' issued by the Department of Finance.

Cover Note

- 1 This Specification is compiled in three sections namely:
Section 1: General Specification, and
Section 2: Particulars of the Works
The provisions of Section 2, Particulars of the Works, take precedence over those of Section 1, General Specification.

- 2 Nothing stated in this Specification is to be construed as discriminating against products and material manufactured in any of the Member States of the European Union.

Where items to an Irish standard Specification, a British Standard Specification, or any other standard specification of a Member State of the European Union are called for, this requirement shall be read as including items to a relevant national standard of any Member State of the European Union, which provides an equivalent guarantee of safety and suitability.

The standard shall be deemed to be that issue current at the date of invitation to tender for the works. Where items certified by the National Standards Authority of Ireland as complying with an Irish Standard are called for, the provisions of Circular Letter BM2/87 as amended by BC14/92 shall apply, i.e. the requirement shall be read as either certified by the National Standards Authority of Ireland as complying with the Irish Standard, or shall be certified as complying with a relevant national standard of another Member State of the European Union, which provides an equivalent guarantee of safety and suitability. Certification is to be by the National Standards Authority of Ireland.

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SECTION 1.1 GENERAL CLAUSES

1.1.1 General Requirements

This Contract includes for the provision of all such plant, equipment, transport, materials and workmanship as may be required for the construction of the Works in accordance with the Conditions of Contract, the Specification for Civil Engineering, Building and Mechanical and Electrical Works, the Contract Drawings, the Preliminary Health and Safety Plan, the Forms of Contract and the Forms of Tender and Schedule prepared by T.J. O'Connor & Associates.

1.1.2 Supply, Storage and Use of Materials

No materials and components for use in the Works shall be used without the prior approval of the Employers Representative and all materials shall be stored in such a manner as to preserve their quality and condition to the standards required by the Contract.

There shall always be sufficient approved supplies of materials on the Site to permit adequate time for testing of any new consignment before use. Any delay incurred due to disregard of this requirement by the Contractor shall not be taken into consideration in the case of an application for an extension of time for completion of the Contract.

Materials and components shall be handled in such manner as to avoid any damage or contamination, and in accordance with the applicable recommendations of the manufacturers.

Unless otherwise described in the Contract, the use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of the manufacturers. Where appropriate, the Contractor shall make use of any technical advisory services offered by manufacturers.

The Contractor shall ensure that, prior to issuing quotations, all suppliers and sub-contractors are made fully aware of the purpose for which any materials supplied by them are to be used. He shall ensure that they are issued with all relevant drawings and specifications, and that quotations are not sought solely on the basis of the Pricing Document or other lists.

1.1.3 Standards and Submission of Materials

All materials, workmanship and tests shall comply with the appropriate Irish Standard or alternatively with a national standard of another Member State of the European Union which provides an equivalent guarantee of safety and suitability. Where European standards are introduced these will take precedence over national standards.

Where items are certified to a specific standard in this Specification this requirement shall be read as and shall be deemed to include items to the relevant national standard of any Member State of the European Union, which provides an equivalent guarantee of safety and suitability.

The standard shall be deemed to be that issue current at the date of invitation to tender for the works.

Wherever, in respect of any Irish Standard, an Irish Standard mark licensing scheme is available, all materials required to comply with that Standard, or the containers of such materials, shall be marked with the Irish Standard Mark or shall be certified to an international standard or a national standard of another Member State of the European Union which provides an equivalent guarantee of safety and suitability.

As soon as possible after the Tender has been accepted, the Contractor shall submit to the Employers Representative for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.

Samples shall be taken in accordance with the appropriate Irish Standard where applicable. The materials subsequently supplied shall conform to the quality of samples which have been approved by the Employers Representative.

Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Employers Representative's approval.

1.1.4 Health & Safety

The Contractor shall ensure that all health safety and welfare measures required under or by virtue of the provision of any enactment or regulation or working rule relevant to the construction industry are complied with in accordance with the provisions of the Factories Act 1955, the Construction (Safety, Health and Welfare) Regulations 1975, the Safety in Industry Act 1980, the Safety Health and Welfare at Work Act 2005, the General Application Regulation 2007 and with the Safety, Health and Welfare at Work (Construction) Regulation 2013 and any amendments or replacements thereof.

The Contractor shall provide all necessary canteens, sanitary conveniences and welfare facilities for his personnel in accordance with the regulations of the relevant Sanitary Authority. He shall maintain these facilities and shall ensure that they are properly used by his personnel.

The successful Tenderer shall be required to submit to the Employer's Representative, job specific Health and Safety Plan separately for each of the component of works two weeks before commencement of any work on site. No work shall commence until such Health & Safety Plan is approved by the Employer's Representative.

1.1.5 Setting Out

The Contractor shall establish, maintain and remove on completion adequate temporary survey stations to control the vertical and horizontal alignment of the Works by conventional field survey techniques as well as GSM system where required. The Contractor shall re-install, re-level and re-coordinate any survey stations which become damaged or dislodged during the Contract. All datum levels shall conform with those mentioned in the drawings.

All levels shall be referred to Ordnance Datum, and shall be taken from Ordnance benchmarks or permanent benchmarks established at convenient intervals where required, before the commencement of the Works.

The Employers Representative will give the levels of such permanent bench marks but the Contractor shall check same and will be responsible for their accuracy at all times during the construction.

The Contractor shall be entirely responsible for accurately setting out all the work, regardless of whether the Employers Representative has checked the setting out or not and he shall at his own expense make good any defect arising from errors in the lines or levels. The Contractor shall also provide for the use by the Employers Representative and his staff throughout the contract, precision levels and staffs, complete with all ancillary equipment, steel and linen tapes,

poles, pegs, stagings, templates, profiles, levelling instruments etc., necessary for the setting out and measurement of the work, and the services of experienced chainmen.

1.1.6 Samples

Samples of all the materials to be used on the Works are to be provided by the Contractor in proper containers. These samples will be retained if approved of by the Employers Representative, and all deliveries of materials shall be equal to, or better than, the samples in respect of quality. The source and type of materials shall only be altered with the prior approval of the Employers Representative.

As soon as possible after the Tender has been accepted, the Contractor shall submit to the Employer's Representative for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.

Samples shall be taken in accordance with the appropriate Irish Standard where applicable. The materials subsequently supplied shall conform to the quality of samples which have been approved by the Employer's Representative.

Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Employer's Representative's approval.

1.1.7 Quality and source of materials

The whole of the materials, appliances and fittings required for the works mentioned in this Specification shall be of the best of their respective kinds. No materials shall be used in any part of the work without previous sanction from the Employers Representative.

1.1.8 Safeguard excavations and provide pumping equipment

The excavations shall be sheet piled or close timbered and strutted where necessary for protection and kept free of water by pumping or otherwise during the progress of the works. Where pumping is necessary the sump hole for the pumps shall be kept clear of the foundations and the Contractor shall if necessary lay drain pipes along the bottom of the excavations and lead same to a sump hole so that pumping may be continued during deposition of concrete without draining away the cement. No water shall be pumped into any sewer without the Employers Representative's approval.

1.1.9 Explosives

The use of explosives for loosening or splitting up rock or hard materials will not be allowed at any part of the works.

1.1.10 Resident Engineer's Office

The Employer will appoint a resident engineer (who will act as Employer's Representative) whose duty it will be to supervise the Works on behalf of the Employer.

The Contractor shall establish, maintain and remove upon completion of the Permanent Works, suitable accommodations, services and equipment for the exclusive use of the Employer's Representative and staff as specified in Section 2 at on-site location(s) where directed.

1.1.11 Notices

Before the commencement of any work in connection with this Contract, the Contractor shall serve notices on all private property owners and tenants of same, as well as all public authorities and owners of any undertakings likely to be affected by the construction of the Works. The Contractor's attention is drawn to the requirements for the appointment of an authorised representative and for a consultation period of 4 weeks following acceptance of his tender and prior to the commencement of the Works.

In particular he shall notify all relevant Authorities when the Works are being proceeded with. The Contractor shall be responsible for notifying owners and occupiers of premises and properties at least five (5) working days before entering, interfering with, or carrying out other work connected with the premises or property or any services serving the premises or property.

1.1.12 Exploratory holes and trenches

The Contractor shall, prior to the commencement of any excavation work, and at his cost sink such trial holes and dig such trial trenches as may be necessary to ascertain the location of foundations and the exact position and levels of existing sewers, drains, services or other obstructions to the work. Such trial holes and trenches shall be excavated carefully by hand except where express permission to excavate by machine is granted by the Employers Representative.

1.1.13 Control of Traffic

Where Works related activity takes place in or near public roads the Contractor shall at all times endeavour to maintain two-way traffic. If single way traffic is unavoidable on any particular length of the road the Contractor shall provide competent flagmen or portable automatic traffic signals to regulate traffic movement. In all cases advance warning signs shall be erected and traffic cones shall be provided at longitudinal intervals of 1m to control and direct traffic movement. In cases where public roads are unavoidably obstructed outside working hours, adequate flashing hazard lights shall be installed and maintained during hours of darkness. All traffic signs and other safety aspects at the Works shall be in accordance with the Guidance for the Control & Management of Traffic at Road Works published by the Department of Transport and the National Roads Authority and any amendments thereof. Where excavations or the deposit of materials or the work generally cause obstruction to the public or persons in the ordinary use of their premises for business or other purposes the Contractor shall provide all necessary secure means of ingress and egress in proper substitution of those interfered with.

No public roads and streets or part thereof shall be closed to traffic during the progress of the Works except with the consent of and in compliance with the requirements of the relevant Road Authority.

No public roads and streets or part thereof shall be closed to traffic during the progress of the Works without the written permission of the Road Authority. The Contractor shall be responsible

for obtaining any road closures deemed necessary for the construction of the Works and for obtaining all permissions associated therewith.

1.1.14 Cleaning of Roads

If any public roads, lanes and public property adjacent to the Site or which form part of the Site become littered with mud, clay or any material which has been deposited there as a result of the Contractor's operations or has spilled from or been carried out on the wheels of vehicles then the roads shall be cleansed immediately by him and as often as required and at the Contractor's own expense.

1.1.15 Underpin and support existing structures.

The Contractor shall design and install all necessary systems of shoring, strutting or supporting any walls, visible foundations or built structures whose stability may be endangered by the execution of the Works. Where excavation is carried below the foundations of walls of adjoining/adjacent premises, the Contractor shall give consideration to the underpinning of such walls from the level of excavated ground up to at least the underside of existing foundations with concrete and proper wedging courses. The whole of the underpinning is to be executed in lengths not exceeding 1.0m at one time and shall incorporate where appropriate any details, if any, shown on the drawings or any instructions which may be given by the Employers Representative. The design construction and efficacy of this work shall be entirely the responsibility of the Contractor. The Contractor shall keep under observation at all times, all such adjoining/adjacent buildings, and shall notify the Employers Representative immediately of any signs of distress or any other indications of actual or potential damage to these structures.

1.1.16 Protection of Existing Services & Liaison with Service Providers

Existing sewers, storm drains, pipes, cables etc., exposed in trenches during excavations shall be underpinned, supported adequately or diverted during the progress of the works so as to prevent settlement and damage and all posts, poles, cables, boxes, chambers etc., shall be properly shored or propped.

The Contractor shall maintain these existing services, in, on, along and across the Site of the Works. He shall take all the necessary precautions and satisfy the Employers Representative that all underground and overhead services and utilities such as sewers, cables, pipes, poles, walls, fences and other structures are properly maintained and protected against damage during the carrying out of the Works. If any damage or injury occurs to any service or utility, he shall notify immediately the appropriate department or authority and the Employers Representative. Where overpumping is required to facilitate sewer repair, the Contractor shall provide all necessary plant and equipment and shall take all necessary measures to ensure avoidance of pollution of adjacent watercourses. He shall also indemnify the Employer against any claim for damages to these services caused by his operations.

Where drawings of existing services are prepared or provided by the Employers Representative and made available to the Contractor, the Contractor should note that the Employers Representative does not guarantee the accuracy of these records or their completeness and that they are provided merely to assist the Contractor in preparing his tender and in executing the Works by giving him the information insofar as it is known to the Employers Representative.

The Contractor shall assign a person who shall be responsible for conducting all liaison functions which he is required to do with Statutory Bodies and other interested parties during the course of the works. These shall include but not be limited to:

Local Authorities for statutory notifications, water supply and sanitary services,

Telecoms providers,

Electricity supply bodies,

Cable television operators,

Gas supply bodies,

Broadband services.

1.1.17 Temporary Works

The term “Temporary Works” shall mean all temporary works of every kind required for the construction and completion of the works; it shall include temporary works to support and ensure the stability of the partially completed permanent works and of adjoining structures and lands, as well as such matters as trench shoring, scaffolding, propping, working platforms, gangways, access stairs and landings.

The Contractor shall be responsible for the design of the Temporary Works. The Contractor shall ensure that the design of all Temporary Works is carried out by a competent Temporary Works Engineer who understands the complexity of the forces involved in temporary works / permanent works interaction, and who can design the temporary works to safely take account of these forces.

The Contractor shall at all stages ensure that the temporary works and any temporary loads applied to the structure during construction do not exceed the design imposed load capacity of the structure. In this respect for new construction work the Contractor shall assume that design imposed loads are in accordance with BS6399 for the category of usage applicable to the area of the structure being considered, unless specifically noted on the construction drawings.

1.1.18 Temporary Stability

The Contractor shall be responsible for the stability of the partially completed, or partially altered structure at all times.

Where the design assumes a particular erection or construction sequence, or requires particular risk control measures, which are unusual for the type of project and which would not be apparent to a competent contractor, these are noted on the construction drawings or other contract documentation.

1.1.19 Demolition Works

In the Safety, Health & Welfare of Work (Construction) Regulations, (2013) demolition, de-commissioning and dismantling are defined as construction work and the Contractor is responsible for the “design” as defined in the Regulations of any such work on the project including temporary supports to partially demolished structures.

1.1.20 Character of Site and Soil Investigation.

The sections of the ground, invert levels of existing sewers, culverts, watermains, and the like, summer and maximum flood levels in rivers, tide levels, etc., are to be deemed approximate only.

The Contractor before tendering shall visit the site and satisfy himself as to the nature of the works including ground conditions and generally in respect of the position, dimensions and levels of the proposed constructional work and the adequacy of the method of construction he intends to follow.

He should also satisfy himself as to the nature of any difficulties that may be expected underground and to any obstructions or ground water levels that may influence his schedule rates.

The Contractor must accept the site as he finds it, and any work that may be necessary to complete the Contract must be provided for in his Contract Sum. Where subsoil information is provided by or on behalf of the Employer, the provision of this information does not absolve the Contractor from the responsibility of making his own interpretation of and judging the completeness of the information given.

All data provided by any test carried out is given without any guarantee that the conditions as shown are truly representative of the entire site. They merely show the findings at the indicated locations.

1.1.21 Restore Existing Structures

Where, for purposes of construction, it is necessary to break through walls, wall foundations, floors, or other structures or to remove or alter buildings, the said walls, wall foundations or buildings shall be restored and made good by the Contractor to the reasonable satisfaction of the persons, company or authority in whom the properties are vested or their representatives. The Contractor shall arrange for duplicate photographs to be taken by a professional photographer of all such structures prior to the commencement of the Works.

1.1.22 Excavated and other Materials

All materials on the site are the property of the Employer and may not be removed from the works without the Employers Representative's permission.

1.1.23 Use of Heavy Rock Breaking Machinery

Heavy rock-breaking machines shall be used to break up rock and other hard materials only where the use of such machinery can be shown not to cause such ground vibration effects as might cause damage to buildings or other structures in the vicinity. The Contractor shall demonstrate such to the Employers Representative at the Contractor's own expense.

1.1.24 Temporary Electrical Power, Water Supply & Telephone Connections

The Contractor is required to make his own arrangements for all necessary temporary water, electricity supply, etc. for testing and general use wherever necessary on the Works. The Contractor shall arrange for the installation of separate telephone lines on the Site, both for the Employer's Representative's office and his staff and for his own use, and he shall pay all charges for installation, rent, calls, and disconnection. The Contractor shall be deemed to have included for the cost of installation, rent and disconnection of the telephones in the Employer's Representative's office and for calls made by the Employer's Representative and / or his staff as outlined in Section 2 of the Specification, in his Contract Sum

1.1.25 Facilities for Workmen

The Contractor shall provide all necessary canteens, sanitary conveniences and welfare facilities for his personnel at the locations provided by the Employer or at such other location as he may choose in accordance with the conditions of contract, his statutory requirements and any byelaws or regulations of the Sanitary Authority and with public health requirements and shall ensure that these conveniences are properly used and maintained by his personnel.

1.1.26 Protective Clothing

The Contractor shall supply and maintain during the course of the Contract five complete sets of protective clothing comprising heavy duty reflecting raincoats c/w hoods, reflecting vests, donkey jackets, overalls, knee length rubber safety boots, safety boots which shall have steel toe caps with puncture resistant sole and oil resistant finish, safety helmets, protective eyewear and hearing protection (where appropriate) for the sole use of the Employer's Representative and his assistants. Six additional safety helmets, reflecting vests and pairs of rubber safety boots shall be provided for visiting personnel entitled to be on the Site.

1.1.27 Remove Rubbish

All rubbish shall be deposited in suitable dumps, provided by the Contractor and approved by the Employers Representative. On completion of the constructional works, the Site shall be cleared of all rubbish to the satisfaction of the Employers Representative. In this regard the Contractor shall be mindful of his obligations in respect of recycling of waste materials.

1.1.28 Precaution to Avoid Frost Damage

The Contractor shall take special precautions to avoid frost damage to sluice valves, pipes etc., above ground and where similar damages may be caused due to accumulation of water into recesses of concrete etc., before the Permanent Works are completed.

1.1.29 Temporary Fencing to Site

In addition to protective fencing which is the Contractor's responsibility under the Conditions of Contract, where directed in the Contract and where permanent fencing cannot be erected

immediately, the Contractor shall erect and maintain temporary fencing for the proper protection of the Works. The fencing shall be dismantled and re-erected when and where necessary and access shall be provided through it where directed for owners, tenants and occupiers of adjacent lands.

The temporary fencing shall be of the following minimum standards:

- (i) Timber posts 75 mm by 75 mm, or equivalent round posts at approximately 3 metre intervals with 3 lines of No.10 gauge wire at 450 mm, 750 mm and 1050 mm above ground respectively. Straining posts shall be erected at intervals and at changes in direction so that wires are kept taut.
- (ii) For fencing against animals, the top wire shall be barbed and where required sheep netting 1050 mm high with a 100 mm square mesh of No. 17 gauge wire shall be provided. Where netting is to be affixed, the middle line wire shall be omitted and the bottom wire lowered to 75 mm from the ground.
- (iii) Where approved, electric fencing operated from the main through a controller complying with B.S. 2632 may be used for cattle.
- (iv) Where a fence is required only to mark the boundary of the working area, it shall consist of a single line of No. 10 gauge wire properly strained at a height of 1050 mm above ground on timber posts as in (i) above.
- (v) Where required by the Contract, a 2000 mm high chain link fence shall be provided, supported on reinforced concrete fence posts to I.S. 136, 3000mm long, standing 2150 mm overground and spaced 3 metres apart and bedded in Mix "A" concrete which shall fill the post hole for its full depth. Intermediate straining posts shall be at intervals of not more than 30 metres and centre, end and intermediate straining posts shall have concrete struts and suitable winding brackets. Straining wire shall be 3 No. lines of No. 8 gauge solid drawn plastic coated galvanised wire. Chain link mesh shall be 50m x 12.5 gauge plastic coated 2000mm high. Where required three lines of galvanised thickset barbed wire shall be fixed at the outside of the fence to deter cattle.
- (vi) Temporary vertical concrete safety barriers in accordance with Clause 411 of the National roads Authority Specification for Road Works.
- (vii) Where required, a close board temporary fence 2.4m high constructed using treated 38mm ply fixed to 75mm x 75mm (minimum) treated timber horizontal members top and bottom supported on 150mm x 150mm (minimum) treated timber posts at 2.4m centres which shall be set to a depth of 1m in concrete. Additional bracing shall be installed to frame as necessary to ensure stability.
- (viii) Temporary wire mesh fencing 2.0m high founded on precast concrete bases to locations where below ground support cannot be provided.
- (ix) Timber posts 1950mm x 150 mm x 75 mm or equivalent round posts at 2.1 metre intervals with 4 lines of timber rails 4200mm x 100mm x 44mm at 200 mm, 500 mm, 850mm and 1200 mm above ground respectively.

Gaps formed in walls, hedges or fences crossing the route of a pipeline shall be closed during construction where required for the proper security of the affected premises and shall be stockproof where animals are kept in the adjoining land.

If temporary fencing is removed temporarily for the execution of any part of the Works it shall be reinstated as soon as possible, and in the meantime the gap in the fencing shall be patrolled so that no unauthorised entry on to the adjoining land takes place and no stock escapes from the adjoining land.

Temporary fencing shall remain in position until either it is replaced by permanent fencing or, where none is required, completion of the related section of the Works unless the Employers Representative permits its earlier removal.

The Contractor shall erect other fencing, which may be either temporary or permanent in specific locations as shown in the Contract at the times and to the extent ordered.

All fencing shall be neatly and effectively joined to existing fences, walls etc.

All fences shall be regularly inspected and maintained, any defects being made good immediately they are noticed by or brought to the attention of the Contractor.

The Contractor shall be responsible for all wear and tear of permanent fencing howsoever arising until the construction of all the related Works has been completed and the expiry of the relevant period of maintenance when the fencing shall be handed over in sound condition as specified.

When required, concrete for post footings shall be Mix B as specified in Clause 1.2.9 unless otherwise specified, and shall fill the hole for not less than half its depth, being well rammed as filling proceeds. After the concrete has hardened, the remainder of the hole shall be filled with earth well rammed as the filling proceeds.

1.1.30 Tidiness of Site

The Contractor shall be responsible for the proper upkeep and maintenance of the Site and the Works and shall remove from the Site rubbish and other waste as it accumulates. Materials and equipment shall be positioned, stored and stacked in an orderly manner. On completion of the constructional work on any portion of the Site, this portion shall be cleaned of all rubbish and material deposited during construction and shall be left in a neat and tidy condition.

1.1.31 Packing of Imported Materials

The Contractor shall ensure that all materials imported shall be packed in packing materials approved by the Department of Agriculture, i.e. wood-wool, paper or cardboard.

1.1.32 Method of Measurement

The Standard Method of Measurement used in the preparation of the Pricing Document is nominated in the Preamble to the Pricing Document. The Contractor's attention is drawn to the fact that certain individual items in the Pricing Document may not have been measured in accordance with the Standard Method nominated and the fact that the Pricing Document shall be used as a schedule of rates for the works which is essentially a Fixed Price Lump Sum Contract.

1.1.33 Programme and Order of Work

The Employer's Representative shall require the programme to be submitted in accordance with Clause 4.9.1 of the Conditions of Contract. This programme shall reflect all the items listed in

Clause 4.9 of the Conditions of Contract and Section 2 of this Specification. If the Employer's Representative shall consider the programme unsatisfactory it will be revised and resubmitted within a period of 15 working days from the date of the request by the Employer's Representative.

The submission to and approval by the Employers Representative of such programme or the furnishing of such particulars shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

1.1.34 Insurance of the Works

Before commencing the Works the Contractor shall be responsible for taking out and maintaining the following insurance policies in accordance with the General Conditions of Contract:

- (a) "Contractors' All Risks Policy" in the joint names of the Employer and the Contractor to cover the Works, temporary works, materials and constructional plant and machinery with excess limits which shall not exceed those stated in the Appendix to the Form of Tender.
- (b) Third Party Liability Policy (Public Liability Insurance) for an amount at least equal to that stated in the Appendix to the Form of Tender.
- (c) Workman's Compensation Insurance (Employer's Liability Insurance).
- (d) Professional Indemnity Insurance where required in Schedule 1D of the contract.

The Contractor shall within 10 working days of being requested to do so and before commencing the Works and whenever required produce to the Employer for inspection copies of these policies together with the receipts in respect of premiums and subsequent renewals paid under such policies. Copies of the policies and proof of premiums paid shall be submitted to the Employers Representative.

During the currency of the Contract any material alteration to the insurance policies shall be immediately notified by the Contractor to the Employer.

1.1.35 Wayleaves & Restricted Access Areas

The Employer will have obtained ownership of and/or wayleaves through sufficient land for the Permanent Works. Details of such wayleaves, etc and of any special conditions attaching thereto shall be included in the tender documents. The Contractor shall make his own arrangements for acquiring any additional areas of land or wayleaves for the purposes of constructing the Works and shall be deemed to have included for this in the Contract Sum and to be aware of any special conditions attaching to wayleaves obtained by the Employer or of any restrictions in the Contractor's use of the Site. Furthermore, any areas in which works are to be carried out where full wayleave width is not available shall be noted in the tender documents and the Contractor shall be deemed to have included for any special measures required as a result of such restriction in the Contract Sum.

1.1.36 Progress Reports and Meetings

The Contractor and/or his Agent shall in accordance with the conditions of contract attend monthly progress meetings or such other meetings as may be requested or convened by the Employers Representative. In addition, the Contractor shall attend any co-ordination meetings

that may be convened by the Employer to review progress or to provide any information to him on the programming of the Works. Furthermore the Contractor shall allow for attendance at night-time / public meetings when requested by the Employers Representative and shall be deemed to have included for such attendance in the Contract Sum.

The Contractor's Agent shall provide a written report at monthly intervals on the progress of the Works. These reports shall include the following:

- (i) Quantitative descriptions of the Permanent and Temporary Works relative to the approved programme for the Works,
- (ii) Change orders, delay days, omissions from the works, reductions in time, use of programme contingency and any adjustments to the contract sum
- (iii) Details of all Constructional Plant, Labour and resources used on the Works
- (iii) Progress Photographs

The report shall compare progress with the approved programme and if necessary shall include proposals to maintain progress in keeping with the programme. It shall indicate the variation in status of each item of work during the particular month and the projected work for the month ahead. These reports shall be submitted to the Employer's Representative 3 working days in advance of the monthly progress meetings. The Contractor shall be deemed to have included for the requirements of this clause in his Contract Sum.

1.1.37 Records

The Contractor shall record all technical and survey data of the as-constructed works including all deviations in line, level and dimensions of the completed works, location and identification of underground services, obstructions and other physical conditions encountered during the construction of the Works. These records shall be in AutoCad format with the Contractor updating the original contract drawings but adding his own company details to the title block along with updating the drawing revision status to 'As-Constructed'. The exact details shall be agreed with the Employers Representative and the Project Supervisor Design Process and shall be prepared by competent technical staff. They shall be submitted to the Employers Representative and the Project Supervisor Design Process on an on-going basis as each section or part of the Works is completed and prior to any notice which the Contractor may issue requesting a Certificate of Substantial Completion for any part of the Works. Draft copies may be issued in both digital and A3 colour hard copy formats. Final drawings shall be provided in hard copy (2 No. A1 colour copies) and digital copy formats. The Employers Representative shall make available to the Contractor clean copies of the Original Contract Drawings subject to his reasonable requirements for the purpose of his compliance with this clause. The Contractor shall be deemed to have included for the requirements of this Clause in the Contract Sum.

1.1.38 Compatibility of materials

Materials to be used shall be compatible with each other so that no deleterious effects are brought about in the final construction.

In particular, where metal components are used, all cast-in channels, bolts etc. shall be compatible with the components so that bimetallic action cannot occur.

1.1.39 Quality of workmanship

All workmen employed upon, or in connection with the work, shall be competent tradesmen, and the workmanship shall be of the best quality. Incompetent workmen, tradesmen or foremen are to be dismissed from the works, and shall not be employed again thereon without the approval of the Employers Representative.

SECTION 1.2: CONCRETE AND GENERAL CONCRETE CONSTRUCTION

1.2.1 Cement

Portland cement used in concrete, concrete products and other cement based products shall be certified as complying with I.S. EN 197-1 (Cement type CEM 1). Manufacturer's certificates of compliance with the Standard shall be provided when requested by the Employers Representative.

The use of Rapid Hardening cement shall not be allowed in any of the Works except in special cases with the prior permission of the Employers Representative, and no extra claim shall be allowed for the use or non-use of Rapid Hardening cement. High alumina cement shall not be used in any part of the works.

The Contractor must produce certificates of satisfactory tests carried out on each consignment of cement, and no cement will be allowed on site if the required certificate is not produced. The Employers Representative shall be at liberty to take samples from cement delivered and to have tests carried out on these. If the results of the tests prove unsatisfactory, then the cement shall be removed forthwith from the site notwithstanding the previous production of a satisfactory certificate of tests.

All cement is to be stored under cover in a dry and airy store until required for use.1.2.2 Fine Aggregate

The sand or fine aggregate to be used on the works shall comply with the requirements of Irish Standards IS EN 206-1, IS EN 12620:2002+A1:2008 and Irish Standard Recommendation SR 16. It shall comply with the requirements of Table A.1, Annex A, of SR 16.

1.2.3 Coarse Aggregate

The coarse aggregate shall comply with the requirements of Irish Standards IS EN 206-1, IS EN 12620:2002+A1:2008 and Irish Standard Recommendation SR 16.

The coarse aggregate is to have a nominal maximum size of 20mm unless shown otherwise. The coarse aggregate shall be approved broken stone in all cases except with the prior approval in writing of the Engineer. It shall comply with the requirements of Table A.1, Annex A, of SR 16.

1.2.4 All-in Aggregate

All-in aggregate shall comply with the requirements of Irish Standards IS EN 206-1, IS EN 12620:2002+A1:2008 and Irish Standard Recommendation SR 16, with a nominal maximum size of 20mm. It shall comply with the requirements of Table A.1, Annex A, of SR 16.

1.2.5 Water

The water used for concrete and testing shall be clean and free from oil, acid, organic matter or other deleterious substance in suspension or solution and shall be from a source approved by the Employers Representative.

1.2.6 Gauging Materials

All concrete is to be composed of cement, water, fine and coarse aggregate measured by weight in a suitable weight-batching plant, in the proportions as designed to give the characteristic compressive strengths at 28 days as specified in Clause 1.2.9 of this Specification.

The total water in each batch shall be deemed to consist of the water carried by the aggregate plus the water added in the mixer.

The mixer shall comply with B.S. 1305 or B.S. 4251 where applicable. The mixing time shall be not less than that used by the mixer manufacturer in assessing its performance.

The accuracy of the measuring equipment shall be within $\pm 3\%$ of the quantity of cement, water or total aggregate being measured. All measuring equipment shall be maintained in a clean, serviceable condition and shall be zeroed daily and calibrated monthly.

1.2.7 Grading

The proportions of fine and coarse aggregate and the grading thereof shall be such as to produce a dense concrete of the specified strength and consistency that will work readily into position without segregation and without the use of an excessive water content.

A set of Sieves to I.S. 24 shall be provided by the Contractor for the testing of aggregate on site, and the Contractor shall ascertain from time to time, under the direction of the Employers Representative, the relative proportions of fine and coarse aggregate that will give the most suitably graded mixture for the type of concrete to be used.

Where samples of fine and coarse aggregate are required by the Employers Representative for testing during the course of the Contract, they shall be procured from stock piles in the standard manner and shall weigh not less than 3 kg in the case of fine aggregate or 6 kg in the case of coarse aggregate. Standard tests for content and organic matter shall be carried out before any aggregates will be approved by the Employers Representative.

1.2.8 Consistency

Sufficient water shall be used for mixing the concrete to produce a tough mixture which will only just flatten when deposited, but not enough to cause it to flow. It shall be of such consistency that after tamping only a slight laitance appears on the surface and it should be sufficiently plastic to allow it to be tamped into all parts of the mould and between reinforcing steel.

The amount of water used should be such that a consistent water cement ratio is maintained as required by the mix design. To this end determination of moisture contents in both fine and coarse aggregate should be made at least once per day or more frequently in showery weather and the amount of water and aggregate added should be adjusted to compensate for any observed variations in these moisture contents.

The Contractor shall provide a standard slump cone for use on the Site and shall carry out suitable consistency tests in accordance with Clause 1.2.10.

The specified slump is 75mm. The workability of the concrete shall be within $\pm 25\text{mm}$ of the specified value and the Contractor shall ensure that the workability of the concrete is appropriate for each of the various applications during the course of construction of the Works.

1.2.9 Concrete Mixes

The concrete mixes in the various sections of the Works shall be designed mixes in accordance with the B.S. 5328 and shall be as follows: -

Mix Designation	Mix "A"	Mix "AW"	Mix "B"	Mix "C"	Mix "D"	Mix "E"	Mix "F"	Mix "W"
Characteristic compressive cube strength at 28days (N/mm ²)	10	20	30	35	42.5	40	50	35
Cement type (Ordinary Portland Cement = OPC)	OPC	OPC	OPC	OPC	OPC	OPC	OPC	OPC
Nominal maximum aggregate size (mm)	20	20	20	20	20	20	20	20
Minimum cement content (kg/m ³).	150	180	275	340	400	350	400	325
Maximum cement content (kg/m ³).	550	550	550	550	550	550	550	400
Maximum free water/ cement ratio (by mass)	0.8	0.8	0.65	0.6	0.45	0.55	0.45	0.5

The class of concrete to be used in the different sections of this project is indicated hereunder.

- Mix "A" - Blinding Concrete to underside of all foundations.
- Mix "C" - all other in-situ reinforced concrete except as noted otherwise.
- Mix "W" - Sub surface concrete including pump sump walls and concrete cradles and all exposed external surfaces.

Mix "C" and Mix "W" shall contain shall contain 30% GGBS replacement in all mixes.

1.2.10 Sampling and testing of concrete cubes

Sampling of concrete shall be at the rate specified in the following table:

Recommended Minimum Rates of Sampling of Concrete	
Average Rate of Sampling One Sample Per:	Structures to which applicable
10m ³ or 10 batches whichever is the lesser volume	Masts, columns & cantilevers
20m ³ or 20 batches whichever is the lesser volume	Beams, slabs, walls, footings and bridge decks
50m ³ or 50 batches whichever is the lesser volume	Solid raft foundations

In any case, at least one sample should be taken of each grade of concrete on each day that concrete is placed.

The sample of fresh concrete shall be obtained at the point of discharge from the mixer or ready mixed concrete delivery vehicle.

Three 150mm test cubes shall be made from the sample of concrete. The cubes shall be made and cured in accordance with Clause 1.2.11 of this Specification.

One cube is to be tested at 7 days, a second cube is to be tested at 28 days and the third cube is to be retained for testing at the discretion of the Employers Representative.

(Note: It has been found that cubes which have been cured by the method specified in Clause 1.2.11 will generally achieve approximately 75% to 80% of their 28 day compressive strength when tested at 7 days).

A slump test is to be carried out on each sample of concrete taken and the result of this test is to be submitted with the cube test results.

A copy of each cube test result is to be forwarded direct to the Employers Representative by the Testing Authority, which shall be approved by the Employers Representative.

The Contractor is to ensure that all relevant information regarding cubes is submitted to the Testing Authority for inclusion in their report i.e. strength of mix, slump, location of concrete in the Works, etc.

1.2.11 Making and curing of concrete test cubes

The moulds for the 150mm test cubes shall be of metal with the inner faces accurately machined so that the opposite sides of the cube are plane and parallel. Each mould shall be provided with a metal base having a smooth machined surface. The interior surfaces of the mould and base shall be lightly oiled before concrete is placed in the mould.

The cubes shall be made by placing the fresh concrete in the mould in 50mm layers, each

layer being thoroughly compacted with a steel bar 380mm long and having a ramming face 25mm square and weighing 1.8 kg. The concrete shall be subjected to at least 35 strokes per 50mm layer. Alternatively the concrete shall be compacted by vibration, each layer being vibrated by means of an electric or pneumatic hammer or by means of a suitable vibrating table.

Test cubes shall be placed in moist air of at least 90% humidity and at a temperature of 20 degrees C $\pm$ 2 degrees C for 24 hours $\pm$ ½ hour, commencing from the addition of water to the mix. After 24 hours the test cubes shall be removed from the moulds and placed in water at a temperature of 20°C $\pm$ 2°C until required for test.

1.2.12 Compliance with Characteristic Compressive Strength

Compliance with the characteristic compressive strength as specified in Clause 1.2.9 shall be assumed if the conditions give in both (a) and (b) hereunder are met:

- (a) The average strength determined from any group of four consecutive test results exceeds the specified characteristic strength by

3 N/mm² for concrete Mixes 'B', 'C', 'D', 'E', 'F' and 'W'.

2 N/mm² for concrete Mixes 'A' and 'AW'.

or 1.64 times the Standard Deviation of the group, whichever is the greater.

- (b) The strength determined from any test result is not less than the specified characteristic strength minus

3 N/mm² for concrete Mixes 'B', 'C', 'D', 'E', 'F' and 'W'.

2 N/mm² for concrete Mixes 'A' and 'AW'.

1.2.13 Ready Mixed Concrete

Ready mixed concrete may be used if the requirements of this Specification and those of B.S. 5328 are complied with. However, compliance with the characteristic compressive strength shall be as set out in the above clause.

When a truck or agitator is used for the delivery of concrete, no water from the truck water system or elsewhere shall be added after the initial introduction of the mixing water for the batch.

The concrete shall be placed and compacted in its final position within 2 hours after the introduction of the mixing water to the cement and aggregate or the introduction of the cement to the aggregate. The time at which this occurs shall be recorded on the delivery note accompanying each load. At all times the mixed concrete shall be kept agitated at the speed recommended by the manufacturers which shall be capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass. Truck mixers and agitators should be equipped with means by which the number of revolutions of the drum, blades or paddles may be readily verified.

1.2.14 Work in cold weather

No concrete shall be placed when the air shade temperature is below 2°C on a rising thermometer or below 5°C on a falling thermometer unless the following precautions are taken:

- (1) The temperature of the concrete at the time of placing is at least 5°C.
- (2) The temperature of the concrete is maintained at not less than 5°C and water curing is not used until it reaches a strength of 5 N/mm² as determined by tests on cubes which were cured as far as possible under the same conditions as the concrete in the members.
- (3) The aggregate and water used in the mix are free from snow, ice and frost.
- (4) Before placing concrete, the formwork, reinforcement, prestressing steel and surface with which the fresh concrete will be in contact are to be free of snow, ice and frost and preferably should be at a temperature close to that of the freshly placed concrete. Special care shall be taken where small quantities of fresh concrete are placed in contact with larger quantities of previously cast concrete at a lower temperature.

When night frosts are expected suitable covering shall be provided so that the fresh concrete is sufficiently protected against the frost so as to allow the setting to continue.

Dependence shall not be placed on salt or other chemicals for the prevention of freezing. A maximum and minimum recording thermometer is to be provided for use on the site and shall be fixed in a suitable position to be determined by the Employers Representative.

All concrete damaged by frost shall be removed at the Contractor's expense.

The Employers Representative reserves the right to prohibit concrete work during cold weather if conditions appear unsuitable or adequate precautions are not being taken.

1.2.15 Transporting and placing concrete

The Employers Representative shall be previously notified whenever concreting is to take place. Concrete shall be transported to place of final deposit, as rapidly as possible and special care shall be taken to prevent segregation of the mix.

The temperature of the concrete at the point and time of delivery from the mixer or ready-mixed concrete truck shall not be less than 5° C.

No concrete shall be shot into moulds from a height greater than 3 metres and where there is any sign of segregation of the larger aggregate from the mass, such concrete shall be forthwith removed from the mass and wheeled to spoil.

The concrete shall be placed in its final position before setting has commenced, and shall not subsequently be disturbed during the process of setting. In no case shall the interval between adding of water to the dry mix and the placing of the mix in-situ exceed 30 minutes, except in the case of ready mixed concrete (See Clause 1.2.13).

A record shall be kept on the site of the time and date of placing the concrete in each

position of the structure.

All concrete shall be carefully spread in continuous layers, worked well into the corners of formwork, around embedded fixtures and steel reinforcing bars, and thoroughly compacted with approved vibrating machines.

No concrete shall be deposited under water without the permission of the Employers Representative and unless otherwise specified the amount of cement in the concrete shall be increased by 25% above the amount required for similar concrete placed in air.

1.2.16 Stops, Junctions and Shrinkage Gaps

The ends of concrete layers shall not be allowed to tail off but shall be carried up to prepared construction joints so that the concrete can be properly rammed and so as to provide proper bond. These construction joints shall be plain butt joints with notches for the reinforcement as necessary.

Approval for the position and design of construction or day joints not described in the contract documents shall be obtained by the Contractor. Extra reinforcing bars shall be placed at any joint where the Employers Representative considers that a member may be weakened by the inclusion of a joint.

The work shall be carried out in such a manner as to minimise the effect of shrinkage of the concrete.

If no particular stopping points are specified, they should be arranged as nearly as practicable in planes perpendicular to the lines of main reinforcement and of minimum shear. Construction joints in walls shall be formed at a maximum spacing of 7.5 metres unless specified otherwise.

At all horizontal construction joints excess water shall be removed from the surface immediately after deposition of the concrete and any laitance that appears should be thoroughly scraped off not later than twenty-four hours after placing the concrete. The surface shall be left rough to provide good bond with the succeeding layer.

Where the finished concrete surface will be left exposed, or where cracking of the concrete must be kept to a minimum and in all water retaining structures the following restrictions on placement of concrete shall apply.

- (a) Fresh concrete shall not be placed against in-situ concrete which has been in position for more than 30 minutes and for less than 4 hours unless a construction joint is formed as described above.
- (b) When in-situ concrete has been in place for more than 4 hours no further concrete shall be placed against it for a further 20 hours.
- (c) In the case of vertical joints the minimum period between successive concrete pours shall be 3 days and for infill panels, 7 days.
- (d) In the case of horizontal joints successive layers of concrete shall be placed as soon as possible.

1.2.17 Admixtures

The use of admixtures for any purpose will not be permitted without the prior approval of the Employers Representative and when approval is given they shall be used strictly in accordance with the manufacturer's instructions.

1.2.18 Addition of fresh concrete to existing work

Before depositing concrete against any temporarily stopped work, the old concrete must be cleaned and washed free of all loose material.

The surface film of the first placed concrete shall be removed whilst the concrete is still green to expose the aggregate and leave a sound, irregular surface.

Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned, freed from loose mortar and slightly wetted. The Contractor shall take special care to avoid segregation of the concrete along the joint plane and to obtain full compaction. Forms should be re-tightened in all cases before the new concrete is put in place.

1.2.19 Curing concrete

Concrete after placing should be protected during the first stages of hardening from harmful effects of sunshine, drying winds and cold and also from running water, surface or subsoil water or shocks. Faulty joints in the timbering shall be remedied to prevent any loss of liquid. The concrete when placed shall be kept moist for seven days and an adequate supply of straw, jute sacking and other covering materials shall always be kept on site. If polythene sheeting is used, its exposed face must be kept wet for seven days.

Proprietary concrete curing compounds which are emulsion based and which comply with Clause 1.2.20 of this Specification may be used if approved by the Employers Representative. The curing compound shall be applied on the surface of the concrete in an even coating immediately after the shuttering to vertical surfaces has been removed or on horizontal surfaces immediately after the initial set of the concrete has taken place.

1.2.20 Concrete curing compounds

Proprietary concrete curing compounds shall be emulsion based and shall be of approved manufacture and used strictly in accordance with the manufacturer's instructions.

The curing compounds shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application.

It shall contain a colouring agent or have its own colour so that treated areas can be easily identified.

1.2.21 Steel reinforcement

All mild steel bars, mesh reinforcement, binding wire and fabric or other types of reinforcement shall conform to the latest BS for the material and shall be of approved

manufacture.

All high yield bars are to be round deformed and ribbed bars with a minimum guaranteed proof stress of not less than 500 N/mm² and of approved manufacture to the latest BS and shall carry the "CARES" approval mark. For diameters up to and including 12mm Grades B500A, B or C may be supplied. For bar diameters greater than 12mm, Grades B500B and C shall be supplied.

The manufacturer's certificate of tests should be obtained for the materials supplied and submitted to the Employers Representative for approval.

1.2.22 Bending and placing of reinforcement

The steel must be bent cold to the required shapes and placed exactly as shown on the detail drawings and the Contractor shall without extra charge, provide all fixings required and shall take precautions that all such temporary fixings are removed as the concrete is brought up. High yield reinforcement shall not be bent when the air shade temperature is below 5°C and mild steel shall not be bent when the air shade temperature is below 0°C.

The reinforcement is to be held in position by means of purpose made concrete blocks with tying wires or approved spacers. The use of loose pieces of brick or tile for holding the reinforcement will not be allowed. For "Woodwool" slabs, plastic bar spacers may not be used except the type that is specially manufactured for use with this type of formwork.

Upper layers of reinforcement which are not self-supporting are to be maintained in position by means of temporary or permanent chairs, spacers or fixing bars. The cost of supplying and fixing these chairs will be the responsibility of the Contractor.

Steel reinforcement bending schedules are supplied with the working drawings. The Contractor shall be deemed to have checked these schedules against the reinforcing drawings before ordering steel. Any discrepancies found shall be referred to the Employers Representative for his decision.

All the steel shall be free from scale, loose rust, oil or paint before fixing in the work. It shall be delivered in straight lengths to the site unless otherwise instructed by the Employers Representative. If the Contractor does propose to have reinforcement cut and bent off site, details of the proposed steel supplier shall be submitted for approval complete with confirmation that they are compliant with the requirement of BS8666:2005.

At intersections the bars shall be securely bound together at frequent intervals with No. 16 SWG wires so that the reinforcement may not be displaced in the process of placing the concrete.

The main steel must be free from wavy lines and the ties, stirrups, links, etc., formed to obtain contact at each crossing or lapping with the main bars.

Before concreting the Contractor shall see that all reinforcement is checked in place and shall have the Employers Representative's approval of same, but such approval shall not relieve the Contractor of his liability if bars are subsequently found to be placed otherwise than as shown on the drawings.

All the reinforcement shall have minimum protective covering as shown on the drawings.

The lapping of all bars where shown, or otherwise, shall be sufficient to develop the full bond strength of each bar, but should in no case be less than 450mm.

1.2.23 Formwork

Formwork shall comply with Section 6.2.6 of BS. 8110: Part 1.

In every case the joints of the shuttering are to be perfectly close to prevent loss of liquid from the concrete. The shuttering is to be properly renovated before re-use.

The shuttering is to be arranged for the parts to be removed in an approved sequence without disturbing the concrete or rendering the remaining shuttering insufficient.

All shuttering shall be tightly assembled and be of substantial and rigid construction to withstand all load vibration and shocks without bulging or distortion to the entire satisfaction of the Employers Representative.

The supporting struts or props etc., shall be provided with suitable wedges or some other arrangement to allow for adjustment without external displacement and in general the formwork shall be such as to ensure that the concreting may be carried out exactly to the line and level indicated on the drawings.

Before the placing of the concrete, the shuttering must be coated with an approved preparation for preventing absorption of water from the concrete and the adhesion of the concrete to the moulds and is to be of such nature and so applied that it will not stain or mark the surface of the finished concrete in any way.

Suitable camber shall be provided in formwork for beams and slabs to compensate for any subsequent deflection.

The Contractor shall be responsible for the safety and stability of all shuttering and scaffolding.

1.2.24 Striking of formwork

The responsibility for the timely and safe removal of the formwork and supports rests entirely with the Contractor and before any formwork is removed he shall ensure that the concrete has attained sufficient strength for striking to proceed. Periods during which the air shade temperature remains below 3°C shall not be included as effective for concrete maturing. The minimum period for retaining formwork in position before striking shall not be less than that indicated in the following table: -

Type of Formwork	Minimum period before striking formwork (Cement type-Ordinary Portland Cement)	
	Mean Air Shade Temperature	
	7°C	16°C

Vertical Formwork to columns, walls and beams	18 hrs.	12 hrs.
Soffit Formwork to Slabs	6 days	4 days
Props to slabs	15 days	10 days
Soffit Formwork to beams	15 days	10 days
Props to beams	21 days	14 days

1.2.25 Surface finish of formed concrete

The surface finish of concrete shall comply with Section 6.2.7.3 of BS. 8110: Part 1. Unless noted otherwise on the drawings or in the Pricing Document or if directed by the Employers Representative the surface finish of the concrete shall be as follows:

- (a) All surfaces which are to be left permanently unexposed shall be of **Type "A"** finish. This finish shall be obtained by the use of properly designed formwork or moulds of timber, plywood, plastics, concrete or steel. Small blemishes caused by entrapped air of water may be expected, but the surface should be free from voids, honey combing or other blemishes.
- (b) All surfaces which are to be left permanently exposed shall be of **Type "B"** finish unless **Type "C"** is specified.

Type "B" finish can only be obtained by the use of high quality concrete and formwork. The concrete shall be thoroughly compacted and all surfaces shall be true, with clean arrises. Only minor surface blemishes will be accepted and there shall be no staining or discolouration from the release agent.

Type "C" finish shall be obtained by first producing a Type "B" Finish. The surface shall then be improved by carefully removing all fins and other projections, thoroughly washing down, and then filling the most noticeable surface blemishes with a cement and fine aggregate paste to match the colour of the original concrete. After concrete has been properly cured, the face shall be rubbed down, where necessary, to produce a smooth and even surface.

Making good of surface defects shall be in accordance with Clause 6.2.7.5 of B.S. 8110. Voids may be filled with a fine mortar, preferably incorporating styrene-butadiene rubber (SBR) or polyvinyl acetate (PVA), while the concrete is still green or when it has hardened. Fine cracks can be filled by wiping in cement grout, an SBR, PVA or latex emulsion, a cement/SBR or a cement PVA slurry across them. Fins and other projections shall be rubbed down.

If on removal of shuttering and after final making good, the surfaces are not properly finished to the Employers Representative's satisfaction the Contractor will be required to rebuild the defective section or effect such reconstruction at his own expense as may be called for by the Employers Representative to achieve the required finish.

On all surfaces where a rendered or plastered finish is specified the concrete surfaces shall be treated to provide an adequate key. Alternatively, the formwork may be coated with an approved retarding compound which shall be removed with water and wire brushed as soon

as possible after concreting. Precautions shall be taken to ensure that the retarding compound does not come in contact with the reinforcement.

1.2.26 Precast units

Precast concrete slabs, plain or reinforced as well as kerbs, or other units shall be formed to the specified mix in wrought timber or steel moulds and shall be finished free from air holes, or showing segregation of aggregate at any part. The surface shall be finished smooth to the satisfaction of the Employers Representative.

Precast slab units shall be matured for at least 28 days before being placed and shall be handled with care to avoid reverse bending. To prevent a precast slab being placed upside down the top of the slab shall be suitably marked before it has hardened in the mould.

See also if applicable the particular specification herein for "Precast Concrete Construction" and "Precast Concrete Cladding Panels"

1.2.27 Polythene

Approved 1200 gauge heavy duty polythene sheeting shall be placed under all concrete work bearing on hardcore.

In using Polythene sheeting adequate precautions shall be taken to ensure that it is not torn in placing reinforcement and concrete. Where an overlap of sheets is necessary this shall be at least 300mm. Joints in the sheets shall be sealed with "Monobond" sealant tape or similar equal and approved.

1.2.28 Hardcore

'Hardcore' shall be crushed rock and shall be in accordance with IS EN 13242:2002+A1:2007 and SR 21:2004+A1:2007 and comply with the requirements of the following Table.

Properties	Category to I.S. EN 13242:2002
Grading and fines content	In accordance with Cl. 804 Granular Material Type B
Crushed or Broken and totally rounded particles – Crushed Rock	C _{90/3}
Shape of coarse aggregate – Flakiness Index	FL ₃₅
Resistance to Fragmentation	LA ₃₀
Water Absorption to I.S. EN 1097-6:2000, Cl. 7	WA ₂₄₂
For WA>2% magnesium sulphate soundness value	MS ₂₅
Acid-soluble sulphate content: Aggregates other than air-cooled blastfurnace slag	AS _{0.2} (≤0.2%)
Total sulfur: Aggregates other than air-cooled blastfurnace slag	S ₁ (≤1.0%)
Petrographic analysis	A petrographic examination is required to ensure that no reactive form of pyrite is present.
NOTE: Specifying values for all other properties described in I.S. EN 13242:2002 is not necessary because, as specified in I.S. EN 13242:2002, clause 4.1, 5.1, 6.1 and 7.1, they are not appropriate to the particular application at end-use or origin of the aggregate.	

Hardcore in the top 500mm zone shall comply with the liquid limit requirements of Clause 804, Granular Material Type B, of the NRA Specification for Road Works.

Hardcore shall not be used if, when tested in accordance with TRL Report 447 either:

- (i) the water-soluble sulphate (WS) content exceeds 1500 mg of sulphate (as SO₄) per litre (Test No.1); or
- (ii) the oxidisable sulphides (OS) content exceeds 0.5% of sulphate (as SO₄) (Test No.2 and Test No.4); or
- (iii) the 2:1 water to soil extract prepared for the determination of water-soluble sulphate in (i) has a pH value of less than 7.2, when tested using the electrometric method of pH determination in accordance with BS 1377-3.

The material shall be compacted to 100% of the maximum dry density determined using the 2.5kg rammer method and shall have a minimum elastic modulus (E_{v1}) of 40 MN/m² obtained using a 450mm diameter plate in accordance with BS 1377, from an initial seating loading of 10kPa, and a reload modulus (E_{v2}) not greater than $2E_{v1}$. The plate shall be loaded to a pressure of 350 kN/m².

Before any hardcore is delivered to site, the Contractor shall submit to the Employers Representative, in respect of each source of hardcore he proposes to use:

1. A report from a suitably qualified petrographer, based on a detailed mineralogical examination, covering the proposed area of extraction, in order to:
 - a) establish the material's suitability for use under concrete floors, footpaths and road pavements, and

-
- b) establish an appropriate test frequency for total sulphur from an assessment of the variability of the quarry deposit
 2. Records of test results for acid-soluble sulphate, water-soluble sulphate, total sulfur, oxidisable sulphides and pH for the preceding six month period, demonstrating compliance with the limits set out above, or with any lesser limits recommended by the petrographer.
 3. Records of test results from an independent testing authority on a sample of hardcore proposed for use by the Contractor.

If the source of the aggregate changes, either to a different quarry or to an area within the same quarry where there is a significant change in quarry characteristics, the requirements outlined under 1,2 and 3 above shall be repeated before any hardcore is delivered from the new source.

All of the above testing shall be at the Contractor's / Supplier's expense.

Furthermore, if the quality of the hardcore, delivered to site, varies from the initial samples, then further samples of this hardcore shall be tested, by an independent testing authority, to demonstrate compliance with the specification.

Any material not complying with the above requirements shall be removed from site at the Contractor's expense.

Furthermore, a sample of the hardcore, proposed for use by the Contractor, shall be submitted to an independent Testing Authority, nominated as a Specialist by the Employers Representative, and shall be tested for compliance with the above requirements before any material is delivered to site. No material shall be delivered to site until written approval is received from the Employers Representative. Further samples, of the hardcore delivered to site, shall be submitted for testing as directed by the Employer's Representative and any material not complying with the above requirements shall be removed from site.

The hardcore shall be compacted by means of mechanical rollers – see Clause 1.10.8 and also as set out in Clause 802 of the "Specification for Roadworks" to 100% of the maximum dry density obtained from the BS1377: Pt 4:1990 compaction test using the 2.5kg rammer or to a subgrade modulus of 90 MN/m³ obtained using a 450mm diameter plate in accordance with ASTM D 1196-64 but corrected for a 300mm plate. The Reload Modulus of Subgrade Reaction, when measured on the surface of the compacted hardcore, using a plate diameter of 300mm or 450mm as appropriate, shall exceed 150 MN/m²/m. The plate load test is to be taken to an applied load of 140 kN/m² and the subgrade modulus is to be calculated on the deflection measured at an applied load of 70 kN/m² on the initial load sequence of this test. Plate loading tests to check compliance with the above shall be carried out as directed by the Employers Representative. The Contractor shall provide an effective reaction load of approximately 10 tonnes, at any point within the perimeter of the building to facilitate carrying out the test and shall make such areas of the site available for testing as directed by the Employers Representative. This may require the construction of certain areas of ground beams or rising wall to be temporarily deferred to facilitate access for the test load.

1.2.29 Mortar for grouting

Cement Mortar for grouting shall be mixed in the following proportions:-

Mix	Cement	Clean washed Siliceous Sand
1 : 1	50kg	0.035 cu.m.

The mortar shall be mixed by machine and used within 1 hour of mixing.

An approved "non shrink" compound is to be added to the above mix in accordance with the manufacturer's instructions.

1.2.30 Trial panels of concrete

In order to ensure that the specified formed finished can be obtained by the method of construction proposed and to provide a standard by which the finishes in the Works can be assessed, trial panels shall be cast on site. These panels shall be subject to approval before similar construction is begun in the Works.

The trial panels shall employ the materials, plant and concrete mix proposed for the Works. They shall be at least storey height and 1m wide. They shall be of similar thickness and similarly reinforced to the elements they represent and shall incorporate all features, which may contribute to the final appearance of the work, i.e.

- (a) horizontal and vertical construction joints
- (b) horizontal and vertical panel joints
- (c) arises and chamfers
- (d) tie bolts or other fixing devices
- (e) means of maintaining concrete cover to reinforcement
- (f) release agent
- (g) any other feature

1.2.31 Tolerances

The tolerances to be achieved on the Concrete Work and which will be allowed are as shown below:

Building Structures

- (a) Setting out dimensions $\pm 6\text{mm}$
- (b) Section of concrete member $\pm 3\text{mm}$
- (c) Surface levels of floor and floor slabs $\pm 6\text{mm}$

-
- (d) Vertical lines per storey $\pm 3\text{m}$
- (e) Finished concrete floor surfaces shall be true to line and level within the following tolerances:

Maximum of $\pm 3\text{mm}$ under a 3 metre straight edge when the straight edge is held with both ends equidistant above the floor and a minimum wave length of 2 metres. The overall tolerance is to be $\pm 6\text{mm}$ from datum.

Water Retaining Structures

- (f) Horizontal deviation from intended position $\pm 6\text{mm}$
- (g) Deviation from intended level $\pm 10\text{mm}$
- (h) Deviation from vertical or near-vertical plane (plumbness) $\pm 2\text{mm}$ per m with a maximum of 25mm for heights in excess of 12.5m

Note: For specification requirements on tolerances to be achieved on structural steelwork and masonry, refer to Sections 1.3.32 and 1.4.3.9 respectively.

SECTION 1.3 STRUCTURAL STEELWORK

1.3.1 General

Structural steelwork shall be fabricated and erected in accordance with the drawings. If the Contract so requires, the steelwork contractor shall be a specialist appointment. Otherwise the Contractor may carry out the work himself provided that in the opinion of the Employers Representative he has the necessary experience and expertise or if not the Contractor shall sub-let that part of the work to a specialist steelwork contractor who shall, in the opinion of the Employers Representative, have the necessary experience and expertise.

Where structural steelwork is being carried out by the Contractor or by a specialist, the Contractor shall ensure that his obligations as described in the Specification for Structural Steelwork are fulfilled. If any matters in the drawings, Specification, or any other contract documents are not clear to the Contractor or to the Steelwork specialist then the Employers Representative's instructions shall be sought.

The work shall be carried out in accordance with the requirements of the current editions of BS. 449 or BS. 5950, the National Structural Steelwork specification for Building Construction and the latest relevant British Standards, together with the instructions of this Specification and any further instructions deemed necessary by the Employers Representative.

1.3.2 Examination of the site

The site is shown on the drawings. The Contractor shall be deemed to have examined the site and adjacent premises particularly with regard to access and facilities for receiving and storage of materials and equipment before submitting his tender. He shall be deemed to have satisfied himself as to the extent of any necessary access roads, storage and working space which he will require.

1.3.3 Plant

The Contractor shall provide the falsework and all tools, appliances, equipment and machinery necessary for expeditious handling, satisfactory fabrication and erection of the steelwork. Use of construction plant which is unsuitable to produce the quality of work required will not be permitted.

1.3.4 Shop Drawings & Details

The programme for the preparation of workshop drawings and the fabrication and erection of the structural steelwork shall be submitted to the Employers Representative for his review. The structural steelwork programme shall not interfere with the overall programme. The workshop drawings shall be submitted to the Employers Representative on a phased basis in accordance with an agreed programme. At least three weeks shall be allowed in the programme for the review by the Employers Representative of the first of these drawings before fabrication commences. The remainder of the drawings shall be submitted for review on a regular basis to be agreed. The Employers Representative's review should be carried

out prior to any work being started in the workshop. Shop details shall conform strictly to this Specification and to the drawings as supplied by the Employers Representative unless the Contractor is otherwise permitted in writing by the Employers Representative.

The Contractors attention is drawn to the fact that minor revisions may always be made on the Employers Representative's instructions before fabrication commences. Whilst the Employers Representative's review will confirm that his requirements have been correctly interpreted the Contractor is responsible for the accuracy of his shop drawings and the dimensions thereon together with the correctness of details and the proper design of all connections and joints.

The Contractor shall supply to the Employers Representative a complete set of all final reviewed drawings i.e. both shop and site drawings. He shall also supply all drawings necessary for the setting out of the foundations to suit the steelwork and he will be responsible for the accuracy of these drawings.

1.3.5 Alternative materials

The Contractor may wish to use heavier sections than those specified due to left over stock etc. He shall obtain the Employers Representative's approval before any substitution is made from the sections specified.

1.3.6 Sub-Letting

The Contractor shall not sub-let any fabrication or erection unless the prior written permission of the Employers Representative is obtained.

1.3.7 Inspection & Tests

The Contractor shall notify the Employers Representative when steelwork is ready for inspection and delivery and the Employers Representative shall have free access during working hours to any section of the workshop or site where work is being done under this Specification.

The Employers Representative may order tests to be carried out during fabrication of the steelwork on selected cuttings of the steel which, where required, shall be scheduled in Section 2 of the Specification.

If two test pieces taken from the same steel casting fail to comply with the requirements of the appropriate British Standard Specification, then two further cuttings shall be taken from the same cast as the first test pieces and tested in accordance with the British Standard Specification. Should either of these second set of test pieces fail then all fabrication using this cast of steel shall be rejected.

The acceptance of any material or finished members by the Employers Representative shall not prevent their subsequent rejection if found defective.

Rejected material and workmanship shall be replaced promptly or made good by the Contractor at his own expense.

1.3.8 British Standards relevant to this Specification

The following British Standards are referred to by this Specification and the latest issue together with all supplements, addenda and revisions shall be applicable at the time of performing the work. It is the Contractor's responsibility to obtain copies of these documents.

B.S. 4:	Part 1: Hot rolled sections
B.S. 449:	The use of structural steel in building.
	Part 2: Metric Units
B.S. 639:	Covered carbon and carbon manganese steel electrodes for manual metal arc welding.
B.S. 709:	Methods of destructive testing fusion welded joints and weld metal in steel.
B.S. 729:	Hot dip galvanised coatings on iron and steel articles.
B.S. 1449:	Steel plate sheet and strip.
	Part 1: Carbon and carbon manganese plate, sheet and strip.
B.S. 1494:	Part 1: Fixings for sheet, roof and wall coverings.
B.S. 2451:	Chilled iron shot and grit
B.S. 2521 & 2523:	Lead based priming paints
B.S. 2633:	Class 1 arc welding of ferritic steel pipework for carrying fluids.
B.S. 2901:	Filler rods and wires for gas shielded arc welding
	Part 1: Ferritic steels.
B.S. 2994:	Cold rolled steel sections
B.S. 3139:	High strength friction grip bolts for structural engineering.
B.S. 3692:	ISO metric precision hexagonal bolts, screws and nuts.
B.S. 3923:	Methods of ultrasonic examination of welds (Parts 1, 2 & 3)
B.S. 4165:	Electrode wires and fluxes for the submerged arc welding of carbon steel and medium tensile steel.
B.S. 4190:	ISO metric black hexagon bolts, screws and nuts.
B.S. 4320:	Metal washers for general engineering purposes.
B.S. 4360:	Weldable structural steels.
B.S. 4395:	High strength friction grip bolts and associated nuts and washers for structural engineering
	Part 1: General Grade.
	Part 2: Higher Grade bolts and nuts and general grade washers
B.S. 4570:	Fusion welding to steel castings.

B.S. 4604:	The use of high strength friction grip bolts in structural steelwork (Metric series).
	Part 1: General Grade.
	Part 2: Higher Grade (parallel shank)
B.S. 4848:	Hot rolled structural steel sections.
	Part 2: Hollow sections
	Part 4: Equal and unequal angles
	Part 5: Bulb flats
B.S. 4870:	Approval testing of welding procedures.
	Part 1: Fusion welding of steel
B.S. 4871:	Approval testing of welders working to approved welding procedures
	Part 1: Fusion welding of steel.
B.S. 4872:	Approval testing of welders when welding procedure approval is not required.
	Part 1: Fusion welding of steel
B.S. 4929:	Steel hexagon prevailing-torque type nuts.
	Part 1: Metric series.
B.S. 4933:	ISO metric black cup and countersunk head bolts and screws with hexagon nuts.
B.S. 5135:	Metal arc welding of carbon and carbon manganese steel.
B.S. 5493:	Code of practice for protective coating of iron and steel structures against corrosion.
B.S. 5950:	Structural use of steelwork in building (Parts 1, 2, 3, 4, 5 & 8).
B.S. 6223:	Seamless and welded steel tubes for automobile, mechanical and general engineering purposes (Parts 1, 2, 3, 4, 5, 6, 7 & 8).
B.S. 6363:	Welded cold formed steel structural hollow sections.
B.S. 7079:	Part 0: Preparation of steel substrates before application of paints and related products.
	Part A1: Rust grades and separation grades of uncoated steel substrates and of steel substrates after overall removal of previous coating.
	Part A1: Supplement 1: Photographic examples of the change of appearance imparted to steel when blast cleaned with different abrasives.
B.S. 7084:	Carbon and carbon manganese steel tubular cored welding electrodes.

1.3.9 Materials and workmanship

The structural steel used shall comply with the latest edition of the relevant British Standards and evidence of this shall be provided if required to the Employers Representative. All material and workmanship shall be to the satisfaction of the Employers Representative or the welding inspector who are empowered to attend the Works at which the steel is being fabricated during working hours. Any material or workmanship condemned by them during manufacture or after delivery shall be replaced to the Employers Representative's satisfaction at the Contractor's cost.

Other materials used in association with steelwork shall conform to the appropriate Irish Standard where this exists, otherwise to the appropriate British Standard except where it may conflict with or differ from any relevant by-law or regulation.

1.3.10 Test certificates

Manufacturer's test certificates for all steel used for the work shall be supplied to the Employers Representative. Where steel is ordered direct from rolling mills, copies of rolling mill orders shall also be provided.

1.3.11 Connections and other works

In addition to supplying and erecting structural steel members of the sizes set out on drawings, the Contractor will be required to design, provide and erect complete, based on the Employers Representative's drawings all necessary cleats, cover plates, gussets, stiffeners, caps etc., as well as rivets bolts and welds that are required to erect the structural steel framework as a complete and finished unit in accordance with this Specification. The design of all steelwork details shall conform to the current edition of B.S. 449 or B.S. 5950 and appendices thereof. Where the Employers Representative's drawings indicate the loads on the members at the connections, the Contractor shall design the connections and complete the details. Where no loads are shown, the Contractor shall request the Employers Representative in writing for same. Failure to do so and any consequential losses arising therefrom shall be borne by the Contractor.

Welded connection shall be designed for the actual load in the member or a minimum load of 50 KN (5 tonnes) whichever is the greater.

Bolted connections shall have at least two bolts of minimum diameter 16mm.

The ends of beams, etc., fitting into others shall be finished true and square and the cleats flush or proud with the ends of the webs. Clearances shall not exceed 3mm.

Generally, all shop connections shall be welded. Site connections are to be bolted. The attention of the Contractor is drawn to the need to consider the effect on the stresses at the connections due to the rigidity given by welding in the case of welded shop connections.

At all splices in stanchions & beams, web and flange splice plates are to be provided. If at a stanchion splice there is a change in depth and type of section a division plate with adequate angles shall be used in place of the web splice. No stanchion or beam splices shall be permitted unless approved by the Employers Representative prior to fabrication.

Where members are to be cambered the amount will be specified on the drawings. The method of providing the camber shall be agreed with the Employers Representative.

1.3.12 Welded connections

The dimensions of all welds shall be clearly shown on the workshop drawings and the length of the weld specified shall be the minimum and shall exclude the end run-out of the weld.

Tests of welds when required by the Employers Representative shall be made in accordance with B.S. 709 and acceptance levels shall be in accordance with Appendix 'H' of B.S. 5135:1984. The acceptance levels shall be category "B" for fillet welds and category "A" for butt welds as defined in Appendix 'H'.

1.3.13 Bolted connections

At all bolted connections, the reduced sectional areas of the members are to be computed in accordance with B.S. 449 or B.S. 5950 and the connection shall be strengthened if so required.

1.3.14 Handling and storing material

The Contractor shall be responsible for the off-loading and storage of all materials and plant required for his contract.

Material to be stored shall be placed above the ground upon platforms, skids or other supports. It shall be kept free from dirt, grease, and other foreign matter and properly drained and protected as far as practicable from corrosion. Girders and beams shall be placed upright and shored. Long members, such as columns and chords shall be supported on skids placed near enough together to prevent damage due to excessive deflection.

1.3.15 Method and equipment

The Contractor shall submit to the Employers Representative the method of erection he proposes to use and the amount and type of equipment he proposes to use. Both the method of erection and equipment shall be to the satisfaction of the Employers Representative.

The approval of the Employers Representative shall not however relieve the Contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the plans and this Specification.

1.3.16 Supervision and workmen

During the progress of the work the Contractor shall have a competent supervisor in personal charge of the work. Instructions given to the supervisor shall be considered as being given to the Contractor. All work shall be done by skilled, competent workmen.

1.3.17 Straightening material and finish

Rolled materials before being worked, shall be straight. If straightening is necessary it shall be done by methods approved by the Employers Representative. Sharp kinks and bends may be cause for rejection of material.

1.3.18 Cutting

All members shall be perfectly straight and true with square ends after cutting and of the exact final length required by the shop detail drawings. Members shall be cut by cold saw.

All burrs left by cutting shall be removed and sharp arrises are to be lightly ground down. Undercut gusset plates will not be accepted. Sheared plates shall be flattened. Where notches are formed in joists a 13mm radius hole shall be drilled at the angle of the notch and the saw cut run into the hole so formed.

1.3.19 Holing

Holes through more than one thickness of material for members such as compound stanchion and girder flanges shall be drilled after the members are assembled and tightly clamped or bolted together.

When holes are drilled in one operation through two or more separable parts, these parts, when so specified by the Employers Representative, shall be separated after drilling and the burrs removed.

All matching holes for rivets and black bolts shall register with each other so that a gauge 2mm less in diameter than the diameter of the hole will pass freely through the assembled members in a direction at right angles to such members. Finished holes shall not be more than 2mm in diameter larger than the diameter of the rivet or black bolt passing through them, unless otherwise specified. Gas blown holes are prohibited.

1.3.20 Welding

All welding, including preparations shall comply in all respects with the British Standards quoted in Clause 1.3.8. Qualified operatives shall be employed on the work at all times. Welders proficiency certificates shall be furnished for inspection to the Employers Representative if requested. Where welders do not hold approved current proficiency certificates, the Contractor shall submit for approval evidence in accordance with B.S. 4872 of the proficiency of welders for the class of work to be carried out. The Employers Representative reserves the right to indicate the gauge of electrodes and the welding gap to be used. The members to be welded shall not be at a temperature less than 10°C (50°F). Tack welds shall not be greater than the root run to be employed. The length of tack welds which shall be incorporated in the finished work shall be not less than four times the thickness of the thicker plate or 50mm whichever is the smaller. Any cracked tack welds shall be ground out and re-tack welded.

The Contractors attention is drawn to the possibility of an incomplete penetration in a butt weld producing an internal notch-effect. This may provide a point of initiation leading to a fatigue fracture or a brittle fracture under certain conditions of loading and low atmospheric

temperatures.

Testing of welds shall be carried out in accordance with the National structural Steelwork Specification for Building construction publication and BS 5950, Part 2. Key and critical elements such as hangers and trusses shall required 50% of the welds tested with Magnetic Particle Inspection and 100% of the welds visually inspected.

Inspection of welding will be carried out by a testing authority taken from the Specialist list who shall be given all the assistance necessary to carry out their inspection.

If normal methods of inspection such as visual, gauge or light methods fail, then it may be necessary for the Employers Representative to request further and more detailed inspections by means of radiographic or other specialised methods to satisfy himself as to the soundness of the work. Where these are required they shall be identified in Section 2 of the Specification.

Where such tests are required by the Employers Representative as a standard testing procedure prior to acceptance of the work, the Contractor will be separately instructed on this point.

1.3.21 Shearing, Milling and Ending

Except where bolts or rivets carry loads, butt ends of compression members are to be machined to provide contact throughout except for small clearances which shall not exceed 0.125mm.

The ends of stanchions and compression members shall be machined to a uniformly flat surface at right angles to the axis or such other angles as might be indicated. This machining shall be carried out with the angle cleats and gussets on the end of the shaft fixed in their permanent position.

Where a load is transmitted by a direct bearing, stanchion base and cap plates and splice division plates shall be machined to a uniformly flat surface so that the permitted stress in bearing is not exceeded nor eccentricity of loading created.

The edges and undersides of slab bases that are to bear on concrete need not be machined if the underside is true and parallel to the upper face. Except where otherwise indicated on the Drawings, web stiffener angles intended as supports for concentrated loads shall be milled, ground or welded to secure an even bearing against the flange angles.

To facilitate grouting, holes shall be provided where necessary to stanchion bases for the escape of air.

1.3.22 Riveting

Rivets before driving shall be to British Standard dimensions and of the diameter specified and shall be free from furnace scale. Rivets shall be heated uniformly throughout their length, without burning or excessive scaling, and shall be of sufficient lengths to provide a head of standard dimensions. When countersunk they shall also completely fill the holes, and any proudness of the otherwise non-defective rivets shall be replaced.

Wherever practicable, machine riveting shall be carried out, using machines of the steady

pressure type. All scale and other foreign matter shall be cleaned off after driving.

1.3.23 Bolting

All bolts other than H.S.F.G. bolts shall be in accordance with B.S. 4190 or B.S. 3692 and have steel washer in accordance with B.S. 4320 under each nut. All bolts and nuts shall be spun galvanised to B.S. 729 to a thickness of 70 microns. The bolt shall project beyond the nut at least 3mm. Tapered washers shall be used to give a true bearing on all sloping surfaces.

The holes for turned bolts shall be reamed and the holes shall be finished to provide a driving fit.

Where a tubular member is drilled to take bolts or studs, provision shall be made to prevent the access of moisture to the interior of the tube. Either a transverse sleeve where a bolt passes through a tube or grommets shall be used under the heads and nuts.

High strength friction grip bolts; nuts and washers shall comply with the requirements of B.S. 4395. The bolts shall be of the load indicating bolt type or have load indicating washers and the torque method or part turn method of tightening shall not be allowed. All bolts and nuts shall be spun galvanised to B.S. 729 to a thickness of 70 microns. All load indicating and hardened steel washers shall be sheradised CLASS 1. Reference shall be made to the manufacturer's instructions on the method of tightening and assessing the value of the applied load. The Employers Representative's approval shall be obtained for the type of friction grip bolt to be used. The areas of metal directly under the washers shall be clear and free of any paint or similar material. Matching surfaces of connections made with friction grip bolts shall be thoroughly cleaned and be free from any paint primer or other foreign matter.

1.3.24 Flattened ends of tubes

For welded, riveted or bolted connections, the ends of tubes may be flattened or otherwise formed provided the methods adopted are such as not to injure or deface the material. The change in section shall be gradual.

1.3.25 Marking

Each and every piece of steelwork shall be clearly and distinctly marked before dispatch in accordance with the Contractors marking diagram.

1.3.26 Erection Programme

The Contractor shall submit details of the erection programme to the Employers Representative at least three weeks before commencement of work. Erection shall be carried out in accordance with a programme and work procedures to be agreed between the Contractor and the Employers Representative.

1.3.27 Assembly

The Contractor shall ensure the accuracy of the workmanship and correctness of the fit of the members.

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers, if any, are provided.

All tubular members shall be sealed so as to prevent the access of moisture to the inside of the members.

Members shall then be assembled with sufficient tack bolts and drifts to register all holes and bring the surfaces closely in contact. Any drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or to distort the metal.

1.3.28 Holding Down Bolts

The Contractor shall supply all necessary holding down bolts or anchorage devices to fix into the foundations. The Contractor shall satisfy himself prior to erection that the foundations have been properly formed and, in particular, that the holding-down bolts have been accurately set and have the full amount of play required.

1.3.29 Drilling

All site holes shall be drilled and the burrs removed. Gas blown holes are prohibited.

1.3.30 Site Welding

In general, site welding shall not be allowed. Where it is desired to use site welding prior written permission shall be obtained from the Employers Representative. All welding, including preparation shall comply in all respects with the British Standards quoted and with Clause 1.3.20 of this Specification for shop welding. Welding shall not be permitted on any surface at or below 0°C (32°F).

1.3.31 Erection

The steelwork shall be set accurately to the agreed lines and levels and shall be absolutely plumb. Measurement shall be verified by the Contractor on site. He is also responsible for correct setting out of the steelwork as the work progresses.

The Contractor shall take full responsibility for the assembly of the steel framing, the lifting of the latter into position and the final connection. Any specific erection requirement shall be stated in the contract documents.

During erection, the work shall be securely bolted or otherwise fastened, and if necessary temporarily braced, so as to make adequate provision for all erection stresses and conditions, including those due to erection equipment and its operation. Neither riveting,

permanent bolting, nor welding shall be done until proper alignment has been obtained. All temporary bracing, ties etc., shall not interfere with the work of other contractors on the site.

The members shall not be permanently connected until a sufficient portion of the structure has been erected and temporarily connected up to ensure that there shall be no straining of members during the erection and lining up of the remainder of the structure.

1.3.32 Tolerances

The permissible dimensional deviations of structural steel elements shall be as follows:-

For any nominally horizontal surface measured from the nearest reference level $\pm 10\text{mm}$.

For any nominally vertical surface measured from the nearest reference line $\pm 10\text{mm}$.

Notwithstanding the tolerances permitted above, the permissible deviation in plumbness of elements shall be 1:500 max. and the permissible deviation in bow shall be 1/1000 max. of the length of the members. The maximum permissible overall deviations for horizontal and vertical dimensions shall not exceed $\pm 1:1000$ or $\pm 30\text{mm}$ whichever is the smaller. Any resulting deviation from these tolerances shall be brought to the attention of the Employers Representative. The Contractor will be responsible for the cost of all corrections required by the Employers Representative to rectify work which is not erected within these tolerances.

1.3.33 Rectangular and Circular Hollow Sections

All hollow sections are to be hot formed hollow sections to B.S. 4360:1990 and B.S. 4848: PT2 1991.

In the case of fixing to hollow section, prevention of ingress of water must be accomplished in the fixing arrangement.

1.3.34 Shear Studs

Proprietary studs used in composite construction shall be the headed type in accordance with B.S. 5950: Part 3: Section 3.1 or similar approved and with the following properties after being formed.

- (i) Minimum yield strength - 350N/mm^2
- (ii) Minimum ultimate tensile strength - 450N/mm^2
- (iii) Elongation of 15% of a gauge length of $5.65 \sqrt{A}$, where A is the area of the test specimen.

1.3.35 Bedding and Grouting

Bases, bearing plates and ends of members which require to be grouted are to be supported at the correct level before grouting by sufficient wedges or packings to avoid local failure or displacement. The wedges or packings are to be left permanently in position. The Employers Representative shall be informed when the stanchions have been lined, levelled and plumbed and are ready for grouting or concreting.

After approval by the Employers Representative, the grouting up under the stanchion bases will be carried out by the Main Contractor.

The bedding space under the bearing plates shall be packed with a non-shrink pre-packed high strength material approved by the Employers Representative having a minimum compressive strength of 50 N/mm² at 7 days at 5°C. The material shall not be used when the air temperature is below 5°C.

1.3.36 Cleaning of structural steelwork for painting

Before painting all steel shall be weathered in accordance with Swedish Standard SIS 055900 to rust grades B or C. Then it shall be shot blasted in accordance with Swedish Standard SIS 055900 to give surface quality Sa 2½ and/or B.S. 4232 or similar approved second quality. Shot blasting shall be carried out in accordance with BS EN ISO 11124- 3:1997, BS 7079-E3:1994 and B.S. 7079-E3 & BS 7079-E4. "Preparation of steel substrates before application of paints and related products; Specifications for metallic blast-cleaning abrasives; High-carbon cast-steel shot and grit" and B.S. 4232 or similar approved. The maximum possible amount of fabrication of the member shall be carried out before shot blasting.

All mill-scale and rust shall be removed to leave the surface suitable to receive a priming coat as specified in Clause 1.3.37.

The maximum profile after shot-blasting shall be 0.05mm and any lamination or surface defects exposed by blasting shall be chipped off and ground flush before priming.

The blast-cleaned surface shall be finally cleaned with a vacuum cleaner, clean dry compressed air or a clean brush, to remove all traces of blast-cleaning products from the surfaces or from pockets and corners.

The surface preparation shall be thorough and the bare metal shall be kept dry and shall be primed as soon as possible and in any case within two hours of shot blasting.

1.3.37 Painting of structural steelwork

Steelwork to be embedded in concrete shall not be painted. Painting shall only be carried out in dry non-humid conditions.

When painting over blast-cleaned surfaces, it is essential that sufficient thickness of priming paint be applied to ensure that high spots of the steel surface are adequately covered. Should inspection reveal that this is not the case, the number of priming coats shall be increased accordingly at the Steelwork Sub-Contractor's cost.

- (a) All steelwork shall be shot blasted to SA 2½. The blast primer shall be applied within 2 hours of shot blasting and after fabrication the steelwork shall be painted, all in accordance with B.S. 5493 as follows:
 - 1. Internal steelwork shall be painted in accordance with Section Two, Table 3 Part 6 for a long period to first maintenance.
 - 2. Steelwork exposed in the cavities of external walls shall be painted in accordance with Section Two, Table 3 Part 7 for a long period to first maintenance.

-
3. External exposed steelwork shall be painted in accordance with Section Two, Table 3 Part 2 for a long period to first maintenance.

(b) Preparation and Spot-priming after Erection:

After erection all damaged areas, all boltheads and other unpainted surfaces shall be thoroughly prepared and carefully spot-primed and allowed to dry overnight prior to painting.

(c) No painting shall take place on site when

- (i) the temperature falls below 4°C (40°F),
- (ii) during periods of inclement weather, and
- (iii) condensation has occurred or is likely to occur on the steel.

It is to be noted that this treatment is a structural anti-corrosion treatment and if the colour of the paint used by the structural Steelwork Sub-Contractor is not suitable for architectural reasons, at least two further coats of paint shall be added to the Architect's Specification. However, should this be required the finishing coat of paint shall be compatible with the anti-corrosion treatment.

1.3.38 Quality of painted steelwork

The Contractor shall be fully responsible for any deterioration of the painted surfaces which may occur before the various sections of the building are handed over to the Employer. Such deterioration may result from poor cleaning of the steelwork, inadequate priming or both and from general wear and tear during delivery and erection. The Contractor shall make good all such damaged areas to the satisfaction of the Employers Representative.

1.3.39 Temporary Works

The term "Temporary Works" shall mean all temporary works of every kind required for the construction and completion of the works; it shall include temporary works to support and ensure the stability of the partially completed permanent works and of adjoining structures and lands, as well as such matters as trench shoring, scaffolding, propping, working platforms, gangways, access stairs and landings.

The Contractor shall be responsible for the design of the Temporary Works. The Contractor shall ensure that the design of all Temporary Works is carried out by a competent Temporary Works Engineer who understands the complexity of the forces involved in temporary works / permanent works interaction, and who can design the temporary works to safely take account of these forces.

The Contractor shall at all stages ensure that the temporary works and any temporary loads applied to the structure during construction do not exceed the design imposed load capacity of the structure. In this respect for new construction work the Contractor shall assume that design imposed loads are in accordance with BS6399 for the category of usage applicable to the area of the structure being considered, unless specifically noted on the construction drawings.

1.3.40 Temporary Stability

The Contractor shall be responsible for the stability of the partially completed, or partially altered structure at all times.

Where the design assumes a particular erection or construction sequence, or requires particular risk control measures, which are unusual for the type of project and which would not be apparent to a competent contractor, these are noted on the construction drawings or other contract documentation.

1.3.41 Connection of Steel Frames to Concrete Cores

Where a steel frame is connected to concrete cores or walls, these cores/walls have been assumed in the design of the permanent works to provide stability to the structure. The design assumes that these cores/walls will be constructed, and will have achieved their design strength, prior to steel erection, and thus are in position to contribute to the stability of the steel frame as it is erected. If the Contractor proposes an alternative erection sequence, which necessitates temporary bracing, he shall be responsible for the design of all such temporary bracing. Any such temporary bracing shall be maintained in position until all permanent cores/walls have been completed and have achieved their design strength, and until all connections of the steel frame to these cores/walls have been completed.

1.3.42 Lateral Torsional Stability of Steel Beams During Construction.

The structure has been designed to accommodate the design loads in its completed state. More onerous loading conditions may apply during construction, which will depend on the Contractor's construction methods and sequence. The Contractor's attention is drawn, in particular, to the fact that the erection of precast units onto steel beams, and the placement of structural topping on such units, will result in unbalanced loading on laterally unrestrained beams. The Contractor's Temporary Works Engineer must check the stability of such beams under all load conditions resulting from his construction methods and sequence and any temporary works necessary to ensure the stability of the beams in the temporary condition must be installed by the Contractor. Any such temporary bracing shall be maintained in position until the beams in question have achieved their full design capacity, which will normally require that any structural topping has achieved its full design strength.

SECTION 1.4 - MASONRY

1.4.1. General

The work shall be carried out in accordance with the requirements of the current edition of the following British Standards together with the instructions of this Specification and any further instructions deemed necessary by the Employers Representative: -

B.S. 5628: Part 1: 1978 "Structural use of un-reinforced masonry".

B.S. 5628: Part 3: 1985 "Materials and components, design and workmanship.

1.4.2 Materials and properties

1.4.2.1 Blocks and Bricks

The minimum standards of concrete blocks, concrete bricks and clay bricks are set out in Clauses 1.4.2.2, 1.4.2.3 and 1.4.2.4. Reference shall be made to the drawings and to Table 13 of B.S. 5628: Part 3: 1985 for higher standards of bricks and blocks required for particular elements of construction as indicated.

1.4.2.2 Concrete Blocks - Solids and Hollow for general use

Concrete blocks shall be of approved manufacture to I.S. 20. All blocks shall have a minimum guaranteed crushing strength of 5 N/mm² and shall comply with special category of manufacturing control in accordance with clause 27.2 of BS 5628: Part 1 : 1978. The block supplier shall supply the Employers Representative with results of his quality control scheme to demonstrate that special category of manufacturing control is being met consistently in practice. Sample blocks shall be tested at a laboratory to be approved by the Employers Representative. Blocks shall be left at least 28 days after casting before being used. All blocks shall be well-compacted and true and square in shape.

1.4.2.3 Concrete Bricks for general use

Concrete bricks shall be of approved manufacture to I.S. 189. All bricks shall have a minimum guaranteed crushing strength of 15 N/mm². Sample bricks shall be tested at a laboratory to be approved by the Employers Representative. Bricks shall be left at least 28 days after casting before being used. All bricks shall be well compacted and true and square in shape.

1.4.2.4 Clay Bricks for general use

Clay bricks shall be of approved manufacture of ordinary quality to I.S. 91. They shall have a water absorption of not greater than 12% and a minimum guaranteed crushing strength of 15 N/mm².

1.4.2.5 Mortar

1.4.2.5.1 General

The mixing and use of mortars shall be in accordance with the recommendations given in B.S. 5390.

1.4.2.5.2 Materials for mortar

- (a) Cement - The cement used in the mortar shall be in accordance with I.S.1 The use of high alumina cement is not permitted.
- (b) Lime - Lime used in mortars shall be non-hydraulic limes to conform to the requirements of I.S.8.
- (c) Sand - The sand shall be free from deleterious substances and shall comply with the requirement for quality and grading of sand for mortar given in B.S. 1200.
- (d) Water - Water shall be free from impurities that are harmful to the mortar. The Contractor shall obtain approval from the Employers Representative of the source of water supply if the supply is not obtained from a public mains supply.

Where the quality of supply is doubtful the water shall be tested in accordance with B.S. 3148 or equivalent.
- (e) Admixtures - Admixtures may only be used in mortar above D.P.C. level, their use being subject to the Employers Representative's approval.
- (f) Colouring Compounds - Colouring compounds shall be added to the mortar if required.

1.4.2.5.3 Preparation of mortars

- (a) Mix Proportions

The following cement-lime mortar shall be used for all walling constructed using masonry units to Clauses 1.4.2.2, 1.4.2.3, and 1.4.2.4.

Mix	Cement	Non Hydraulic lime	Clean washed Siliceous sand
1 : 1 : 6	50Kg	50Kg	0.213 cu.m

Reference shall be made to Tables 13 and 15 of B.S. 5628: Part 3 1985 for mortar mixes to be used in conjunction with higher standard bricks and blocks.

- (b) Batching of mortars

The materials for the mortar shall be measured accurately to conform with the above specified mix proportions either by weight batching or by the use of gauge boxes. The

proportions of sand are based upon the use of dry sand. The Contractor shall adjust the proportions of sand for bulking due to moisture content. If admixtures are used, the proportions shall be further adjusted in accordance with the manufacturer's written instructions.

(c) Mixing of mortars

The mortar shall be mixed by machine which shall be clean before starting to mix. Mortars containing cement shall be used within one hour of the mixing of the cement and water and any mortar not then used shall be discarded and not retempered.

(d) Ready Mixed Mortar

Ready mixed sand-lime mortar shall comply with the requirements B.S. 4721 or equivalent.

1.4.2.5.4 Testing of mortars

Testing of mortars shall be carried out in accordance with Appendix A.1 of BS 5628: Part 1: 1978. Preliminary tests shall be carried out at least six weeks before the masonry building is started. Six specimens of one of the following types:

- (a) 75mm cube
- (b) 100mm cube
- (c) 100mm x 25mm x 25mm prism.

shall be tested for each mortar designation proposed for use on site.

Six specimens of the type used for preliminary testing, shall be tested for every 150m² of wall, using any one designation of mortar, or for every storey of the building, whichever is the more frequent.

The mortar will be deemed to pass if the average of the values for compressive strength at 28 days obtained from three cubes exceeds the appropriate value given in Table 1 of BS 5628: Part 1: 1978.

1.4.2.6 Reinforcement, wall ties and bonding ties

1.4.2.6.1 Bed joint reinforcement

Bed joint reinforcement where shown shall be either of expanded metal complying with the requirements of B.S. 405:1987 or of the tramline or truss type, both approved by the Employers Representative and made from 18/8 Stainless Steel. In the case of the tramline or truss type reinforcement, the rod diameter shall be between 3mm and 5mm.

1.4.2.6.2 Cavity wall ties

Cavity wall ties shall be vertical twist ties made from austenitic stainless steel strip complying with the requirements of B.S. 1449: Part 2 and B.S. 970: Part 4, minimum 18/8 composition and excluding free machining specifications, with end anchorage subject to the Employers Representative's approval and shall conform to the requirements of the Irish Standard for

Wall Ties for Cavity Wall construction and/or B.S. 1243, 1978. The Contractor shall supply the Employers Representative with written evidence from an approved testing authority to show that the wall ties meet the above specification.

1.4.2.6.3 Bonding ties

Metal strips for bonding blockwork and brickwork to concrete shall be austenitic stainless steel (material specification as for cavity wall ties) dovetail slot and anchor ties or their equivalent subject to the Employers Representative's approval. Any remedial fixing of ties to concrete shall be drill fixed to the Employers Representative's approval and shot fixings must not be used. Metal strips for bonding blockwork and brickwork to structural steelwork shall be austenitic stainless steel (material specification as for cavity wall ties) vertical twist ties with one turned down and the other end anchorage subject to the Employers Representatives approval and shall otherwise conform to the requirements of the Irish Standard for Wall Ties and Cavity Wall Construction and / or EN845-1:2003. The turned down end shall be pre-drilled to suit a shot fixing. The type of shot fixing shall be approved by the Employers Representative. The ties shall be 2.5m x 20mm min. size. Metal strips for bonding brick to brick or block to block shall be flat austenitic stainless steel (material specification as for cavity wall ties) 2.5mm x 20mm x 200mm min. long with end anchorage subject to the Employers Representatives approval and shall otherwise conform to the requirements of the Irish Standard for Wall Ties for Cavity Wall Construction and / or EN845- 1:2003. Where hollow block walls are bonded to either concrete or steel work then solid blockwork shall be used locally at the location of all bonding ties.

1.4.2.7 Damp proof courses

Damp proof courses (D.P.C.s) shall be used in accordance with the latest edition of B.S. 5628. D.P.C.s shall be laid on a smooth bed of fresh mortar. Materials for damp proof courses shall be in accordance with I.S. 57: 1972. In laterally loaded walls (e.g. subject to wind loading) the D.P.C. to be used at the base of the wall shall consist of a material which can transmit shear and which has been proven by testing to B.S.I.DD86: Part 1 to permit the joint to transmit tension. The characteristic flexural tension developed between the D.P.C. and mortar is to be not less than 0.5N/mm².

1.4.2.8 Handling and storage of materials

1.4.2.8.1 Cement

Cement shall be stored in such a manner as to ensure that it is not affected by damp and shall be used in the order of delivery.

1.4.2.8.2 Lime

Lime shall be stored under weatherproof conditions on a raised floor or in suitable silos.

1.4.2.8.3 Sand

Sands shall be stored separately according to type so that they will not be contaminated. They shall be stored on a hard self-draining area.

1.4.2.8.4 Metals

Reinforcement and ties shall be protected from becoming contaminated, and reinforcement shall be free from loose mill scale and rust.

1.4.2.8.5 Blocks

Blocks shall be carefully unloaded so as to avoid damage to the units. All blocks shall be stacked on prepared level areas to ensure that the stack is stable and blocks used for fairfaced work shall be protected to prevent the exposed faces from becoming stained or marked. It is essential that blocks are protected from the rain and sun by covering with a suitable protective membrane.

1.4.2.9 Testing

Blocks shall be tested by an approved testing authority. A provisional sum of money is included in the Contract for such testing, which shall be carried out at the direction of the Employers Representative.

1.4.2.10 Precast Prestressed Composite Concrete Lintels

Precast prestressed concrete lintels shall be manufactured and installed in accordance with I.S. 240.

The lintel manufacturer shall forward to the Employers Representative the relevant span/load tables for the lintels and also details and results of regular testing carried out in the works to comply with I.S. 240 and to verify the span/load tables.

1.4.3 Workmanship

1.4.3.1 General

1.4.3.1.1 Dimensions

All walling shall be set out and built to the correct dimensions, thickness and heights shown on the drawings.

1.4.3.1.2 Uniformity

All perpend, quoins, joints, etc., shall be kept strictly true and square, and other angles shall be plumbed and the whole properly bonded or tied together and the bed joints levelled as the work proceeds. Walling shall be built in level lifts. Where the walling is raked back no part shall rise more than 1.2m above the general level.

1.4.3.1.3 Bond

The brickwork and blockwork shall be built to the bond indicated on the Contract Drawings. Where no bond is indicated, the units shall be laid in stretcher bond. Where possible the coursing shall be arranged to allow a full block to be positioned directly beneath a lintel bearing. The Contractor shall leave toothing to provide for the bonding of future work. Where shown on the drawings, the Contractor shall form toothing in existing work to provide adequate bond for new work. For bonding of hollow block walls to concrete or steel work see clause 1.4.2.6.3.

1.4.3.1.4 Cutting

Blocks used for facing shall be cut with a masonry saw. Where it is necessary to cut the blocks wet they shall be allowed to dry before being built into the wall.

1.4.3.1.5 Chases, ducts, openings etc.

The positions and size of the chasings shall be approved by the Employers Representative prior to such work commencing or as indicated on the drawings and shall be carried out neatly using a chasing tool. The Contractor shall form ducts, openings etc., in the walling as the work proceeds. Notwithstanding the above, the depth of the chase shall not exceed 1/3 the wall thickness for vertical chases and 1/6 the wall thickness for horizontal chases. The cutting of opes up to approximately 300mm square in walls to accommodate items of equipment may be permitted. **The cutting of chases in hollow units shall not be permitted.**

1.4.3.1.6 Colour Variation

The Contractor shall distribute evenly throughout any facing work bricks and blocks of varying shades of the same colour. The Contractor shall mix deliveries which vary in colour to avoid contrast between adjoining lifts.

1.4.3.1.7 Weather

No block laying shall be carried out when the temperature is at or below 3°C unless precautions are taken to ensure a minimum temperature of 4°C in the work when laid and thereafter to maintain the temperature above freezing point until the mortar has hardened. Should any walling be damaged by frost it shall be pulled down and made good at the Contractor's expense. Each lift shall be kept dry including the top surfaces until the commencement of the next lift or other superimposed work. Internal blockwork walling shall be protected from rain until such time as the building has been weathered.

1.4.3.1.8 Laying

Each block and brick shall be laid and adjusted to its final position while the mortar is still

plastic. The maximum height of wall built in any one day shall not exceed 1.5m.

1.4.3.2 Mortar Joints

1.4.3.2.1 Bedding

All blocks shall be laid on a full mortar bed. Vertical joints shall be filled. All joints are to be normally 10mm thick.

1.4.3.2.2 Excess Mortar

Any mortar which extrudes from the joint of fairfaced units shall be cut away and on no account is mortar to be smeared onto the face of the block.

1.4.3.2.3 Exposed Joints

Details of the type of finish required in all permanently exposed joints shall be as shown on the drawings.

1.4.3.3 Control Joints

Control joints shall be located as indicated on the drawings. 15mm wide expansion joints shall be provided in clay brickwork with maximum spacing of 12 metres unless noted otherwise. 10mm wide contraction joints shall be provided in concrete brickwork or blockwork at a maximum spacing of 6 metres unless noted otherwise. Joints need not be continued below the ground floor D.P.C. level. The vertical joints between panels or between a panel and another feature shall be straight and shall be produced by terminating alternative courses in full and half units bedded in the normal way. The subsequent sawing of walling to form a contraction or expansion joint shall not be allowed. If the walling is finished with a thick applied finish such as plaster or render, the edge of same shall be either chamfered or alternatively the joint may be covered with an architrave or other strip material, care being taken that the cover strip is fixed to the wall on one side of the joint only to allow relative movement to occur at the joint.

The joint sealing compound shall be an approved sealant and shall be used strictly in accordance with the manufacturer's recommendations bearing in mind joint width, location etc.

The stability of the wall at an expansion joint shall be achieved as indicated on the Employers Representative's drawings without the use of metal ties across the joint. Expansion joints shall be cleaned out to ensure that mortar does not bridge the joint. The gap shall subsequently have a fully compressible material (not fibre-board) inserted into the joint and be pointed up with a joint sealing compound as described above.

1.4.3.4 Double Leaf (Cavity) Walls

1.4.3.4.1 Wall Ties

The walls shall be built with cavities of the width shown on the drawings and tied together

with ties embedded in the mortar at least 50mm. Unless otherwise detailed the ties shall be staggered in alternative courses and spaced in accordance with the following table.

Least leaf thickness (mm)	Cavity width (mm)	Spacing of Ties		No. of ties per sq.m
		Horizontally (mm)	Vertically (mm)	
Less than 90	50 - 75	450	450	4.9
90 or more	50 - 75	900	450	2.5
90 or more	75 - 100	750	450	3.0
90 or more	101 - 150	450	450	4.9

The spacing may be varied provided that the number of ties per unit area is maintained.

Additional ties shall be provided in every course within 225mm of openings and on each side of control joints. Ties shall be laid falling to the external leaf.

1.4.3.4.2 Cavities

The cavity and ties shall be kept clear and clean of mortar droppings or other materials during construction and any extruding mortar shall be struck off flush. No cavity shall be sealed off until inspected and approved.

1.4.3.4.3 Weepholes (cavity walls)

Weepholes 10mm wide by 75mm high, spaced at centres not exceeding 900mm and extending through the vertical mortar joints of the outer leaf, shall be provided at ground level and at positions where the cavity is bridged or at alternative locations indicated on the drawings.

1.4.3.5 Partition Walls

Partition walls shall not be built on suspended slabs until after the props have been removed.

1.4.3.6 Reinforcement

1.4.3.6.1 Bed Joint Reinforcement

Bed joint reinforcement shall have an effective side cover of mortar of not less than 20mm and shall be continuous except at control joints, or where otherwise indicated. Bed joint reinforcement shall be positioned as shown on the drawings. Sufficient mortar shall be used in the joints in which the reinforcement is bedded to ensure that the whole surface of the steel is in contact with mortar to provide adequate bond and protection against corrosion.

1.4.3.7 Protection

1.4.3.7.1 Stability

The Contractor shall ensure the stability of all walling including non-load bearing and non-structural partitions during erection. These partitions can be subjected to severe wind loading if the construction sequence allows major openings to be left in the building outer envelope during or after construction of the partitions. The Contractor's Temporary Works Designer must ensure that stability of the partitions is maintained at all stages. The Contractor shall also take precautions to ensure stability of walls during backfilling and concreting operations.

1.4.3.7.2 Finished Work

The tops of constructed walls shall be protected from rain and in addition fairfaced work shall be protected against staining from construction activities.

1.4.3.8 Making Good

At the completion of the work all temporary holes in mortar joints of fairfaced work shall be filled with mortar and suitably tooled. Any damaged walling shall be repaired with approved materials or replaced.

1.4.3.9 Tolerances

The permissible deviation for walls shall be as follows:-

- (a) Level: $\pm 10\text{mm}$ for dimensions to any nominally horizontal surface measured from the nearest reference level.
- (b) Position on Plan: $\pm 10\text{mm}$ for dimensions to any nominally vertical surface at the lower edge measured horizontally from the nearest reference line.
- (c) Plumbness: $\pm 5\text{mm}$ in any 1 meter nor more than 20mm for plumbness.
- (d) Straightness: $\pm 10\text{mm}$, measured horizontally.
- (e) Joint thickness:
 - (i) horizontal joints - joint thickness $\pm 3\text{mm}$
 - (ii) vertical joints - joint thickness $\pm 3\text{mm}$.

1.4.3.10 Masonry Support Angles

All steel angles supporting external masonry shall be austenitic stainless steel minimum 18/8 composition type 304 (18% chromium content, 8% nickel content) to the dimensions and thickness shown on the drawings.

All proprietary support lintels shall also be of austenitic steel as above.

SECTION 1.5: SITE CLEARANCE AND EARTHWORKS

1.5.1 Demolition and site clearance

Buildings, other structures and pipelines shall be demolished and removed from the site where shown on the drawings or where instructed by the Employers Representative.

The Contractor shall uproot and dispose of hedges and brushwood where shown on the drawings or where instructed by the Employers Representative. All hedging, brushwood etc. within the works area shall be removed as required to complete the works regardless of the extent shown on the Drawings and the Contractor shall be deemed to have included for this in the Contract Sum.

Where indicated on the drawings or directed by the Employers Representative, trees shall be uprooted or cut down close to ground level and removed from the site. Stumps and tree roots shall be grubbed up and removed from the site. Where directed by the Employers Representative the voids resulting from tree root removal shall be filled with approved excavated material in 225mm consolidated layers. The Contractor is deemed to be responsible for the removal of all necessary existing trees located in the works area and shall be deemed to have included in the Contract Sum for all tree clearance and removal.

1.5.2 Remove topsoil

Topsoil at sites for the various constructions shall be removed for a depth of 225mm or such other depth as instructed by the Employers Representative and carefully set aside separately from other material for reuse in filling as directed.

1.5.3 Excavation

Excavation shall be carried out in accordance with BS 6031 "Code of Practice for Earthworks". The Contractor shall submit to the Employers Representative proposals of the method and lines along which he proposes to excavate, so that the Employers Representative may review his proposals. The Employers Representative's consent to his proposals however, will not relieve the Contractor of his responsibility. Before commencing any excavation work the Contractor shall acquaint himself with the location and nature of all existing underground services by reference to all available drawings and other documents and by the excavation of trial holes and trial trenches and by consulting with the relevant service authorities to ascertain the exact location of all such services. The excavation shall be carried out to the dimensions; levels, lines and profiles indicated on the Contract Drawings or to such other dimensions as may be directed in writing by the Employers Representative. The excavations shall be performed in whatever material may be found.

Provision is made in the Pricing Document for the Contractor to price for the excavation of rock, artificial hard material, topsoil or other material. Rock is defined as natural material which, in the opinion of the Engineer, can be removed only by the use of compressed air plant, blasting, wedging or other quarrying methods and which occurs in continuous beds, exceeding 75mm in thickness or boulders exceeding 1.0m³ in volume in the case of

earthworks and 0.25m³ in volume in the case of trench excavation for pipework. Soft surface rock or the soft top of hard rock or rock so adequately divided by cleavage planes as to allow excavation without the use of specialised rock breaking equipment shall be classified as other material. Soft surface rock or the soft top of the hard rock or rock adequately divided by cleavage planes as to allow excavation without the use of specialised rock breaking equipment shall be classified as other material.

It should be noted that the practical constraints of rock excavations within a trench may preclude the use of conventional ripping equipment. In such circumstances the use of conventional rock breaking equipment would be required.

Artificial hard material is defined as concrete, brickwork, blockwork or masonry exceeding 75 mm in thickness, which cannot be loosened or broken down by picks or crowbars or by normal excavating machinery. Topsoil is defined as the organic soil on the natural surface of the ground not exceeding 300mm deep when this is required to be separately excavated. Other material is defined as any material not classified as rock, artificial hard material or topsoil.

In all cases of dispute as to the classification of any material to be excavated the Engineer alone will decide and his decision will be final and binding.

The use of explosives for rock or other excavations will not be permitted at any part of the Works (see Clause 1.1.9).

The Contractor shall include for getting out the excavated material by hand or machine and for levelling and ramming surfaces prior to commencing any constructional work.

The faces and beds of all excavations, having been excavated to the required dimension, shall be carefully trimmed to the required profiles and levels and cleaned of all loose mud, dirt and other debris. The bottom 150mm of materials in the beds of excavation shall not be removed until immediately prior to the execution of the permanent work.

No excavation shall be refilled or built upon until the formation has been inspected and approved by the Employers Representative. Where the Contractor excavates below the required level in good ground, he shall make up the void in concrete (Mix A).

Mechanical excavation will not be permitted for pile caps where there is any possibility of the excavation bucket striking the protruding length of pile and thereby causing damage to the piles.

1.5.4 Bad ground

If the Contractor encounters unsuitable ground at the formation level of foundations, he shall excavate same to a solid foundation, and shall fill up such excavation with mass concrete or approved fill properly compacted as may be determined by the Employers Representative.

1.5.5 Removal of excavated material

No excavated material suitable for or required for re-use in the Works shall be removed from the Site except on the instruction, or with the permission of the Employers Representative.

1.5.6 Disposal of surplus excavated material

Disposal of surplus excavated material from the site shall comply with the requirements of the Waste Management Act 1996 – 2011 and the associated regulations and it shall be removed from the site to a tip to be provided by the Contractor. The Contractor shall refer to Section 2.1 herein for particular requirements in this regard. The site shall be kept as free as possible from accumulations of surplus excavated material.

1.5.7 Filling

Filling shall be carried out in accordance with the requirements of B.S. 6031 except that backfilling of pipe trenches shall be carried out as specified in Clause 1.6.21. Filling shall, wherever practicable, be undertaken immediately the specified operations preceding it have been completed. Filling shall not, however, be commenced until the works to be covered or adjoining works have achieved a strength sufficient to withstand all loading imposed thereon.

Filling of excavations, other than under slabs on grade, shall be carried out in layers of compacted thickness appropriate to the fill material and type of plant used, as set out in Table 4 of BS 6031. Filling shall be carried out using suitable excavated material or suitable imported material. All filling under slabs on grade shall be carried out using hardcore in accordance with Clause 1.2.28. If none of the excavated material is suitable, in the opinion of the Employers Representative, it shall be removed from the Site and approved imported material shall be used for filling. The fill material shall be carefully placed around foundations, etc., and shall be thoroughly consolidated with care being taken to prevent any damage being caused to the Permanent Works. No filling shall be deposited until all silt, mud or other soft material has been removed from the excavations.

Each layer of fill shall be thoroughly compacted in accordance with Clause 1.5.8.2 before the succeeding layer is placed.

1.5.8 Fill

1.5.8.1 Materials

(a) General fill

Selected and approved excavated material shall be used for fill but certain additional material may have to be imported. Suitable excavated material shall mean material arising from excavations on site, which complies with the requirements of Class 1 or Class 2 Materials in accordance with Table 6/1 of the "Specification for Road Works" (NRA). General fill material shall be classified and grouped in accordance with Clause 601 of the "Specification for Road Works" (NRA).

Suitable imported general fill material shall consist of material complying with the requirements of Classes 6A to 6P of Table 6/1 of the "Specification for Road Works" (NRA). The particular class of material shall be appropriate for the filling application as defined by the "Typical Use" column of Table 6/1, to the approval of the Employers

Representative.

(b) Fill under structures

Fill under structures shall be hardcore complying with the requirements of Clause 1.2.28.

1.5.8.2 Workmanship

The areas over which permanent embankments or other areas of fill are to be constructed shall be stripped of topsoil or other soft material unless required to do otherwise under the Contract.

Filling shall be carried out in accordance with B.S. 6031 "Code of Practice for Earthworks" and with the "Specification for Road Works" (NRA.). Sample loads of excavated material, which is intended for filling under roads and embankments, shall be submitted to an approved laboratory for testing. Soil samples shall be taken in accordance with Section 4 of B.S. 5930: 1999: "Code of Practice for Site Investigations". The Contractor will be notified, after receipt of laboratory test results, of

(a) Approved type of filling materials.

(b) Moisture content at which filling material shall be placed for compaction.

The Contractor shall not change the source of filling without the prior approval of the Employers Representative. Filling shall be spread and levelled in layers of thickness appropriate to the type of compaction plant used and be so placed that water may drain freely from exposed surfaces.

Material classified as General Fill in Clause 1.5.8.1(a) shall be deposited in accordance with Clause 608 and shall be compacted in accordance with Table 6/1 of the "Specification for Road Works" (NRA). Each layer of earth fill shall be compacted until the dry density of the material is not less than 95%, unless stated elsewhere in the Specification, of the maximum dry density obtained by compacting a sample of the material by the method specified in B.S. 1377 Test 12. The moisture content of the earth fill shall be within $\pm 2\%$ of optimum and shall be adjusted as instructed and all necessary water sprinkling equipment shall be provided for this purpose.

Material classified as **Fill under structures** in Clause 1.5.8.1(b) shall be constructed, laid and compacted in accordance with Clause 802 of the Specification for Road Works (NRA.). Each layer of fill shall be compacted until the dry density of the material is not less than 100% of the maximum dry density obtained by compacting a sample of the material by the method specified in B.S. 1377 Test 12.

The compaction of fill shall be tested as the Work progresses. The type of test to be executed will be B.S. 1377 Test no. 15. The minimum extent of the testing on site shall, where required, be stated in the contract documents and all costs associated therewith shall be deemed to be included in the Contract Sum. Should compaction of any filling be found to be inadequate then the Contractor shall carry out further compaction to the specified degree. -

The Contractor shall reconstruct to the proper level and profile any filled areas, which may

settle or spread during the execution of the work or during the maintenance period.

1.5.9 Topsoil for re-use, soiling and grassing

Topsoil for re-use shall be that removed for a depth of 225mm or such other depth as decided by the Employers Representative, and shall be stock-piled separately and kept free from weeds. Where soil is stored in the form of turves, it shall be treated with lime and stacked in heaps with grass side down until required.

All areas to be grassed shall be filled to the depth required by the Contract (and in no case less than 150mm in depth) with suitable top soil free from all rubbish, large stones, long rooting weeds and other harmful material. It shall be finished to a fine seed tilth, not less than 50mm thick.

At the proper season an approved fertiliser shall be distributed at the rate of 0.05 kg/m² followed by best quality approved grass seed at the rate of 0.06 kg/m², which shall be lightly raked in and lightly rolled if the surface is dry. The seedbed shall be irrigated if the weather is dry. When the grass is about 50mm high it shall be rolled and all surface stones shall be picked. The grass shall then be given its first cutting with mower blades set high.

If by the end of the maintenance period or within six months of sowing the seed, whichever is the later, bare patches are present in the grassed area, these shall be re-seeded. A suitable selective weed killer shall be applied when the grass has become established and the grass shall be mown at two weekly intervals either until the Works are completed, or until two months after the grass has been given its first cutting, whichever is the later.

1.5.10 Restricted use of plant

If for any reason the Employers Representative is of the opinion that it is undesirable that any excavator, mechanical digger or other plant should be used by the Contractor for the purpose of excavation or that any such plant is unsuitable for use on the Works or any part of them, the Employers Representative may instruct the Contractor not to use and/or to remove the plant from the site.

1.5.11 Keeping excavations free from water

The Contractor shall keep all excavations free from water at all times unless permitted to do otherwise by the Employers Representative. The Contractor shall provide, operate and maintain a system satisfactory to the Employers Representative of adequate pumping plant, temporary drains, sumps, well points and de-watering equipment as may be necessary to keep water out of the excavations. Water shall not be discharged to watercourses but shall be conveyed from the Works to an approved disposal point in such a manner as to avoid any nuisance, pollution or damage to roads, ditches, streams, rivers, etc. or private property and it shall not be pumped into any service without the Employers Representative's approval.

All temporary work for the control of water shall be sited outside the area excavated for the Permanent Works, except where temporary sub-drains under the works are approved by the

Employers Representative. Any drainage sumps required shall be re-filled with "Mix A" concrete to the level of the underside of the adjacent Permanent Works.

Where temporary drains are permitted they shall be laid in a narrow trench or gripe formed below the bottom of the excavation in an approved position. The pipes shall be open jointed and shall be surrounded with a minimum of 75mm of Type A bedding material. Grouting pipes shall be inserted in the line of temporary drains at intervals not exceeding 25m. On completion, the drains shall be solidly filled with a 1:10 cement-sand grout and the grout pipes shall be cut off.

The Contractor shall take all necessary precautions to prevent any adjacent ground from being adversely affected by loss of fines through any de-watering process. If the Contractor employs sump pumping, well point dewatering, etc., he shall provide filters on the suction side of the pump and silt traps on the delivery side. The rate of dewatering shall be monitored and controlled in order to avoid causing distress to adjoining structures.

The Contractor will not be permitted to carry out any concreting or other constructional work unless the excavations are dry and the excavations shall be kept free from water until the concrete has set sufficiently so as not to be damaged by water.

1.5.12 Safeguard excavations

The Contractor shall provide whatever supports are deemed necessary to support the sides of excavations so as to ensure the safety of workmen, freedom from damage of any structures or services and to prevent any movement of adjacent soil. The Contractor shall be responsible for the design, sufficiency, stability, maintenance and safety of the temporary works.

The Contractor shall be deemed to have included in his tender price the cost of supplying and fixing all necessary timbering, sheet piling, steel sheeting, strutting, shoring, etc., required for the above. All such supports shall be maintained until the constructional work is sufficiently advanced to permit the timbering, etc., to be withdrawn. The Contractor shall also be deemed to have included the cost of removing or leaving in place where necessary any such timbering, steel sheeting, sheet piling etc., from the excavations as the work progresses.

All other sheeting and bracing shall be removed in such a manner as not to endanger the Permanent Works or other structures or properties whether public or private. All voids left or caused by the withdrawal of sheeting shall be immediately refilled and rammed and shall be watered if so directed.

Any bridges, railways, buildings, walls, sewers, culverts, mains, cables, etc., likely to be damaged by the excavations shall be properly supported and the Contractor shall be held responsible for any damage arising in this connection. The Contractor shall be responsible for any damage to the Permanent Works due to inadequacy of timbering, etc, and any other consequential damage caused by the removal of timbering, steel sheeting or other supports from excavations.

Note : The following clauses 1.5.13 to 1.5.15 inclusive, relate to general reinstatement of roads and other surfaced areas. The Contractor shall refer to Section 2.3 for specific reinstatement details for pipe trenches.

1.5.13 Reinstatement of Road Base and Sub-Base

Backfilling of subgrade up to formation level (i.e. underside of sub-base) shall be carried out in accordance with Clauses 1.5.7 and 1.6.21 of this specification.

The sub-base shall be reinstated using material in accordance with Clause 804 of the "Specification for Road Works" (NRA) and shall be constructed in accordance with Clause 1.10.8 of this specification.

The roadbase shall be reinstated using one of the four materials and methods specified in Clause 1.10.9 of this specification.

Total thickness of road base and sub base shall be as shown in the drawings or the combined thickness of the existing road base and sub base whichever is the greater. The top of the road base is to finish not higher than 75mm down from the finished surface of the road.

1.5.14 Temporary reinstatement of surfaces and maintenance of same

The Contractor shall be responsible for the temporary reinstatement of all surfaces interfered with by him and shall maintain same to the satisfaction of the Employers Representative until such time as the permanent reinstatement is carried out.

Temporary reinstatement of road carriageway surfaces and within 1m of the edge of roadways shall be as specified in Section 1.10 and Clauses 1.6.32 and Section 2 of this Specification.

Where the excavations are through grass surfaces the topsoil and sods shall be replaced and compacted in their original position and any subsidence shall be made good from time to time as required. Reinstatement shall be carried out in accordance with Clause 1.6.36.

The tender price quoted by the Contractor for breaking up and temporary reinstatement of public roads and breaking up temporary and permanent reinstatement of footpaths shall include neatly cutting the edge of all excavations with a mechanical saw, breaking the surface and reinstatement of road base and surface as described in this clause. The rate quoted for reinstatement shall include for completing the joint between the existing and newly reinstated surface by painting the joint with 50 or 70 PEN hot bitumen or cold applied thixotropic bitumen compound to B.S. 4981 Part 2: 1988 A2 Sealant. It shall also include for maintenance of the surface, including topping up with bituminous material in the case of any subsidence or pot holing and attendance to same during weekends and holiday periods to maintain the surface as necessary.

1.5.15 Permanent reinstatement of surfaces

The permanent restoration shall not be carried out until all subsidence has ceased. The

Contractor shall carry out permanent restoration of all grass surfaces. All replaced sods shall be finally levelled by lifting and adding fine loam as necessary underneath. All damaged areas shall be cut out and replaced with a 150mm layer of loam and reseeded in accordance with clause 1.5.9 or alternately resodded.

The Contractor shall carry out the permanent reinstatement of all road and carpark surfaces (other than public road surfaces, see Clause 1.6.34) as follows. The permanent restoration unless shown otherwise shall consist of a 50mm thick base course of 20mm size Dense Basecourse Bitumen Macadam and a 40mm thick wearing course of 14mm size Close Graded Wearing Course Bitumen Macadam. The specification for material, method of laying etc. shall be as described in Clause 1.10.10 of this Specification.

SECTION 1.6: PIPEWORK CONSTRUCTION

1.6.1 Types of pipes

The Contractor shall construct the pipelines using the designs of pipe, bed, haunch and surround set out in the Works Requirements.

'Rigid pipes' shall mean pipes of cast or spun iron, concrete, clay or similar materials.

'Flexible pipes' shall mean pipes of steel, PVC, GRP, HDPE, HPPE or other plastic, pitch fibre, ductile iron or similar materials.

'Rigid joints' shall mean joints made by bolting together flanges integral with the barrels of the pipes, by welding together the barrels of the pipes, by caulking sockets with non-deformable material, such as cement mortar, or by similar techniques.

'Flexible Joints' shall mean joints made with factory-made jointing materials, loose collars, and rubber rings etc., and which allow some degree of flexing, however small, between adjacent pipes.

1.6.2 Excavation and backfilling of pipe trenches

Trench excavation, including temporary support, shall be carried out in accordance with the requirements of BS 6031 "Code of Practice for Earthworks".

Top soil shall be stripped, laid aside and kept separate from other excavated materials. Where directed, turf shall be stripped by hand and carefully stacked. Road bottoming and surfacing material which is approved as suitable for re-use shall be laid aside and kept separate from other excavated materials.

Trenches for pipes, other than those forming part of a field or french drain, shall be excavated to a sufficient depth and width subject to the restriction in Clause 1.6.3, to enable the pipe and the specified or other approved joint, bed, haunch and surround to be accommodated.

The bottoms of all trenches shall be of such width as to provide at least 150mm clearance between the barrels of the pipe and the excavation or timbering or such greater clearance as may be necessary to accommodate the concrete surround of the thickness prescribed and within the limits of widths shown hereunder in this clause or such other widths shown on the drawings for a height up to a minimum of 300 mm above the top of the pipe barrel. Battering the sides of trenches shall only be permitted above this level (i.e. 300mm) in fields and open country where approved by the Employers Representative and the toe of the slope shall be set back not less than 300mm from the vertical face of the trench.

Where rock or boulders are present in pipe trenches the sides of the trench shall be so trimmed that when the pipe is laid to the correct level and alignment no projection of rock comes within 100 millimetres of the outside of the pipe barrel at any point and the trenches shall be excavated to sufficient depth so that no rock comes within 150mm of the underside of the pipe.

Trenches for pipes carrying water under pressure, except where otherwise specified in the

drawings or specifications or where otherwise required by the Employers Representative, shall be excavated to a sufficient depth to ensure, after consolidation of the refilling, a normal minimum depth of cover of 1.0m from the ground surface to the top of the pipe. Gravity pipelines carrying sewerage shall have a minimum depth of cover from the ground surface to the top of the pipe of 1.2m. Pressure pipelines carrying sewerage shall have a minimum depth of cover from the ground surface to the top of the pipe of 1.0m. Where the pipeline is required to be laid to a level which does not permit this condition to be fulfilled the ground surface shall be made up locally with banking, or the pipe shall be protected by concrete encasing 150mm thick as described in Clause 1.6.10, or otherwise as directed by the Employers Representative.

The Contractor shall fill up with well compacted Type A granular bedding material or with Mix A concrete where ordered by the Employers Representative, any excessive depth of trench below the proper level arising from his method of working.

Where directed trenches close to existing structures shall be opened in short lengths and refilled or partly filled with Mix A concrete or other approved material.

The material excavated in forming pipelines shall, if unsuitable for backfilling, be disposed of and replaced with suitable material. Suitable material shall be set aside for use as backfill and shall be protected to prevent it from becoming unsuitable.

From the bottom of the trench to a level 300mm above the crown of the pipe the trench width shall not be less than 300mm plus the external diameter of the pipes. All sheeting and supports shall be outside this width. Trenches for pipes shall be cut to a sufficient width to allow the pipes to be easily and properly jointed but not to a greater width than is necessary in the opinion of the Employers Representative. The Contractor shall either provide a higher strength of pipe or provide additional means of strengthening or protecting the pipe (by bedding, surround, etc), if the width of the pipe trench be exceeded from the specified design width due to his method of working. The nominal trench width shall be taken as 500mm plus the internal diameter of the pipe for pipes not exceeding 1m in diameter and 750mm plus the internal diameter of the pipe for pipes of diameter greater than 1m. In certain unforeseen ground conditions, e.g. rock or poor ground where overbreak might be reasonable foreseen, the following maximum trench widths will be acceptable :

Nominal pipe diameter (mm)	Nominal Widths (mm)	Maximum trench width (mm)	Nominal pipe diameter (mm)	Nominal Widths (mm)	Maximum trench width (mm)
100	600	750	700	1200	1600
150	650	800	750	1250	1600
200	700	900	800	1300	1900
225	725	900	825	1325	1900
300	800	900	900	1400	2200

375	875	1200	1000	1750	2300
400	900	1200	1050	1800	2300
450	950	1300	1100	1850	2400
500	1000	1400	1200	1950	2500
525	1025	1400	Above 1200		Pipe diam plus 1500mm
600	1100	1500			
675	1175	1600			

1.6.3 Pipelaying in bad ground

If bad ground such as peat, mud, silty ground, soft alluvial clays, filled ground etc. is found at or below trench formation level the Employers Representative shall be notified before any pipes are laid. Where the trench formation is in ground which, in the opinion of the Employers Representative, is too soft to afford proper support to the pipes, one of the following construction methods, as directed by the Employers Representative, shall be adopted.

- (i) The trench shall be excavated down to solid ground and the extra depth shall be refilled with either Mix A concrete, Type A granular bedding material in accordance with Clause 1.7.15, gravel or broken stone, as the Employers Representative directs, well compacted to form an even bed.
or
- (ii) The pipes shall be supported by fascinets, piles or such other means as the Employers Representative directs.
or
- (iii) The trench shall be over excavated to an approximate depth of 600mm to 800mm below formation, as the Employers Representative directs, and a firm trench bottom achieved by refilling with gravel or small hardcore carefully compacted in layers and covered with a 50mm concrete screed. The thickness of the pipe bedding material shall not be less than 200mm when pipes are laid over the concrete screed. In water logged ground both the gravel or hardcore foundation and the pipe bedding and surround material shall be wrapped in geotextile material of the correct pore size to hold back fine material which may be washed out of the surrounding ground.

In the case of highly compressible material such as peat only method (i) or (ii) described above shall be used.

The Contractor shall avoid unduly disturbing the finished trench formation and shall make good disturbed areas and excavate any wet or puddled material which might result from his failure to do so. Voids shall be made good as for soft ground as described above. When trench dewatering is required prior to and during pipeline installation in bad ground, well point dewatering shall normally be used and suitable filters shall be used to prevent continuous removal of fine sands and silts. Steel or timber trench supports shall normally be used in

preference to proprietary movable shoring systems, and they shall be driven and extracted with the use of vibratory hammers.

1.6.4 Pipelaying - General

Pipelaying shall be carried out in general accordance with the requirements of BS EN 752.

Where pipes are to be laid to gradients appropriate means (sight-rails, laser) of ensuring correct falls shall be employed.

Flat braided steel wire slings or band slings shall be used for slinging all pipes except externally coated pipes and plastic pipes for which only special band slings not less than 300 millimetres wide shall be used. Chain or rope slings, hooks or other devices working on scissor or grab principles shall not be used.

Subject to the requirements of inspection before acceptance, protective bolsters, caps or discs on the ends of flanges of pipes, specials or fittings shall not be removed until the pipes, specials or fittings are about to be lowered into the trench.

Before a pipe is lowered into the trench, it shall be thoroughly examined to ensure that the internal coating or lining and the outer coating or sheathing are undamaged. Where necessary the interiors of pipes, specials and fittings shall be carefully brushed clean. Any damaged parts of the coatings or linings shall, before a pipe is used, be made good as directed.

Pipelaying shall not commence until the bottom of the trench and the pipe bed have been approved. Pipes shall be laid with the socket leading uphill.

Flexible pipes, rigidly jointed, may be joined on the ground surface before being lowered into the trench. All joints shall be supported by slings as the pipes are lowered and the pipeline shall not be deformed to a greater extent than that recommended by the manufacturer.

Pipes shall be brought to the correct alignment and inclination, concentric with the pipes already laid.

All pipes less than 600 millimetres in diameter with flexible joints shall be accurately marked prior to laying to ensure that the correct gap is left in the joint.

PVC pipes should be handled and installed as recommended by the manufacturer. Normally PVC pipes should be loaded and unloaded by hand and the use of skids should be avoided. Where mechanical handling of PVC pipes is employed every precaution should be taken to ensure that the handling methods and equipment used do not damage the pipes or subject them to stresses which will induce permanent set or ovality.

PVC pipes shall always be laid down gently and should never be dropped on a hard surface. Pipes at the top of a stack should always be the first to be removed. PVC pipes should be stored on site on a level surface free from stones or sharp objects and a layer of sand not less than 50 mm should be spread evenly over the storage area. The stacks should not be more than 1 meter high with the sockets, if any, protruding at opposite ends of alternate layers. PVC pipes of different sizes and classes should be stacked separately.

Rubber rings, gaskets etc., must be stored in a cool, dry, dark place, safe from contamination by oils, petrol or grease. Cement and lubricant must be kept in tightly closed containers.

PVC Pipes shall be protected from the effects of temperature in accordance with the manufacturer's recommendations and shall not be laid in freezing temperatures.

1.6.5 Withdrawal of supports

During the placing of bedding, haunching, surrounding or anchoring material, temporary side supports and sheeting shall be removed except where directed to be left in and the full width of the trench shall be infilled with bedding, haunching, surrounding or anchoring materials.

1.6.6 Bedding and protecting pipes

Bedding, haunching, surrounding and anchoring pipes shall be of the arrangements and dimensions shown on the drawings and as described in clauses 1.6.7, 1.6.8, 1.6.9, 1.6.10 and 1.6.11.

A cavity of adequate size shall be excavated in the sides and bottom of the trench or left in the pipe bed at each joint and at each sling position.

The bottom of the trench or surface of the bed shall be finished to a smooth even surface at the correct levels to permit the barrel of the pipe to be solidly and evenly bedded throughout its whole length between joint and sling holes.

The preparation of the trench bottom or surface of the bed shall be completed for at least one full pipe length in advance of the pipelaying, except where in exceptional circumstances another arrangement is approved.

No bedding material shall be placed in trenches containing water.

Where granular bedding is to be used, stones, bricks or similar materials shall not be used below or against the pipes to locate them in position in the trench or to level the pipes. Sufficient volumes of the infill materials shall be placed around the barrels of pipes to prevent movement.

Where pipes are to be laid on a concrete cradle or where pipes are surrounded in concrete, the concrete under and around the pipes shall be laid in a single operation. Precast concrete blocks shaped to the barrel of the pipe with one block at the back of each socket shall be used to support the pipes before the concrete is placed.

After each block has been properly set and boned in to the correct level a padding of two layers of compressible material shall be placed between the supporting blocks and the barrel of the pipes and the pipes laid on them and properly centered and jointed.

The plan areas of the supporting concrete blocks for the different diameter pipes shall be as follows unless otherwise directed by the Employers Representative

<u>Pipe Diameters</u>	<u>Areas of Supporting Block</u>
Pipe diameters up to 300 mm	0.10 m ²
Pipe diameters between 375 mm & 525 mm	0.15 m ²
Pipe diameters between 600 mm & 900 mm	0.30 m ²
Pipe diameters between 1050 mm & 1350 mm	0.60 m ²
Pipe diameter 1500mm	2 x 0.5 m ²
Pipe diameters between 1800 mm & 2100 mm	2 x 0.6 m ²

For pipe diameters greater than or equal to 1500mm concrete support blocks shall be provided at both ends of each pipe. These support blocks shall have flat tops and be used with steel shims / wedges.

The cost of the pipe supports are deemed to be included in the Contract Sum.

Where dictated by the requirements for testing pipelines the method of haunching and surrounding pipes shall be modified to leave pipe joints exposed.

1.6.7 Hand trimmed bottom for rigid pipes

Where rigid pipes are to rest on the natural bottom of the trench, Class C bedding as shown on the drawings shall be used.

For Class C bedding the bottom of the trench shall be carefully trimmed by hand between joints and sling holes. After the pipes have been laid and tested Class C bedding shall be completed by carefully placing TYPE B fill to Clause 1.7.15. under the barrel of the pipes into the spaces between the pipe and the sides of the trench to the level of the crown of the pipe. The material shall be thoroughly packed and rammed by careful hand tamping in layers 150 millimetres thick before compaction. Placing and tamping shall proceed equally on both sides of the pipe. A further layer of the same material at least 300 millimetres thick after compaction and the full width of the trench shall be placed over the crown of the pipes in two equal layers, each layer being lightly tamped by hand.

For Class D bedding, the bottom of the trench shall be carefully trimmed by hand between joint and sling holes. After the pipes have been laid and tested, Class D bedding shall be completed by replacing the excavated material loosely around the pipes to 300 millimetres above the crown of the pipe.

1.6.8 Granular bedding for rigid pipes

Where rigid pipes are to be bedded on granular material to Clause 1.7.15, Class S bedding as shown on the drawings, shall be used.

Type A granular material to Clause 1.7.15 shall be placed by hand in the excavation below the level of the pipe barrel to the depths shown on the drawings and shall be tamped and rammed by hand in layers not exceeding 150 millimetres thick before compaction, to provide a dense well compacted bed free from soft spots throughout the length of the pipeline between joint and sling holes.

After the pipes have been properly bedded and tested Type A granular material shall be carefully placed into the spaces between the pipe and the sides of the trench to the level of half pipe. The Type A material shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 150 millimetres thick before compaction. The placing and the tamping of the material shall proceed equally on both sides of the pipe.

Thereafter Type A fill to Clause 1.7.15 shall be placed into the spaces between the pipe and the sides of the trench to the level of the crown of the pipe. The Type A fill shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 150mm thick before compaction. The placing and the tamping of the material shall proceed equally on both sides of the pipe.

Class S bedding shall be completed by placing Type A fill material at least 300 millimetres deep after compaction and the full width of the trench in two equal layers over the crown of the pipe, each layer being lightly tamped by hand.

1.6.9 Granular bedding for flexible pipes

Where flexible pipes are bedded on granular material to Clause 1.7.15, Class E bedding as shown on the Drawings shall be used.

Type A granular material to Clause 1.7.15 shall be placed by hand in the excavation below the level of the pipe barrel and shall be tamped and rammed by hand in layers not exceeding 150 millimetres thick before compaction to provide a dense well compacted bed free from soft spots throughout the length of the pipeline. After the pipes have been properly bedded and tested, Type A granular material shall be carefully placed into the spaces between the pipe and the sides of the trench to the level of the crown of the pipe. The Type A material shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 150mm thick before compaction. This placing and the tamping of the material shall proceed equally on both sides of the pipe.

Class E bedding shall be completed by placing Type A fill material at least 300 millimetres deep after compaction and the full width of the trench in two equal layers over the crown of the pipe, each layer being lightly tamped by hand.

1.6.10 Concrete cradles, arches and surrounds

Concrete for cradle, arch or surround to pipes shall be Mix B to Clause 1.2.9, and no backfilling of the trench shall be done until the concrete has reached a strength of 15 N/mm².

Before placing concrete to concrete cradle or surround the pipes shall be supported as described in Clause 1.6.6 on precast concrete setting blocks. Compressible packing for use between pipes and precast concrete setting blocks shall consist of two layers of bitumen damp-proof sheeting complying with BS 743, Type G. Concreting shall not be done until the pipes have been jointed and inspected. The concrete shall be vibrated into place under the pipe and the concrete shall be in full contact with the underside of the barrel of the pipe throughout its length. The concrete shall be placed in one operation and shall be well worked to form a homogeneous mass. There shall be no horizontal construction joint in the concrete below the level of half pipe. The pipe shall be carefully anchored against flotation.

Concrete cradle, arch or surround to pipes shall be discontinuous at flexible pipe joints. Shaped formwork made from fibreboard or other equally compressible material (eg. Bitumen impregnated insulating board to BS 1142, Part 3) of the thickness shown on the drawings and of size and shape equal to the net section of the concrete protection to the pipes shall be used and left at the pipe joints as shown on the drawings.

The formwork shall be neatly cut and properly supported by temporary struts and raised where necessary.

Where the concrete is not carried up to the crown of the pipe the spaces between the barrel of the pipe and the sides of the trench shall be filled as specified in Clauses 1.6.8. and 1.6.9 above with carefully compacted Type B fill material to Clause 1.7.15. Thereafter fill material at least 300 millimetres deep after compaction and the full width of the trench shall be placed in two equal layers over the crown of the pipe, each layer being lightly tamped by hand. PVC pipes shall be wrapped in polythene sheeting or roofing felt about 2mm thick wherever they are in contact with concrete.

Where a concrete cradle or surround is being constructed in wet conditions, the Contractor shall, if the Employers Representative deems it necessary, lay an underbed of Type A granular material to Clause 1.7.15 over the full width of the trench. The Employers Representative may also require that a temporary drain be laid in the underbed. The drain shall be sealed on completion.

Where an underbed of granular material is used, and elsewhere as required by the Employers Representative, a 50 mm thick screed of Mix "A" concrete shall be placed over the full width of the trench.

1.6.11 Concrete anchors and thrust blocks

At all bends, tees, junctions, changes of direction and gradient, Mix "A" concrete to Clause 1.2.9 shall be placed to prevent movement of pipelines due to thrust from water pressure. The concrete shall be placed between the outside of the bend and recessed into the solid wall of trench as shown on the drawings. At tees for all scour valves and hydrants a concrete thrust

block shall be placed between the tee and the wall of the trench as shown on the drawings. Where hydrants are placed vertically on mains a thrust block shall be provided on each side of the tee. Details of the different sizes of thrust blocks required are shown on the contract drawings.

1.6.12 Plugs

Immediately after laying, the open end of a pipe shall be sealed with a wooden plug or approved stopper of appropriate size to prevent the entry of material which might contaminate the pipeline, damage the linings, obstruct the waterway or affect the working of valves, metres etc. Plugs shall be unperforated and shall be shaped to fit neatly so that water from the trench excavations shall not be allowed to gain access to the pipeline.

Water pipes and fittings 150mm and under in diameter shall have a brush equal in diameter to the internal bore of the pipe drawn through them as the work proceeds. The brush shall not be removed from the pipeline from commencement until completion.

The plugs in sewers may, with the Employers Representative's approval, be provided with small holes for drainage purposes, but water from the trench excavation which is heavily charged with silt shall not be allowed to gain access to the pipe.

Where the work is interrupted for a period, the plugs left in position shall be regularly inspected for their fixing to ensure that there has been no tampering by unauthorised persons. Whenever any plug is removed, the immediate length of pipe shall be examined for dirt or obstructions and shall be cleaned as required.

Adequate precautions shall be taken by way of backfilling or other means to anchor each pipe securely to prevent flotation of the pipeline in the event of the trench being flooded.

1.6.13 Gaps for Valves etc.

If the normal continuity of construction requires to be interrupted pending the delivery of valves or specials, the exact extent of the temporary gaps to be left shall be predetermined after reference to the Employers Representative. The Contractor shall submit dimensioned sketches to the Employers Representative for approval, showing details of the pipe and jointing arrangements to be adopted to effect ultimate closure. Care shall be taken to preserve the accurate alignment of the pipeline across all such temporary gaps.

1.6.14 Jointing pipes - general

Joints shall be made strictly in accordance with the manufacturer's instructions. The Contractor shall make use of the technical advisory services offered by manufacturers for instructing operatives in the methods of assembling joints. Where manufactures recommend the use of special jointing tackles, the Contractor shall use these for the assembly of all joints to pipes.

Before making any joints, all jointing surfaces shall be thoroughly cleaned and dried and

maintained in such condition until the joints have been completely made or assembled.

Notwithstanding any flexibility provided in the pipe joints, pipes must be securely positioned to prevent avoidable movement during and after the making of the joint. The space between the end of the spigot and the shoulder of the socket of flexibly jointed pipes when jointed shall be as recommended by the manufacturer or as ordered by the Employers Representative.

Where loose collars are used to join cut pipes, special tools shall be employed to keep the inside of the pipes flush and the collar concentric with the pipe while the joint is being made.

Subject to the Employers Representative's approval or otherwise on his instructions two or more lengths of PVC pipe may be jointed overground, before being placed in the trench. Adequate support shall be provided in lowering the completed section into the trench and special care shall be exercised to prevent damage to the joints, or excessive sagging of the pipeline.

Joints in steel mains shall be made with flexible couplings after ensuring that the coupling sleeve and pipe ends are clean and dry. The steel pipe shall then be adjusted in the trench, so that its end shall be truly opposite the end of the pipe previously laid and the clearance between the ends of the pipes shall be checked with the appropriate distance gauge supplied with the pipes. Where the steel pipes are laid at an angle the gauged distance shall be the minimum distance between the pipe ends. The coupling bolts shall then be tightened and the internal cone mandrel machine of the correct diameter shall be run in from the open end of the steel pipe so that the clearance between the pipe ends is evenly bridged, the rubber ring in contact with the pipe having previously been coated with whitening or other suitable substance to prevent molten bitumen from sticking to the ring. The bitumen shall be heated to a temperature of 480°F and poured into the space between the pipe ends and the sleeve of the flexible couplings in one continuous pour until the bitumen appears in the venting funnel. The funnels and backing up machine shall then be removed and the original plugs and fibre washers replaced in the vent and filler holes and screwed tightly home.

The external protection shall then be applied after ensuring that the steel pipe ends and joints are clean, dry and first painted with a quick drying bituminous paint supplied by the pipe manufacturer. A special mould coated on the inside with a lime wash, or clay shall be fitted over the joint and pipe ends with the filling gate vertical, and the mould shall be filled with a special bituminous compound heated until it runs freely. This compound contracts while cooling and the mould shall be kept full by further addition of the compound as necessary. The mould shall be removed while the bituminous composition is still warm and any defects in the covering shall be made good by applying hot bituminous compound with a steel trowel. In the case of steel pipes larger than 600 mm diameter, the use of an expanding cone backing up machine will not be permitted. Surplus bitumen inside the joint shall be heated and trimmed off and the internal linings moulded into one continuous layer by hot trowels or other approved means. Workmen entering the pipe for any reason must wear rubber soled boots and no one will be permitted to enter the pipe unless so provided.

1.6.15 Welded joints on steel pipes

Site welding of steel pipes shall be carried out by an approved specialist contractor. The welding shall be carried out in accordance with the requirements of BS5135 and BS 4515. Site welds shall be made in a manner approved by the Employers Representative and such that the welds have the strength to withstand all applicable stresses including temperature stresses due to a variation of $\pm 10^{\circ}\text{C}$ from a mean of 10°C . At selected locations the welding of certain joints shall be delayed and carried out under optimum temperature conditions in order to limit the effect of temperature variation. Inspection of welding equipment and procedure and testing of welds shall be carried out by an independent inspector..

1.6.16 Welded joints on polyethylene pipes

Site welding of polyethylene pipes shall be carried out in accordance with the UK Water Industry Specification 4-32-08 (WIS 4-32-08) 'Specification for the Fusion Jointing of Polyethylene Pressure Pipeline Systems using PE 80 and PE 100 materials' and in accordance with EN 13244:2002 (water for general purposes, drainage and sewerage) and EN 12201: 2003 (potable water supply). WIS 4-32-08 specifies the equipment, jointing procedures, maintenance, servicing and calibration records, training and testing for fusion welding of all PE pipes and fittings. Welding shall take place inside a purpose built shelter complete with ground sheet designed to exclude moisture and dust and to maintain an adequate temperature for welding. Rollers shall be used to protect pipes and plugs shall be used on pipes during welding to prevent temperature differentials across the inside and outside of the pipe which may occur if wind was allowed to pass through an open pipe.

All joints shall be individually numbered and their number, joint type and the exact location of their installation in the ground shall be recorded for inclusion on the As-Constructed drawings.

Site welding of polyethylene pipes shall be carried out by suitably trained personnel. All pipe welders shall hold a City & Guilds Certificate of Unit Credit towards the Certificate for Utility Operators- Water Distribution- 1 Module "Mainlaying –Polyethylene Pipes Butt Fusion Joints (Single Pressure)", or approved equivalent and shall present their qualification to the Employers Representative before carrying out any welds as part of the works. Any other approved equivalent independent certificate shall have to demonstrate similar course duration and content.

Where possible, the butt fusion method of welding shall normally be used and pipe manufacturer's recommended procedures for welding shall be followed. Butt fusion welding machines shall conform to the UK Water Industry Specification 4-32-16 (WIS 4-32-16). The pressure gauge and temperature of the hot plates shall be manually checked at least twice per day. The temperature shall be checked on at least 4 spots on the hot plate. At the start of each day, and at any time during the day when the temperature of the welding hot plate goes below 180 degrees, a dummy weld shall be completed and discarded before welding any pipes for progressing the works. All pipe ends shall be checked to ensure they are clean, even and dry prior to commencing a weld.

For sewer mains, all internal and external beads shall be debeaded using an approved tool. For watermains, only the external beads shall be debeaded. All debeaded joints shall be tagged with that individual joint number and be stored and made available for inspection by the Employer's Representative.

Electrofusion welding shouldn't generally be completed within the trench. However, if this is unavoidable then the trench shall be kept dry and a Clause 804 base and 300mm deep sump shall be constructed in the trench. Electrofusion couplers shall be kept in their bag and out of direct sunlight until they are to be used. The elements which will form the weld shouldn't be touched prior to welding. If any coupler element de-oxidizes, it shall be scraped clean using a mechanical scraper which must be maintained, cleaned and sharpened regularly. Clamps shall be used on all electrofusion joints completed. All pipe ends shall be checked to ensure they are clean, even and dry prior to commencing a weld. The couplers external indicators shall be checked to confirm that a weld has been completed satisfactorily. Once the electrofusion joint has been completed it shall be allowed time to set and cool in accordance with the manufacturers instruction, prior to moving the pipe.

1.6.17 Cast iron joint fittings

Cast iron detachable joint collars with flanges shall be tested by striking lightly with a spanner immediately before they are placed and if they fail to ring true shall be set aside and not incorporated in the work until proven sound.

1.6.18 Flanged joints

The flanges shall be correctly positioned and the component parts including any insertion ring cleaned and dried. Insertion rings shall be fitted smoothly to the flange without folds or wrinkles. The faces and bolt holes shall be brought fairly together and the joints shall be made by gradually and evenly tightening bolts in diametrically opposed positions. Only standard length spanners shall be used to tighten the bolts. The protective coating, if any, of the flange shall be made good when the joint is completed.

Bolt threads shall be wrapped with PTFE tape before use.

1.6.19 Laying to curves

Where flexibly jointed rigid pipes are to be laid to curves, the outside of spigots in the joints shall not butt hard against the inside of the socket.

At least one-quarter of the total movement in the joint shall be left in any direction.

Where curves are to be negotiated with straight steel piping with welded joints, no joint shall be flexed more than one degree. Up to two degrees will be permitted with Johnson Couplings.

Where curves are to be negotiated with straight prestressed concrete pipes no joint shall be flexed more than half a degree. For sharper curves purpose-made bevel pipes, bevel adaptors and standard bends shall be provided.

1.6.20 Cutting pipes

Iron Pipes shall be cut by a method which provides a clean square cut of the pipe and of the lining, if any, without damage to pipe or lining. All cut or trimmed ends, and the parts of any pipe on which the coating may have suffered damage shall be recoated with bitumen before the pipes are laid. The external area at cut spigot ends of ductile iron pipes shall be ground for a distance of at least 125mm.

Pitch-impregnated fibre pipes shall be cut by saw and where necessary the end shall be machined to the required 2° taper.

Concrete pipes shall be cut to a square and even finish without splitting or fracturing the wall of the pipe. Reinforcement shall be cut back flush with the concrete and bare metal protected with bituminous paint or cement grout as directed.

Only steel pipes supplied rounded throughout their length shall be used as cut pipes to form closures. The cutting shall be done by an approved method which provides a clean square cut, without separation of the lining from the pipe wall. Oxyacetylene apparatus must not be used to cut steel pipes.

Minor damage to the lining of steel pipes may, if permitted, be repaired on site in accordance with the manufacture's instructions. Where in the opinion of the Employers Representative the damage is serious the steel pipe or special shall be returned to the manufacturer for reconditioning.

1.6.21 Backfilling of trenches

For pipelines in public roads backfilling shall normally be carried out immediately. For other pipelines backfilling shall normally not be carried out until the pipes, drains etc. have been tested and approved.

Unless otherwise specified in Section 2.3 herein, for pipelines in roads, and in road verges where the nearest point of the trench is within one metre of the paved edge of the road, backfilling shall consist of material in accordance with Clause 804 of the "Specification for Roadworks" (NRA) compacted in layers in accordance with NRA Clause 802, unless specified otherwise. In National Primary Roads, all backfill material shall be in accordance with Section S5 of the NRA Specification for the Reinstatement of Openings in National Roads and shall consist of backfill Clause 804 of Series 800 of the NRA Specification for Road Works except where foamed concrete is used (see Appendix A9 of NRA Specification).

All Clause 804 backfill material which is to be placed with 500mm of cement bound materials, concrete pavements, concrete structures or concrete products shall comply with Clause 808 of Series 800 of the NRA Specification for Road Works.

Where the contract provides for the reuse of excavated material for backfilling and where the Contractor allows material which was suitable when excavated to become unsuitable, the Contractor shall make good by disposing of the unsuitable material and replacing it with suitable material. In other cases, the Contract may provide for the main backfilling to be

carried out using imported material.

Where required to meet the specification for testing pipelines, trenches shall be partially backfilled to provide anchorage, but joints shall be left exposed.

Backfilling shall wherever practicable be undertaken immediately the specified operations preceding it have been completed.

No backfill material shall be placed in trenches containing water.

The filling material used beside pipes and for 300 mm above them shall be Type "A" granular material as specified in Clause 1.6.8 and Clause 1.6.9 of this specification.

This material shall be filled in carefully by hand and thoroughly consolidated at the sides of pipes and up to the level of the crown of the pipes. The material up to 300 mm over the crown of the pipes shall be filled in by hand and lightly compacted all as shown on the drawings. In trenches in roads, verges and otherwise where directed, above 300 mm over the crown of the pipe backfill material shall be deposited in layers and compacted all as specified in Clause 1.10.8. Power rammers or vibrating plate compactors shall be used to compact the backfilling from 500 mm above the crown level of the pipe to the formation level. The road base and surfaces shall be restored as specified in Clauses 1.6.31, 1.6.32, 1.6.33 and 1.6.34.

In trenches in fields in open country backfill material above 300 mm over the crown of the pipe may be placed by machine provided the method of operation ensures that the material slides or rolls into position and does not drop from a height. The top 600 mm shall be completed in 300 mm layers and the surface restored as specified in Clause 1.6.36. In cases where settlement occurs in the backfill material the resulting depression shall be made up by the Contractor with top soil at regular intervals until all settlement has ceased.

Where shown on the drawings, or directed, the Contractor shall cover in with banking any pipes wholly or partly above the level of the ground or where the standard cover to the pipes is reduced in shallow trench work. Approved granular material dressed off to the profile shown on the drawings shall be used for banking over pipes. Topsoil to a depth of 150 mm shall be spread over the banking and the area shall be turfed or sown with grass.

Where pipes wholly above the level of the ground are to be covered with banking, the surface soil shall be stripped and laid aside. The banking shall first be formed with stone ballast or other approved hard material well built and binded with fine granular material to a level to permit Class A or Class B Bedding. After thorough consolidation of the ballast and preparation of the pipe bed, the pipes shall be laid true to line and level, the protection carried out, and the banking over the pipe completed.

1.6.22 Existing land drains

Where possible the landowner shall be consulted prior to commencement of pipelaying in fields in order to establish the locations of any existing land drains.

Existing land drains permanently severed by the Works shall be located and connected into new drains. Existing land drains shall be cleaned out from the new drain trench face and any disturbed pipe relaid to ensure a free discharge into the new drain. The disused end of the

intercepted land drains shall be sealed with puddle clay or other approved materials.

Where an existing land drain is exposed and temporarily severed by trench excavation, the position of the drain shall immediately be marked and recorded. The normal functioning of the drain until permanent restoration is made shall be maintained by the construction of a watertight conduit adequately supported across the trench.

Without limiting the Contractor's liability for restoration of damage, the Contractor shall notify the Employers Representative of any land drain which is blocked or is otherwise patently defective when the drain is first exposed.

When the line of an existing drain fouls the line of a pipeline, the Contractor shall deal with the drain as directed by the Employers Representative.

Drains shall be reinstated on their original line, unless the Employers Representative orders otherwise, using new tiles for existing agriculture tile drains and new pipes for existing stone drains.

1.6.23 Service Connections to water mains

Service connections to water mains shall be of the same class as the main they are connected to and are to be laid at the same time as the mains and are to be tested with the mains and to the same pressure.

Service connections shall consist of the pipe diameter as specified laid at a minimum depth of 600mm complete with approved pattern ferrule and saddle and screwdown stopcock as specified in Clause 1.7.13(d). One metre of service pipe shall be laid beyond the stopcock for future use or alternatively the new service pipe shall be connected to the existing service pipe beyond the stopcock in the case of existing supplies.

1.6.24 Service Connections to main sewers

Service connections to main sewers shall be made with angle junctions at the correct angle to minimise the use of bends.

The open ends of all service connections and other pipes not required for immediate use shall be sealed up with purpose-made stoppers secured in position. In the case of connections to existing users the pipe shall be joined to the existing private connection at the footpath or property boundary as appropriate. Alternatively, an inspection chamber shall be provided between the new and existing sewer connections. The ends of connections and all junction positions shall be clearly marked by posts and painted boards of a type and size approved by the Employers Representative and the boards shall be plainly marked with the letter "S" and the size and depth below kerb level or ground level. Every care shall be taken to prevent the marking boards being disturbed and the Contractor shall take the responsibility for their safety. The information shall also be painted on the kerbs in an approved manner when all works are complete and the Contractor shall record on a drawing the position of all branches giving distances from the manhole immediately downstream of the branch.

1.6.25 Pipes built into structures

The outside surfaces of all pipes and special castings to be built into structures shall be thoroughly cleaned immediately before installation. Where ordered protective coatings to metal pipes shall be removed from the sections to be built in, while the external surfaces of fireclay and concrete pipes shall be roughened to form a key for concrete or mortar. Sheathing to steel pipes shall be cut away from the sections to be built-in and after erection the protection shall be completed by applying approved bituminous material around the barrels of pipes at the junctions with structures.

Pipes passing through water retaining walls and floors shall, where possible, be built into the structure in-situ. Puddle flanges shall be provided where specified or shown on the drawings. Shuttering shall be formed closely to the outside of the pipe, and concrete shall be placed and compacted thoroughly around pipe and puddle flange if any.

Where fixing in the course of construction is not possible, temporary openings in structures, formed to the dimensions required shall be left where indicated or directed to accommodate the subsequent erection of the pipes and special castings. In water retaining structures, they shall taper to a smaller dimension towards the external faces of structures and shall include a waterstop. In basements, dry chambers at pumping stations etc., temporary openings shall taper to a smaller dimension towards the internal faces of structures and shall also include a waterstop.

Prior to in-filling, all surfaces against which fresh concrete is to be placed shall be prepared as specified in Clauses 1.2.15 and 1.2.18 while the external surfaces of pipework shall be prepared as described above.

Where a pipe is built into a structure and will be underground there shall be two flexible joints adjacent to the structure. The first shall be not more than one pipe diameter from the outside face of the structure, subject to a maximum of 150mm if a socket faces the structure. The protruding pipe shall be supported from the structure by means of a 150 mm thick concrete bed and surround which shall as far as possible be monolithic with the structure. Care must be taken to ensure the flexibility of this joint. The length of the next pipe (rocker pipe) away from the structure shall not exceed 0.75m for pipes up to 450 mm diameter, 1 m for pipes from 450mm to 750mm diameter and 1.25m for pipes over 750mm diameter.

1.6.26 Setting valves etc

Care shall be taken during storage to prevent damage to all valves, fire hydrants and the like, and their ancillary equipment. Valves etc. and ancillary apparatus shall be stored in clean conditions and in a manner that excludes all water. Headstocks, motors, gearing or indicators shall be removed, adequately labelled for identification, stored carefully in weatherproof premises and reconnected after erection of the valves. Frost cocks shall be kept clear and free from obstruction. Electrical equipment shall be protected from damp and the damp- proofing seals shall remain intact until the electrician is ready to connect up the equipment.

The gunmetal faces and seats of all valves shall be kept clean. No valve shall be closed without first wiping the faces with a clean cloth. The cavity beneath the valve door shall be thoroughly cleaned by hand. In the event of accident, fouling matter shall be either dissolved or carefully removed by methods that do not involve scraping of the gunmetal faces.

Where valves are supplied fitted with mud doors and starting bolts in the bottom of the body, the starting bolt shall be left out, when the door is shut for the first time on Site. When the door has been set down on the seat the starting bolt shall be run to make contact with the door and shall then be turned back to clear the door. In no case shall a starting bolt be inserted without ensuring that the door on closing shall clear the starting bolt.

All valves shall be set so that operating spindles are truly vertical unless otherwise directed.

Before each valve is put into service all gears, bearings and spindles shall be oiled with an approved oil as recommended by the valve maker. Oil baths shall be topped up to the appropriate levels and all grease nipples charged with grease of approved manufacture. No deleterious matter shall be allowed to come into contact with the working faces and oil sumps shall be maintained clean.

Every surface box shall be examined when the main is charged with water and leaking boxes shall be adjusted or repacked with square plaited lubricated hemp packing of approved manufacture. The surface box shall not be so tightly packed as to materially affect the friction of the packing on the spindle.

No air valve shall be stored before erection in the open sunlight, or upside down so as to expose the balls and air cavities. Air valves shall be checked before the main is charged to ensure that the balls and faces are not scored or split and that there is no dirt or other deleterious material in the cavities of the body. All air nozzles should be probed to see that they are clean.

Fire hydrants, frost plugs and similar fittings shall be checked before being incorporated in the line and before the main is charged to ensure that all passageways are clean.

The installation of special types of valves and metering equipment shall be strictly in accordance with the manufacturer's instructions.

Fire hydrants are to be located where indicated on the drawings and fire hydrant outlets shall not be more than 200mm below the top of the surface box.

1.6.27 Cleaning pipelines etc

Immediately before being handed over to the Employer every non-pressure pipeline shall be thoroughly cleaned by high pressure water jetting or other similar approved method. Manholes, chambers, tanks and sumps shall be washed down, emptied and left to dry.

The bore, linearity and jointing of all drains and service ducts less than 300mm diameter shall be checked by drawing through each completed length of pipe a mandrel 750mm long and 12mm less in diameter than the nominal bore of the pipe unless an alternative method of checking is approved.

1.6.28 Cable ducts and cable draw pits

Where a cable duct is required to be laid in the same trench as a pipeline the Contractor shall lay PVC, polyethylene or similar pipe as a cable duct with a draw wire included which shall be suitable for pulling the cable through after backfilling of the trench.

After the pipeline has been laid and tested and the trench refilled to 150mm above the pipeline, the cable duct shall be carefully laid to one side of the trench on a bed of Type A granular material and shall be surrounded with Type A granular material to a depth of 100mm above the crown of the duct.

Cable draw pits shall be constructed at selected locations along the cable duct. Cable draw pits shall consist of a concrete block chamber of internal dimensions 675 x 675mm with 225mm thick concrete block walls, 150mm thick mass concrete base using Mix B concrete and 150mm thick reinforced concrete roof using Mix B concrete and 5 No. 12mm reinforcing bars each direction.

1.6.29 Insulation of watermains

Where watermains of 300mm diameter or less are exposed at bridge and culvert crossings or where they are laid above ground level they shall be covered with a layer of 50mm thick fibre glass insulation which will be held in position by two layers of felt surrounded by chicken wire tied securely to keep the insulation material firmly in position. On completion the felt surface shall be painted with Bitumastic paint.

1.6.30 Identification of buried pipeline and ducts

Plastic warning mesh shall be placed over the centerline of all pressure pipelines and cable ducts at a depth of 350mm below finished ground surface. Plastic warning mesh shall be placed over sewer pipelines where expressly required in the Contract.

Plastic warning mesh shall comply with the requirements of BS EN 12613 and shall contain stainless steel tracer wires to facilitate detection from ground surface. The warning mesh shall be joined using special wire crimping tools in accordance with the manufacturer's recommendations. For pipelines of diameter greater than or equal to 300mm, the warning mesh shall be 400mm wide. For all other pipes the warning mesh shall be 200mm wide. The warning mesh shall carry the identification of the type of pipe constructed. For watermains the mesh shall be blue in colour and tied to the valves. For all other pipelines the mesh shall have an appropriate approved colour.

1.6.31 Breaking up and reinstatement of roads

Before carrying out any excavation in any surfaced road, footpath or other paved areas, both edges of the trench shall be neatly cut by sawing through the full depth of the bitumen or concrete material to avoid damage to the adjoining surface. The width of the trench at surface

level as defined by the cut edges at the surface shall not be greater than 500mm plus the maximum trench width specified in Clause 1.6.2.

When excavating in paved areas, special care shall be taken to support the sides of the trench to avoid ground displacement under the adjacent surface

If undermining of the adjacent pavement occurs the pavement shall be cut back 75mm beyond the edge of the collapse along the whole of that section of excavation to maintain a straight edge parallel to the original excavation. The additional reinstatement required shall be carried out at the Contractor's expense.

Temporary and permanent reinstatement of non-national primary roads shall be carried out as specified in Clause 1.6.32 and 1.6.34 and in accordance with "Guidelines For The Opening, Backfilling and Reinstatement of Trenches in Public Roads" (DOELG).

Temporary and permanent reinstatement of National Primary Roads shall be carried out as shown on the drawings and in accordance with the NRA "Specification for the Reinstatement of Openings in National Primary Roads"

Road reinstatement shall generally be carried out as a two stage procedure. The first stage is the temporary reinstatement where temporary bitumen macadam wearing course is laid over a sub-base of granular material. In the second stage the temporary reinstatement is removed and the permanent reinstatement is completed. Alternatively, road reinstatement may be carried out as a one stage procedure where immediate permanent reinstatement is specified.

1.6.32 Temporary reinstatement of public road surfaces

The Contractor shall reinstate all public road surfaces interfered with by him immediately on completion of backfill, and shall maintain these surfaces as instructed in Clause 1.6.33 below until the end of the Defects period or until the road is taken over by the road authority for the purpose of permanent reinstatement (whichever is the earlier). Unless other wise noted in Section 2, in the case of National Primary Roads, National Secondary Roads, roads and streets in towns and villages, and in the case of Regional and other roads where directed by the Employers Representative, the temporary surface shall consist of 75mm compacted depth of 14 or 20mm (nominal size) Close Graded Bitumen Macadam Wearing Course to Clause 7.3 of BS 4987 – Part 1. The minimum PSV of the coarse aggregate in the macadam wearing course shall be 60. The compacted surface shall have a minimum texture depth of 1.5mm. Before placing the macadam, the surface shall be neatly cut back to the required depth in straight lines and the finished surface shall be within the tolerances specified in "Guidelines for the Opening, Backfilling and Reinstatement of Trenches in Public Roads" (DOELG).

A double layer of surface dressing shall consist of 6mm crushed rock chippings at a rate of 9-12kg/m² and cationic bitumen emulsion at rate of 1.3-1.6 l/m² on 14mm crushed rock chippings at a rate of 12-15 kg/m² and cationic bitumen emulsion at rate of 1.2-1.6 l/m².

The Contract Sum shall be deemed to include for breaking up and temporary reinstatement of public roads and footpaths which shall also include neatly cutting the edge of all excavations with a mechanical saw, breaking the surface and reinstatement of road base and surface as

described in this clause. The Contract Sum shall include for completing the joint between the existing and newly reinstated surface by painting the joint with 50 or 70 pen hot bitumen or cold applied thixotropic bitumen compound to BS 4987 Part 2: 1988 A2 sealant. It shall also include for maintenance of the surface, including topping up with bituminous material in the case of any subsidence or pot holing and attendance by a suitable workman during weekends and holiday periods to maintain the surface as necessary.

When pricing the Works the Contractor shall bear in mind that compliance with this clause will be strictly enforced and if there is any undue delay in restoring either base or surface the Employer is empowered to and will enter upon the site and carry out the restoration and the cost of doing so will be deducted from monies due or becoming due to the Contractor.

1.6.33 Maintenance of temporary reinstatement

Unless otherwise agreed, the maintenance of temporary reinstatement shall be by topping up the reinstated surfaces with surfacing materials similar to those initially applied so that the surface level of the reinstatement is maintained at the initially reinstated level. The Contractor shall ensure adequate bonding between old and new materials and the latter shall be properly compacted to match with the existing adjoining surfaces.

The Contractor shall maintain reinstated surfaces of public roads and shall immediately rectify any defect which appears in the surface to the satisfaction of the Employer and of the roads authority.

The Contractor shall be required to carry out maintenance work as often as necessary and as directed by the Employers Representative.

The Contractor shall include in the Contract Sum for any additional expense for carrying out maintenance of temporary reinstatement for periods as follows:

- (a) Public roads for a period as specified in the Conditions of Contract.
- (b) Areas other than public roads until such time as the permanent reinstatement is carried out as specified in Clauses 1.6.35, 1.6.36, 1.6.37 and 1.6.38.

1.6.34 Permanent reinstatement of public road surfaces

Permanent reinstatement of public road surfaces shall, unless otherwise required by the Contract, be carried out by the road authority or some person other than the Contractor. If, as a result of any action by the Contractor, any part of the surface outside the maximum allowable width of the trench as defined in Clause 1.6.2 needs to be reinstated, the cost of the extra reinstatement shall be borne by the Contractor and shall be recoverable from him by the Employer or may be deducted by the Employer from any monies due or which may become due to the Contractor. The Permanent reinstatement shall include the cutting and taking out of any material from the temporarily reinstated surface in order to prepare the formation for the permanent reinstatement works.

In non-National Primary Roads immediate permanent reinstatement shall be carried out as shown on the drawings and in accordance with "Guidelines for the Opening, Backfilling and Reinstatement of Trenches in Public Roads" (DOELG).

In National Primary Roads immediate permanent reinstatement shall be carried out as shown on the drawings and in accordance with the NRA "Specification for the Reinstatement of Openings in National Primary Roads"

1.6.35 Permanent reinstatement of other paved surfaces

Permanent reinstatement of paved surfaces other than public roads shall be carried out by the Contractor who shall restore the surfaces to a condition not less satisfactory than that which existed immediately before the commencement of the Contractor's work, using similar and equal material. The permanent reinstatement shall not be carried out until the backfill is fully consolidated and not normally within six months of completing the temporary reinstatement.

The permanent reinstatement of concrete or bitumen macadam footpaths shall conform to the requirements of Clause 1.10.16.1.6.36 Reinstatement of land

Where excavation takes place in unpaved land the surface top-soil shall be separately excavated and stored for replacement. When the main backfilling has been carried out, the topsoil shall be spread and consolidated to the original depth or a minimum depth of 100mm, whichever is greater, and raked to achieve a fine tilth. The surface shall be seeded as specified in Clause 1.5.9 and as required to produce grass of the same quality as existing before the commencement of the Contractor's work. Where expressly required, turves shall be cut from the surface before excavation of the trench and used for reinstatement after backfilling. All replaced sods shall be finally levelled by lifting and adding fine loam as necessary underneath and bare patches reseeded in accordance with Clause 1.5.9. In the case of reinstated grass surfaces other than in uncultivated land the Contractor shall allow in his price for two cuts of sown grass to a height not exceeding 100mm at each cut.

1.6.37 Reinstatement of kerbs and channels

Kerbs and channels in or adjoining paved areas and which are moved, diverted, filled in or otherwise disturbed during pipelaying shall be reinstated to their original condition using existing material where possible or otherwise using new matching materials.

1.6.38 Reinstatement of walls, hedges, fences, ditches, earth banks, etc.

All fences, ditches, walls, bridges, culverts, sewers, water mains, gas mains, electric cables, or any other objects or services disturbed during the course of the work shall be restored to their original state and to the satisfaction of the Employers Representative and of the owners concerned. The Contractor shall be deemed to have included for compliance with this clause in his Contract Sum. Where a hedge has been removed, a strong stockproof fence suitable for the location, shall be constructed to provide an interim boundary until the newly planted hedge plants reach maturity.

SECTION 1.7 PIPEWORK MATERIALS

1.7.1 Unplasticised polyvinyl chloride (PVC-U) pipes and fittings for water supply applications

Unplasticised polyvinyl chloride (PVC-U) pipes and fittings for water supply applications shall comply with BS EN 1452:2000 "Plastic pipe systems for water supply. Unplasticised Poly (vinyl chloride) (PVC-U)" and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

1.7.2 Unplasticised polyvinyl chloride (PVC-U) pipes and fittings-non pressure applications

Unplasticised polyvinyl chloride (PVC-U) pipes for non pressure underground drainage and sewerage works shall comply with I.S. EN 13476:2007 "Plastic pipes for non pressure underground drainage and sewerage- structured-wall piping systems of unplasticized poly (vinyl chloride) (PVC-U)" and with the UK Water Industry Specification No. 4-32-08 (WIS 432-08) "Specification for thermoplastic structured wall pipes with a smooth bore for gravity sewers for the size range 150-900 inclusive" and manufacturers shall operate a quality system in compliance with ISO 9001 : 2008.

Non –pressure PVC-U pipes for pipes of diameter up to 160mm (139mm bore) shall comply with I.S. EN 13476-2:2007 "Plastic pipes for non pressure underground drainage and sewerage-structured-wall piping systems of unplasticised poly (vinyl chloride) (PVC-U) - Type A" and manufacturers shall operate a quality system in compliance with ISO 9001 : 2008.

PVC-U pipes for pipes of diameters between 160mm nominal bore and 500mm nominal bore shall comply with I.S. EN 13476-2:2007 "Plastic pipes for non pressure underground drainage and sewerage- structured-wall piping systems of unplasticised poly (vinyl chloride) (PVC-U)- Type B and shall have a ring stiffness of 8 kN/m² and manufacturers shall operate a quality system in compliance with ISO 9001 : 2008.

Joints shall be made by means of a coupler, unless otherwise required under the Contract. PVC-U pipes of diameters in excess of 500mm nominal size shall not be permitted unless required under the Contract. Pipe lengths in excess of 6 metres will not be permitted.

1.7.3 Molecular Oriented (PVC-O) pipes and fittings

Molecular oriented polyvinyl chloride (PVC-O) pipes and integral joints for buried cold potable water systems, grey water systems, irrigation **pipes and sewer rising mains** shall conform to the UK Water Industry Specification No. 4-31-08 and manufacturers shall operate a quality system in compliance with ISO 9001 : 2008.

1.7.4 Unplasticised polyvinyl chloride alloy (PVC-A) pipes and bends for water under pressure

Unplasticised polyvinyl chloride alloy (PVC-A) **pressure pipes and fittings** shall conform to B.S. PAS 27 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

1.7.5 Concrete sewer pipes

Unreinforced, reinforced and steel fibre concrete pipes and fittings with flexible joints and nominal sizes not exceeding DN 1750mm shall comply in all respects with I.S. 6:2004 and manufacturers shall operate a quality system in compliance with ISO 9001 : 2008. Gasket type flexible spigot and socket joints shall be used unless otherwise specified in the Contract.

Unreinforced concrete pipes and fittings with ogee joints for the conveyance of surface water only shall comply with IS 166:1972 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

Where specified, pipes shall be made using sulphate resisting cement.

1.7.6 Prestressed concrete pressure pipes and fittings

Prestressed concrete pressure pipes and fittings shall comply with the requirements of B.S. E.N. 642:1995 or B.S. E.N. 639:1995 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

1.7.7 Acrylonitrile - Butadiene - Styrene (ABS) pipes and fittings

Acrylonitrile-butadiene-styrene (ABS) pressure pipes shall comply with the requirements of BS 5391:Part1:1976. Acrylonitrile-butadiene-styrene (ABS) fittings for use with Acrylonitrile-butadiene-styrene (ABS) pressure pipes shall comply with the requirements of B.S. 5392, Part I: 1976 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

1.7.8 Clayware sewer pipes and fittings

Clayware pipes and pipeline fittings shall comply with BS 65 and BS EN 295 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008. All pipes shall have flexible type joints of approved manufacture.

1.7.9 Glass Reinforced Thermosetting Plastics (GRP) pipes and fittings

Glass Reinforced Thermosetting Plastics (GRP) pipes (fittings and joints) based on unsaturated polyester resin for use in water supply with or without pressure shall comply with BS EN 1796: 2006 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

Glass Reinforced Thermosetting Plastics (GRP) pipes (fittings and joints) based on unsaturated polyester resin for use in conjunction with drainage and sewerage with or without pressure shall comply with BS EN 14364: 2006 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

1.7.10 Ductile iron pipes and fittings

Ductile iron pipes, fittings and joints for potable water shall comply with the requirements of B.S. EN545 and manufacturers shall operate a quality system in compliance with ISO 9001:

2008. Ductile iron pipe fittings and joints for sewage shall comply with the requirements of B.S. EN598 and manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

All ductile iron pipes for potable water shall be coated internally with a cement mortar lining made with sulphate resisting cement complying with B.S. E.N. 545 and shall be sealed with an epoxy resin sealcoat with a minimum thickness of 160µm complying with BS7892. The complete internal lining shall be approved for use in the water industry and shall have independent certification to this effect. External protection shall include a zinc coating to BS EN 545 with a finishing layer bituminous based coating to BS 3416:1991.

All ductile iron pipes for sewerage shall be coated internally with a cement mortar lining made from high alumina cement. External protection shall include a zinc coating to BS EN 545 with a finishing layer bituminous based coating to BS 3416:1991.

Where specified in the Contract, a polyethylene sleeving system shall be used as external protection to all ductile iron pipework. The sleeving shall be blue in colour for watermains. The polyethylene sleeving system shall comply with the requirements of BS 6076.

Where polyethylene sleeving is required in the Contract, joints and fittings shall be protected separately on site. Such protection may consist of proprietary muff type joints, polyethylene sleeving with plastic adhesive tape in accordance with manufacturers recommendations or complete wrapping of the joint or fitting with spirally wound Denso (or similar approved) tape with 50% overlap and extending 150mm either side of the joint or fitting.

1.7.11 Polyethylene pressure pipes and fittings

Polyethylene (PE) piping systems shall comply with EN 12201.

Polyethylene pipes for use in connection with potable water supply and for drainage and sewerage under pressure shall be in accordance with EN 12201-2 and shall be the type PE100 with a standard dimension ratio (SDR) of 11 unless stated otherwise in the contract. Polyethylene fittings for use with potable water supply and for drainage and sewerage under pressure shall comply with the relevant provisions of EN 12201-3. Electrofusion fittings for use in connection with potable water supply and for drainage and sewerage under pressure shall comply with the relevant provisions of BS EN 12201-3 and WIS 4-32-14. Manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

All site fusion jointing of polyethylene pipes shall conform to UK Water Industry Specification Number 4-32-08 and IS EN 12201. Butt fusion jointing machines shall conform to the UK Water Industry Specification Number 4-32-16.

Polyethylene (PE) piping systems for use in non pressure underground sewerage and drainage applications shall conform to I.S. EN 13476 2007 "Plastic pipes for non pressure underground drainage and sewerage structured wall piping systems of unplasticized poly vinyl chloride (PVC-U), polypropylene (PP) and polyethylene (PE)".

The Contractor's attention is drawn to the specific risks associated with the pipelaying operations planned under this Contract. These include unloading of pipe deliveries, use of drilling pipe coil trailers, work in excavations, etc. With regard to the use of coiled pipes, this can cause the release of stored energy during

the unwinding of the pipe. Uisce Eireann have prepared a specific Safety Alerts on a coiled pipe incident. Safety Alerts for other risks have also been prepared by them and the Contractor is referred to their portal where all Safety Alerts are available for the Contractor to review, <https://www.water.ie/contractor-portal/safety-videos> . The Contractor shall incorporate all identified lessons learnt into their Safe Systems of Work for this Contract.

1.7.12 Steel pipes

Non alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption shall comply with the requirements of BS EN 10224:2002. Manufacturers shall operate a quality system in compliance with ISO 9001: 2008.

Pipes and fittings shall be coated externally with an approved bituminous composition except parts to be encased in concrete. Pipes and fittings shall be coated internally with an approved bituminous composition. Steel pipes for cutting shall be supplied rounded throughout their length. They shall be clearly painted with an identifying mark and shall be used only as directed. All damage caused to the external sheathing or internal lining or to the metal of the pipes as a result of handling by the Contractor or in transport shall be made good by him at his own expense to the satisfaction of the Employers Representative. Where such damage is too extensive to permit satisfactory repair the damaged pipes shall be replaced by new ones at the Contractor's expense. When delivered by the manufacturer all steel pipes and specials must be fitted with wood, plastic or metal protection discs on each end and on all branch openings. These discs must not be removed until the pipe is about to be laid except with the permission of, or on order from the Employers Representative.

1.7.13 Pipeline fittings

(a) Sluice Valves

Sluice valves shall comply in all respects with B.S. 5163: Type B (BS EN1074) and shall be double flanged and drilled to BS EN 1092-2. All sluice valves shall have an overall length to BS5163:1986 (PN16 dimensions) and shall open clockwise.

Stem cap shall be grey cast iron BS EN 1561 GJL-HB-195 complete with bolt BZP Gr 8.8 to BS 4168: Part 1. Valve stems shall be Stainless Steel to BS EN 10088 -1.Gr 1.4021 and fitted with an integral collar. Gland assembly shall be ductile iron to BS EN 1563, EN-GJS-500-7 complete with polyamide bushing containing 1 wiper ring and 3 O-rings of NBR and 2 cadmium plated Gr 8.8 bolts to BS 3692:1967. Thrust collar shall be DZR brass to BS EN 12164, CW602N. The body/ bonnet O ring seal shall be EPDM rubber, WBS listed. The wedge assembly shall be ductile iron to BS EN 1563, EN-GJS-500-7 fully encapsulated with EDJ-70 rubber complete with wedge nut of DZR brass to BS EN 12164, CW602N.

Valves shall be suitable for buried in ground service. Valve bonnets shall be fitted with integral lifting eyes with the body fitted with integral feet. Valves shall have working pressure ratings of 16 bar. Valves shall be fitted with an integral nodular top works as standard to facilitate ancillary items such as gearboxes. An Air plug shall be fitted to the valve bonnet to facilitate installation of the valves. The valves shall be coated internally and externally with an electrostatically applied blue epoxy to the WK Water Industry Specification Number 4-52-01 Class B (WIS 4-52-01 Class B). Extension spindles shall be provided, where necessary, to ensure that the valve key is not more than 300mm below the finish surface and these shall be deemed to be included in the Contract Sum.

Surface boxes for sluice valves shall comply with the relevant provision of I.S. EN 124 and shall be of cast iron with 100 mm diameter clear opening and minimum depth of 260mm hinged and locked lid, set in concrete kerbs as detailed on the drawings.

(b) Hydrants

Hydrants shall comply with B.S. 750 (Type 2). They shall be 80mm nominal bore inlet, streamlined screw down spindle hydrant complete with gunmetal working parts, inlet flanged faced and drilled to BS 10 Table E. The hydrant outlet shall be either a 63mm diameter male threaded outlet or a 63mm bayonet lug outlet with loose cast iron cap. The outlet cap shall be attached to the hydrant by W.I. chain. The type of outlet used and the threading of the valve spindle shall comply with the requirements of the local Chief Fire Officer.

The hydrant shall be coated internally and externally with an electrostatically applied blue epoxy to the WK Water Industry Specification Number 4-52-01 Class B (WIS 4-52-01 Class B). Extension spindles shall be provided, where necessary, to ensure that the outlet is not more than 200mm below the finish surface and these shall be deemed to be included in the Contract Sum.

Surface boxes shall comply with the provisions of IS EN 124 and shall be of cast iron heavy pattern with clear opening of 444mm x 246mm and 65mm deep with chained lid set in concrete kerbs as detailed on the drawings.

(c) Air Valves

Air valves for potable water application shall be double orifice air valves and shall have bodies, covers and cowls of ductile iron to BS EN 1563, EN-GJS-500-7 with flanged inlets of the size specified. Valves shall be flanged and drilled to BS EN 1092-2. The float, float guides and float lever shall be Acrylonite Butadiene Styrene (ABS) plastic. The seal shall be EPDM rubber, WBS listed and the seal support ring shall be ABS plastic. Fastners (bolts) shall be stainless steel 316 Grade A4.

Valves shall have a working pressure rating of 16 bar with the seat tested to 17.6 bar and the body tested to 24 bar. The air valve shall be coated internally and externally with an electrostatically applied blue epoxy to the WK Water Industry Specification Number 4-52-01 Class B (WIS 4-52-01 Class B). The minimum dimensions for air valve surface boxes shall be as recommended by the valve manufacturers and of such dimensions that the bottom flange be completely supported on the walls of the chamber. They shall be of cast iron with chained lid set in concrete kerbs as detailed. The covers shall be perforated to allow the free escape of air.

Each air valve shall have a large and small air escape orifice with an isolating valve. The isolating valve shall have a resilient seated gate valve to BS 5163 Type B (BS EN 1074) and shall be of the boltless bonnet design. The isolating valve shall open clockwise. Air valves with integral isolators shall not be accepted. The bearing faces shall be accurately machined and ground to a watertight finish.

The inlet diameter shall be in accordance with the following table:

Diameter of Mains	A.V. Inlet Diameter
Up to 350 mm.	75 mm
375 mm to 525 mm	100 mm
550 mm to 700 mm	150 mm

Small orifice single Air Valves, with screwed brass isolating cock shall be used on bridges and culverts.

Air relief valves for sewerage, raw water and brine applications shall be dual orifice sewage air relief valves as detailed on the drawings or as described in the Contract Documents. The body, cover, airvalve body, air valve cover and cowel shall be ductile iron to BS EN 1563, EN-GJS-500-7 with flanged inlets of the size specified. Valves shall be flanged and drilled to BS EN 1092-2. The top float and float guides shall be Acrylonite Butadiene Styrene (ABS) plastic. The seals shall be EPDM rubber, WBS listed. The ball float and lever shall be polypropylene. The float elevator and fastners shall be stainless steel to BS EN 10088 Gr.1.4401.

Special air relief valves for sewerage systems shall be as detailed on the drawings or as described in the Contract Documents.

(d) Ferrules, Saddles and Stop Cocks

Patent ferrules and saddles for house service pipes shall be of cast brass or bronze to the latest edition of B.S. 1182 and of 12mm or 20mm diameter as required.

Ferrules used in Asbestos Cement mains shall be of the threadless type with plug type seating piece and rubber seal to B.S. 2494.

Stop cocks for house service pipes shall be to the latest edition of B.S. 1010 and shall have square heads for valve keys and be of 12mm or 20mm diameter as required.

(e) Surface Boxes

Surface boxes shall be of cast iron to I.S. EN 124, flanged type, with hinged cover set in concrete kerbs as detailed on the drawings.

(f) Service Pipes

House service pipes may be of:

- (i) Copper tube to the latest edition of BS EN 1057.
- (ii) High density polyethylene to I.S. 135.
- (iii) Low density heavy gauge polyethylene to I.S. 134.

(g) Valve keys

Valve keys shall be of 25mm square aluminium, finished bright, fitted with eye to take 25mm diameter bar. Keys shall be supplied complete with bar suitably formed for opening valve cover lids etc.

(h) Indicator Posts and Marker Plates

Indicator posts and marker posts of approved type are to be provided to mark the position of all air valves, scour valves, sluice valves, and pipelines.

Marker plates to B.S. 3251 are to be provided to all hydrants. Where possible the marker plates are to be fixed to convenient adjacent walls or if not to approved marker posts set in Mix "B" concrete block of 0.05 cu.m.

1.7.14 Works tests on pressure pipes

All pressure pipe shall be tested hydraulically to at least twice its maximum working pressure by the manufacturer before being delivered to the site. In addition, independent third party certification shall be provided from the manufacturers to confirm the pipe meets the required standard (BS, EN, WIS etc.) defined in this Specification. In addition, the Employer's Representative may instruct any other additional testing or certification to be completed in order to demonstrate that the proposed pipe manufacturer meets these standards and the costs shall be borne by the Contractor and are deemed to be included in the Contract Sum.

1.7.15 Material for bedding, surround and backfill to pipes

(a) Type A granular bedding

Type A granular bedding shall consist of rounded gravel complying with the grading limits for 10mm single-sized aggregates in Table 3 of BS 882. Material containing sharp or angular particles will not be permitted.

(b) Type B Fill

The type B fill shall be of uniform readily compactable material free from clay lumps retained on a 75mm sieve, stones retained on 25mm, sieve, tree roots, vegetable matter, building rubbish and frozen soil.

(c) Clause 804 Backfill

Clause 804 backfill material shall comply with the requirements of the "Specification for Roadworks" (NRA).

Sulphates

The material to be used for bedding and surround for concrete pipes shall not contain more than 0.3% sulphate expressed as sulphur trioxide nor shall it be obtained from a site where the ground water contains more than 0.1%.

1.7.16 Compaction factor of granular material

A compaction factor of 0.1 or less as determined by the test described in Clause 1.8.11 is desirable in the case of Granular Bedding Type A. Materials having a compaction factor between 0.1 and 0.3 are suitable, but need extra care in compaction and may not be used in water logged ground. Material having a compaction factor greater than 0.3 are not suitable and may not be used.

1.7.17 Reservoir ventilators

100mm diameter approved pattern cast iron ventilators of total length 900mm are to be fitted where shown in the roofs of reservoirs and surrounded with 300 x 300 x 225mm kerbs of Mix "B" concrete.

SECTION 1.8 TESTING & STERILISATION

1.8.1 Testing – non pressure pipelines (sewers)

1.8.1.1 Testing of pipe materials

Testing of pipeline materials to confirm compliance with the requirements outlined in this Specification shall be completed by the Specialist independent Testing Authority in accordance with Section 2 of this Specification and as follows.

1.8.1.2 Hydraulic pressure testing

Hydraulic pressure testing of the pipelines shall be completed by the Contractor. Testing of sewers shall generally be carried out in accordance with the procedures as set out in BS EN 752.

Wherever possible, testing shall be carried out from manhole to manhole. In no instance, where a sewer is required to be constructed in straight lines between manholes will a length be accepted where the full cross section of the pipe cannot be sighted between manholes. Short branch drains connected to a main sewer between manholes shall be tested as one system with the main sewer. Long branches shall be tested separately.

Non-pressure pipelines shall be given a preliminary air test before backfilling. In addition they shall be given a final water test after backfilling, cleaning and inspection (except where in the opinion of the Employers Representative a pipe line is submerged by a sufficiently high water table in which case an infiltration test will be required).

For the preliminary test (air test), the ends of the pipe shall be sealed and air shall be pumped into the pipeline using a U-Tube (manometer) to a pressure of 100mm head of water. After allowing a period of about 5 minutes for stabilisation of air temperature, and if necessary, adjusting the air pressure to 100mm head of water, the pressure shall not fall by more than 25mm head of water during a period of 5 minutes, without further pumping. An air test shall not be carried out on a section of pipe, which has been surrounded or bedded in concrete during the previous 24 hours.

For the final test (water test), a test pressure of 1.2 metres head of water above the soffit of the sewer shall be applied at the high end but not more than 6 metres at the low end by means of a standpipe. Steeply graded sewers shall be tested in stages where the above maximum head will be exceeded if the whole section is tested as one. After standing for at least two hours for absorption and topping up as necessary, the loss of water over a period of 30 minutes shall be measured by adding water from a measuring vessel at regular intervals of 5 minutes and noting the quantity required to maintain the original water level in the standpipe. The average quantity of water added shall not exceed 1 litre per hour per metre of nominal bore per metre of pipe run.

Before acceptance of any section of sewer after it has satisfactorily passed the above tests, each section of sewer between manholes shall be lamped to check line and level. The permissible tolerances in line and level shall be determined by the Employers

Representative, but unless otherwise specified or determined shall be 6mm in level and 25mm in line between manholes or access points.

Sewers constructed of steel, ductile iron or other material designed for high pressure shall be tested in accordance with the provisions of Clause 1.8.2.

The Water Test will not be required on complete sections of non-pressure pipelines exceeding 750 millimetres nominal diameter. Non-pressure pipes exceeding 750 millimetres nominal diameter shall either have short lengths or each joint individually tested by means of an approved joint testing apparatus with a hydraulic test rig which shall consist of a ring to seal internally the joint surround and enclose the joint area which shall then be tested by pumping water into the sealed space until the pressure reaches 0.10 N/mm². A period of two hours shall be allowed for absorption. Thereafter the test pressure shall be maintained for 30 minutes, and make up water shall be pumped in at 5-minute intervals if necessary to maintain the test pressure. The average quantity of make up water shall not exceed 0.002 litres per hour per millimetre of nominal bore of the sewer at any joint tested.

Where required the sewer shall be tested for obstruction by the insertion and pulling through of twin-coupled rubber plungers of the same diameter as the sewer.

All sewers shall be tested for infiltration after backfilling. All inlets to the system shall be effectively closed and the residual flow shall be deemed to be infiltration.

The following limits of infiltration shall not be exceeded (including those from manholes in a sewer section).

- (i) for sewers not exceeding 750 millimetres nominal internal diameter, 0.08 litre per hour per 100 linear metres per millimetre of nominal bore of the sewer.
- (ii) for sewers exceeding 750 millimetres nominal internal diameter, 0.16 litre per hour per 100 linear metres per millimetre of nominal bore of the sewer.

When manholes are tested separately, infiltration to manholes shall not exceed 5 litres per hour per manhole.

1.8.2 Testing - pressure pipelines

1.8.2.1 Testing of pipe materials

Testing of pipeline materials to confirm compliance with the requirements outlined in this Specification shall be completed by the Specialist independent Testing Authority in accordance with Section 2 of this Specification.

1.8.2.2 Hydraulic pressure testing

Pipelines shall be tested hydraulically in sections during the course of construction. Testing shall be applied to prove the structural soundness of the various units in the line, including pipes, valves and anchorages, and to prove the watertightness of the line. Tests shall be applied to sections of pipeline not exceeding 500 metres in length, or such lesser length as may be required, and pipe joints shall be left uncovered. This test pressure shall be as

specified in the table below.

The initial test pressure on pipeline sections shall be as follows:

Pipe Type	Minimum Test Pressure	Maximum Test Pressure
UPVC Class "B"	1.5 times the working pressure *	91m - 0.90 N/mm ² (130lb/in ²)
UPVC Class "C"	1.5 times the working pressure *	137m - 1.35 N/mm ² (195lb/in ²)
UPVC Class "D"	1.5 times the working pressure *	183m - 1.80 N/mm ² (260lb/in ²)
Ductile Iron Pipes	1.5 times the working pressure *	250m – 2.5 N/mm ²
Polyethylene (PE) pipes	1.5 times the working pressure *	1.5 times the rated pressure

* Subject to a minimum test pressure of 40m (0.4N/mm²) (57 lbs/in²)

In addition to the initial tests on the separate pipeline sections, on completion of all the mains and service connections the main shall be re-tested in whole or in parts to the actual working pressure plus 0.25 N/mm² and by the same procedure as that outlined for individual sections.

The Contractor shall provide pumps, gauges, jacks, struts and all apparatus necessary for carrying out the tests and shall keep them in good order. The pressure gauges shall be calibrated and certified from an approved source or shall be tested to the satisfaction of the Employers Representative.

The Contractor shall provide for transmitting the unsupported end thrusts to solid ground at the ends or into the sides of the trenches. Testing shall not be permitted against a closed valve without the prior approval of the Employers Representative.

Before testing, the Contractor shall ensure that the anchorage of bends is complete and that all branch outlets taking end thrust are properly stayed.

Water required for filling the main shall be obtained from an approved source.

The Contractor shall give the Employers Representative not less than twenty-four hours notice of his intention to test a section of main.

When testing, the pipeline shall be charged with water and all air released. Care shall be taken during the charging of the mains to provide free outlets for air and to prevent water hammer. The pipeline shall then be kept under a nominal pressure of 6 BAR for a period to allow for absorption. Thereafter for a period of two hours the amount of water pumped into the test section during the period of test shall be measured and shall not exceed a rate of 0.1 litres per millimetre nominal internal diameter per kilometre length of main per 30 metres head for each twenty-four hours.

If the amount of make-up water in the two-hour test exceeds the specified quantity, the Contractor shall locate and repair the leaks and repeat the test.

The test on each section shall be repeated until the specified degree of watertightness has been obtained.

Testing of polyethylene pipelines shall take account of the visco elastic properties of the material. Testing shall be carried out in accordance with the test method for PE pipes set out in the WRC publication, "A guide to testing of water supply pipelines and sewer rising mains", June 1999 and digital data loggers shall be used to monitor and provide electronic test data.

House service pipes shall be tested to the same pressure as the mains.

1.8.2.3 Testing of polyethylene joints

Pipe welds to polyethylene pipes shall be carried out by certified welders in controlled conditions in accordance with Clause 1.6.16 of the Specification. A site audit shall be completed on the Contractors site welding set up and procedures by the Specialist independent Testing Authority as provided for in Section 2 of the Specification. This shall verify that they are to acceptable standards and comply fully with WIS 4-32-08 and the results of such inspection shall be given directly to the Employers Representative. This inspection, the subsequent report and the implementations of any recommendations for improvement shall be completed prior to welding of pipelines to progress the works commencing on site.

The Contractor shall take a minimum of 3 sample welds for each butt fusion and electrofusion welding machine to be used in the works prior to commencement of the works and have the weld tested by the Specialist independent Testing Authority for conformance with WIS 4-32-08 as provided for in Section 2 of the Specification. No welding machine shall be used for the progress of the works until the sample weld carried out by that welding machine has been deemed to comply with WIS 4-32-08.

Following approval of the welding machine, sample welds shall be tested at rate of 1 per 200m of pipe laid for butt fusion joints and at a rate of 1 per 10 electrofusion welds by the Specialist independent Testing Authority.

All butt welds tested are required to fail as Ductile in accordance with WIS 4-32-08 and have a minimum virgin mean stress of 90%. All electrofusion welds tested are required to fail as 75% Ductile in accordance with WIS 4-32-08 and have a minimum virgin mean stress of 90%.

As specified in Clause 1.6.16, all debaded joints shall be tagged and numbered and made available to the Employer's Representative for inspection to complete a twist test, check for any pitting in the bead and to check the size of the bead complies with WIS 4-32-08. If any defects are detected in the beading, the Contractor shall excavate and expose that joint in situ and if instructed cut out a section of that weld for testing by the Specialist independent Testing Authority. If this test fails, the joint shall be repaired by the Contractor at his own expense and additional testing shall be undertaken at the Contractors expense to determine if similar weak joints have been laid which also require repair. If the sample of weld passes the test the Contractor will still be required to repair the joint at his own expense.

In addition, ultrasonic non-destructive testing of the joints shall be completed by the

Specialist independent Testing Authority as specified by the Employer's Representative.

1.8.3 Cleansing of water retaining structures

On completion of construction and before any sterilisation, internal surfaces of structures designed to retain an aqueous liquid shall be cleaned thoroughly in such a way as to remove all oil, grit and other deleterious matter.

1.8.4 Testing of concrete water retaining structures

After cleansing of water retaining structures, and as far as practicable before any earth or other filling is placed against the outside wall faces, the structure shall be filled with water at a rate approved by the Employers Representative. After allowing a period of three days or such other period as the Employers Representative may decide, for absorption, the water level shall be recorded by a hook gauge with vernier attachment or by other approved means, and the water shall be allowed to stand for a period of seven days, during which the total permissible drop, after allowing for evaporation and rainfall, shall not exceed 1/500 of the average water depth of the full tank or 10 mm whichever is the less.

Notwithstanding the satisfactory completion of the above test, any leakage visible on the outside faces of the structure shall be stopped. Any caulking or making good of cracks in the wall section shall, where practicable, be carried out from the inside face.

1.8.5 Testing of reservoir roofs

Roofs of service reservoirs shall be watertight and shall, where practicable, be tested on completion by lagooning with water to a minimum depth of 25mm for a period of 24 hours.

Where it is impracticable, because of roof falls or otherwise, to contain 25 mm depth of water, the roof shall be thoroughly wetted by continuous hosing for a period of not less than six hours.

In either case, the roof shall be regarded as satisfactory if no leaks or damp patches show in the soffit.

The roof covering shall be completed as soon as possible after testing.

1.8.6 Testing manholes

All manholes are to be subjected to a water test. Tests should not be carried out until the structures have reached sufficient strength to sustain the pressure from testing. Where possible, backfilling around the manhole should not be carried out until the test has been completed. To carry out the test a bag stopper shall be fitted in the outlet of the manhole. A means of safely removing the stopper from the surface shall be provided. All other connections shall be fitted with expanding plugs or bag stoppers, secured to resist the full hydrostatic head to be applied.

The manhole shall be filled with clean water to a sufficient depth to give a test head of not

less than 1.5m (unless otherwise stated in Section 2), and allowed to stand for at least 8 hours to allow for absorption, topping up the level as necessary at intervals.

The manhole will be deemed to have passed the test if no appreciable flow of water penetrates the permanent work or if the test shows that the construction is substantially watertight. If they show leakage of any kind they shall be made good by additional plastering or other approved methods at the Contractor's own expense.

1.8.7 Cleansing of pipelines

On completion of the initial hydraulic test on water mains, a foam swab shall be passed through the main for final cleansing a sufficient number of times to achieve clear wash water prior to flushing, testing and sterilizing the watermains. The Contractor shall provide the swabs and any temporary pipework required.

Swabs shall be manufactured in one piece from flexible cellular polyurethane material which shall conform to BSEN ISO 5999:2004. Swab sizes shall be as follows:

Nominal size of Pipe (mm)	Minimum Diameter of Swab (mm)	Length of Swab (mm)	Minimum length of Swab Discharge Control Unit (mm)
100	130	250	Not required
150	200	300	Not required
200	275	400	1500
250	335	450	1600
300	400	450	1600
350	450	500	1800
400	475	600	2000
450	550	600	2000
500	625	900	2600
600	750	900	2600

A clean metal plunger or similar type tool shall be used to insert the swab into the main clear of any fittings downstream of the control valve arrangement for swabbing. The discharge control length shall be to the dimensions shown in the above table.

The length of main to be swabbed shall be isolated and all hydrants within the limits of the swab run shall be closed. The main shall be filled via a backflow prevention device and all air shall be bled from the main. The control valve or discharge assembly shall be operated to propel the swab along the main at a velocity between 0.5 to 1.0m/s.

On expulsion of the swab, the Contractor shall thoroughly flush the pipeline and this shall be

continued until the wash water runs clear. The procedure shall be repeated using clean swabs if after a reasonable flushing period the discharge water remains discoloured. The Contractor shall ensure that no erosion or silting occurs in the water courses into which the wash water is discharged.

1.8.8 Sterilisation and Bacteriological Testing of Watermains

Mains shall be sterilised after testing and scouring and immediately before being brought into use.

Sodium hypochlorite solution shall be applied at the charging point as the main is being filled and dosing shall be continued until the main is full and at least 50 milligrams per litre (mg/l) of free chlorine has been made available.

The treated water shall be left in the main for a period as directed but not exceeding 24 hours and all valves in the system shall be operated at least once during this period. Chlorine residual tests shall then be taken at the end of the main furthest from the point of injection. The sterilisation process shall be repeated until the chlorine residual is not less than 10 mg/l. The chlorinated water shall then be neutralised as described hereunder and flushed out and the pipes filled with pure water.

Prior to its disposal, the waste chlorine solution shall be neutralised using sodium bisulphate or approved equivalent chemical. Dosing of sodium bisulphate shall be proportional to the concentration of free chlorine. The chlorine should be just neutralised, without overdosing as this would cause depletion of dissolved oxygen.

The procedure for neutralisation and disposal of chlorinated water from the water mains shall be as follows:

- (a) Determine the concentration of free residual chlorine and oxygen using an online monitor over sufficient time to ensure a reliable result;
- (b) Determine the amount of sodium bisulphate to be dosed;
- (c) Partially open the scour valve on the washout outfall pipe to release the flow into a chamber while simultaneously dosing sodium bisulphate into the chamber in such a way as to ensure good mixing with the flow of water. The rate of discharge shall be such as to ensure adequate contact time between the sodium bisulphate and the chlorinated water;
- (d) The sodium bisulphate shall be dosed using a dosing pump at such a rate as to ensure that the chlorine concentration of the flow being discharged from the chamber is reduced to zero and the dissolved oxygen concentration is not less than 1mg/l lower than the concentration prior to neutralisation. An online monitor shall be used to continuously monitor the chlorine and dissolved oxygen concentrations in the water being discharged to the receiving water.

The Contractor shall dispose of neutralised waste chlorine solution in such a manner as to avoid the pollution of natural waters and reservoirs and artificial water courses. The Contractor shall comply with any directives which the Employers Representative may make in respect of such disposals.

After the sterilisation test has been completed to the satisfaction of the Employers

Representative the Contractor shall refill the watermain with drinking water and leave for a stagnation period of 24 hours. After the stagnation period has been completed, a sample of water shall be taken from the watermain for bacteriological analysis. The Contractor shall take great care when obtaining the sample and only sterile containers obtained by the Contractor shall be used. The sampling shall be witnessed by the Employers Representative or his representative on site.

The samples shall be sent by the Contractor to an accredited laboratory and tested for both Total Coliforms (per 100ml) and E.Coli. (per 100ml) within 6 hours of sampling. The limit for both parameters shall be 0 mg/l (zero). A copy of the test report shall be submitted to the Employers Representative.

If the concentration for either parameter exceeds the limit the Contractor shall empty the watermain and repeat both the sterilization procedure and bacteriological test in accordance with this Clause. All works associated with any repeated sterilization, sampling and testing as a result of failure to pass the bacteriological test shall be deemed to be included in the Contract Sum.

After satisfactory completion of this test the watermain shall be commissioned and brought into use.

1.8.9 Sterilisation of structures for potable water

Immediately before acceptance of any structure for potable water, sodium hypochlorite solution shall be distributed over the floor so as to give a uniform concentration of not less than 20 mg/l of free chlorine in 300 mm minimum depth of water. This solution shall then be used to spray the roof soffit, walls and columns, ensuring that the whole of the exposed areas are covered.

The Contractor shall provide goggles and protective clothing and equipment for the operatives doing this work.

Prior to its' disposal, the waste water chlorine solution shall be neutralised using sodium bisulphate or approved chemical in a similar manner as specified in Clause 1.8.8. Neutralising chlorine in a reservoir should be done gradually with sufficient mixing. This is because if the sodium hypochlorite is dosed all at once without sufficient mixing, the chlorine will only locally be neutralised and locally the oxygen will be removed. An online monitor shall be used to continuously monitor the chlorine and dissolved oxygen concentrations in the water being discharged to the receiving water. The water may only be discharged if the chlorine concentration is reduced to zero and the dissolved oxygen concentration is not less than 1mg/l lower than the concentration prior to neutralisation.

1.8.10 Assistance in sampling and testing

The Contractor shall supply all samples of materials for testing and shall render such assistance as may from time to time be required in taking and packing them into containers, provided by the Contractor, and dispatching them for test or in making, examining and testing them. All testing shall be undertaken by an accredited laboratory.

1.8.11 Testing of pipe bedding material

For testing pipe-bedding material, a representative sample of about 40 kg shall be heaped onto a clean surface and quartered to obtain approximately 10 kg. The moisture content of the sample should not differ materially from that of the main body of material, at the time of use in the trench.

A 150 mm internal diameter open ended cylinder, 250 mm high, shall be placed on a firm flat surface and loosely filled, without tamping, from the 10 kg sample. Any surplus material shall be struck off level with the top of the cylinder. The area around the filled cylinder shall be cleared of all surplus material and the cylinder then lifted clear of its contents and placed alongside the material.

Approximately one quarter of the material shall then be placed into the cylinder and compacted by tamping vigorously with a 40 mm diameter metal rammer weighing about 1 kg until no further compaction can be obtained. This operation shall then be repeated for each of the remaining quarters, tamping the final surface as level as possible.

The distance from the top of the cylinder to the surface of the final layer shall then be measured and this value, divided by the height of the cylinder, shall be taken as the Compaction Factor. Acceptable values of the Compaction Factor for different Bedding Materials are given in Clause 1.7.16 of this Specification.

This testing shall be completed by the Specialist independent Testing Authority as detailed in Section 2 of the Specification.

1.8.12. Closed circuit television (C.C.T.V.) survey of sewers

After the sewers have been laid and successfully tested a tele-camera survey shall be carried out, to approved standards, of all the sewers constructed or refurbished under the Contract in order to determine their condition.

If any faults are found by the CCTV survey then the fault shall be rectified and the CCTV survey shall be repeated until the Employers Representative is satisfied that all defects have been repaired.

The Employers Representative shall instruct the Contractor when to carry out the survey. The Contractor shall include for cleaning and flushing out the sewers as directed by the Employers Representative.

The C.C.T.V. survey shall be carried out in accordance with the WRC Model Contract document for non-entry sewer inspections (2nd Edition and in particular Section 3 "Specifications" thereof).

All C.C.T.V. runs shall be carried out with the camera progressing in a downstream direction. The Contractor shall also provide for a constant flow of clean water in the pipe for the duration of the survey to a height of flow just sufficient to identify any low points that may exist in the pipeline. The survey shall be supervised by the Employer's Representative or his representative on site.

Two copies of the final DVD or CD-ROM and report including plan layout showing the referenced sewer network of the survey shall be supplied to the Employers Representative on completion.

1.8.13 Testing of trench backfill material

Material for use as backfill in trenches shall unless noted otherwise specified comply with Clause 804 of the "Specification for Roadworks" (NRA). A sample of the material, proposed for use by the Contractor, shall be submitted to the Specialist independent Testing Authority, and shall be tested for compliance with the requirements of Clause 804 before any material is delivered to site. No material shall be delivered to site until written approval is received from the Employer's Representative. Further samples, at a frequency of 1 per 100m³, of the hardcore as it is delivered to site shall be tested by the Specialist independent Testing Authority as directed by the Employer's Representative and any material not complying with the requirements of Clause 804 shall be removed from site. Hardcore must also comply with all conditions in Clause 1.2.28 with reference to material and complications.

The hardcore shall be compacted by means of mechanical rollers – see Clause 1.10.8 and also as set out in Clause 802 of the "Specification for Roadworks" to 100% of the maximum dry density obtained from the BS1377: Pt 4:1990 compaction test using the 2.5kg rammer or to a subgrade modulus of 90 MN/m³ obtained using a 450mm diameter plate in accordance with ASTM D 1196-64 but corrected for a 300mm plate. The Reload Modulus of Subgrade Reaction, when measured on the surface of the compacted hardcore, using a plate diameter of 300mm or 450mm as appropriate, shall exceed 150 MN/m²/m. The plate load test is to be taken to an applied load of 140 kN/m² and the subgrade modulus is to be calculated on the deflection measured at an applied load of 70 kN/m² on the initial load sequence of this test. Plate loading tests to check compliance with the above shall be carried out by the Specialist independent Testing Authority as directed by the Employer's Representative, at a minimum frequency of 1 per 200m². The Contractor shall provide an effective reaction load of approximately 10 tonnes, to facilitate carrying out the test and shall make such areas of the site available for testing as directed by the Employer's Representative. This may require the construction of certain areas of ground beams or rising wall to be temporarily deferred to facilitate access for the test load.

SECTION 1.9 MANHOLES, CHAMBERS ETC.

1.9.1 Manholes

The Manholes are to be constructed to the dimensions and levels shown on the drawings. The floor and roof shall be of Mix "C" concrete and the roof shall be reinforced as detailed on the drawings. A 75mm minimum thickness of Mix "A" blinding concrete shall be placed under the manhole floor. The formation level of the 225mm thick floor shall be 275mm below the invert of the exit pipe at the manhole wall 50mm being allowed for rendering and benching to invert.

On foul and surface water sewers the manhole walls may be constructed by one of the following methods unless expressly required otherwise in the contract:

- (a) The walls shall be constructed of in-situ Mix "C" concrete to the thickness indicated on the drawings. All exposed surfaces shall be finished perfectly smooth and fine, showing no shutter marks, irregularities or voids.
- (b) Precast manhole units as specified in Clause 1.9.8 may be used in place of those described above.

Channels and benching shall be as described in Clause 1.9.2 below. Unless otherwise shown the top of the manhole floor shall be 50mm below the channel invert level to allow for rendering and benching to inverts. Short lengths of pipe projecting not more than 450mm beyond the external face of the manhole wall shall be built into manhole walls and surrounded with a 150mm thick surround of Mix "B" concrete 300mm long. The manhole roof shall be cast to suit surface gradients. A square seating shall be formed on the manhole roof, using one or two courses of engineering brick to I.S.91 as detailed on the drawings, for frame and cover.

1.9.2 Channels and benching

For manholes and inspection chambers, channels shall be formed of glazed vitrified clay half round channels or concrete precast half round channels jointed in cement mortar (1:2) to true levels, and to easy curves where required.

Branch channels shall be curved so as to discharge into the main channel at an angle of not more than 45° except where the Employers Representative shall decide otherwise. Branch pipes shall be arranged to enter the manhole with their soffits (TOPs) level with the soffit of the main sewer. Tapered channels shall be used where required. Benching shall be carried up vertically from the channels to the soffit (TOP) level of the pipe or to such other levels as are shown on the drawings.

The top of the benching shall be splayed off at a slope of 1 in 10 to the horizontal with the edges rounded to a radius of 20mm. Benching shall be constructed of Mix 'B' concrete, finished off with a rendering coat of 1 to 2 cement sand mortar 25mm thick and trowelled smooth. Where shown on the drawings channels shall be formed in Class "A" engineering brickwork.

1.9.3 Ramp manholes

Where ramp manholes need to be provided, they shall be constructed in accordance with the details provided by the Employers Representative. The ramp pipes are to be connected to special junctions and curved inlet pipes, and completely encased in Mix 'A' concrete. Sockets or spigots of pipes are not to project into the manholes but finish flush with the inner face of walls, or set back into walls where stoppers are required.

1.9.4 Step rungs/access ladders

For manholes less than or equal to 2.6m deep, galvanised steel step rungs to the pattern and dimensions shown on the Standard Manhole Details drawings shall be fixed in one wall at intervals not greater than 300mm. Holes are to be cut out for the rungs, and same to be firmly bedded in position with 1 to 1 sand / cement mortar. The rungs shall be vertically in line. The top rung shall be located within 450mm of the top of the frame.

No step rungs or access ladders to be provided in manholes greater than 2.6m deep.

1.9.5 Inspection chambers

Inspection chambers shall not be deeper than 900mm and shall be of 450 x 450mm internal dimensions. The floors shall be constructed of Mix "C" concrete 150mm thick. The walls shall be either of in-situ Mix "C" concrete 150mm thick or 225mm solid concrete blockwork with a 1:1:6 mortar mix, or of precast concrete units 115mm thick. The covers and frames shall be of approved manufacture to the weights set out in the drawings and Pricing Document. Channels and benching to inspection chambers shall be in accordance with Clause 1.9.2 above.

1.9.6 Ventilators

Ornamental cast iron ventilating shafts, of an approved type and make, fitted with wire cowls, are to be fixed where shown on drawings, or where required by the Employers Representative. The shafts shall be mild steel, 150mm diameter, and 9 metres high over ground. The shafts shall be fixed in blocks of Mix 'B' concrete one cubic metre in volume and positioned 150mm inside kerbs of paths, or as directed, and painted with two coats of an approved colour after erection.

The Contractor shall lay 150mm diameter vent drains, with adequate falls, from side inlets of shafts to join with manholes, similar in every respect as for 150mm sewers, at an average depth of one metre from ground level to inverts.

1.9.7 Manhole covers and frames

For details of manholes see our Standard Manhole Details drawings.

The appropriate grade of cover and frame which shall be used in any location is given in the following table:

Type	Location
I.S. EN 124, Class D400	Carriageways
I.S. EN124, Class B125 or I.S. 242P, Part 2	Footpaths, verges, vehicular accesses
I.S. EN 124, Class A15 or I.S. 242P, Part 1	Situations inaccessible to wheeled vehicles

1.9.8 Precast concrete manholes

Precast concrete manholes shall comply with the requirements of B.S. 5911: Part 1. Precast concrete manholes for sewers of size 100mm to 750mm shall be constructed as shown on the drawings using precast concrete components set on bases formed from in-situ, Mix "B" concrete. All precast units shall be constructed truly vertical. Precast base units with or without benching shall not be used without the prior permission of the Employers Representative. Tapers or reducing slabs shall not be used until a 2m height of full size chamber has been constructed above the benching level.

The lower chamber section shall be bedded on and haunched with cement mortar and the precast cover slab shall also be bedded in cement mortar on the top-most ring. Joints between chambers, taper and shaft units shall be sealed with cement mortar or approved proprietary mastic. Alternatively rubber ring joints may be used with the prior permission of the Employers Representative.

Step rungs shall have embedment of 80mm and shall be built in at 300mm vertical intervals and where tails project they shall be protected by cement mortar. Step rungs shall not be used for hoisting or lowering components.

If the finished manhole is not watertight, it shall be repaired by a method subject to the Employers Representative's approval.

Precast concrete rings shall be surrounded with 150mm thickness of Mix "C" concrete.

1.9.9 Chambers

Unless detailed otherwise on the drawings, chambers for sluice valves, air valves, domestic meters, mainline meters, waste water meters and hydrants shall be built of 225mm thick solid blockwork constructed in a 1:1:6 mortar mix and of the internal dimensions shown on the drawings and set on Mix 'B' concrete floor. Roofs, kerbs and surrounds to covers etc., shall be of Mix 'B' concrete and as detailed on drawings.

Chambers for stopcocks shall consist of 150mm diameter A.C. or concrete pipe supported on concrete or clay bricks placed on each side of the stopcock and as detailed on drawings.

Precast concrete sections of approved quality will be allowed in lieu of 225mm solid blockwork in the above chambers.

1.9.10 Surrounds to surface boxes

Surrounds to surface boxes shall be of in-situ Mix 'B' concrete to the dimensions and details shown on the drawings.

1.9.11 Manhole ladders

Where required, manhole ladders and fixings shall be of mild steel complying with the requirement of B.S. 4211, and B.S. 5395: Part 3 and galvanised after manufacture.

The stringers shall be placed not less than 380 mm apart with approved fixing brackets located at centres not exceeding 2 metres (minimum of two pairs per ladder). The rungs shall be at 230mm centres.

Bolts, nuts and washers shall be cadmium-plated. The stringers shall be 64mm x 19mm section and the rungs 25mm in diameter.

1.9.12 Manhole safety chains

Manhole safety chain shall be 8mm nominal size Grade M(4) non-calibrated chain, Type 1, complying with EN818-7: 2002. After manufacture mild steel safety chains shall be hot dip galvanised in accordance with BS EN ISO 1461: 1999.

The chain length shall be as detailed on the drawings with one end securely attached to 16mm diameter galvanised mild steel eyebolt and the other end securely attached to a suitable galvanised wrought iron hook for attaching to similar eyebolts.

SECTION 1.10 ROADWAYS, FOOTPATHS ETC.

1.10.1. General

Earthworks, sub-grade, sub-base, road base and surfacing shall be constructed in accordance with this specification and the relevant clauses of "Specification for Road Works" published by the NRA. Formation level of cuttings and embankments is defined in this specification as the level of the ground obtained after completion of the earthworks and sub- grade layer.

1.10.2. Excavation of road cuttings

The Contractor shall carry out the excavation of road cuttings in accordance with the lines and levels shown on the drawings. He shall strip the topsoil to a depth of 225mm separately from other materials and shall set it aside for future use. He shall then excavate in the sub- soil down to formation level or to a lower level where required by the Employers Representative to reach a solid foundation. The width of the excavation shall be 1 metre wider than that of the finished roadway. Excavation of cuttings shall be carried out up hill to maintain free drainage of cuttings. The spoil shall be used for filling elsewhere on the site if approved by the Employers Representative, or otherwise shall be removed from the site to dumps provided by the Contractor, as stated in the Works Requirements. The formation level surface shall be compacted by 4 passes of an 8-10 tonnes smooth-wheeled roller or equivalent. Construction traffic shall not use the surface of the bottom of a cutting unless the cutting is in rock or the Contractor maintains the level of the bottom surface at least 300mm above formation level. Any damage to the sub-grade arising from such use of the surface shall be made good by the Contractor with material having the same characteristics as the material which has been damaged.

All land drains disturbed during the course of excavation shall be properly restored or diverted, before construction of roadworks commences.

1.10.3. Road embankments

The embankments for roads shall be constructed to the lines, levels, slopes and depths shown on the drawings. Filling material in embankments shall consist of natural crushed stone or other approved hard material clean and free from extraneous material and graded from 225mm to 75mm size. The filling shall be placed in layers of 225mm loose depth and each layer shall be compacted by 10 passes of an 8-10 tonnes smooth wheeled roller or equivalent. Embankments shall be built up evenly over the full width and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to drain readily from them. The width of the top of the road embankment shall extend 1 metre beyond the kerb line and shall then be graded off at a slope of 1 in 3 unless shown otherwise on the drawings. During the construction of embankments the Contractor shall control and direct constructional traffic uniformly over their full width. Damage to compacted layers by constructional traffic shall be made good by the Contractor.

If the Contractor wishes to continue to use the surface of embankments for constructional traffic before trimming to formation level he shall bring up and maintain the area between the extremities of the carriageway including hard shoulders to a level not less than 150mm above formation level. However any damage caused to the sub-grade by the use of such surface shall be made good by the Contractor at his own expense. In areas of shallow filling where after removal of topsoil the ground level is within 300mm of formation level, constructional traffic shall not use the surface unless the Contractor brings up and maintains the surface level at least 300mm above formation level. Any damage to the sub-grade caused by such traffic shall be made good by the Contractor at his own expense.

1.10.4. Filling of sub-grade

Filling of sub-grade up to formation level as necessary shall be in accordance with Clause 1.5.8.

1.10.5. Protection and surface treatment of formation

To avoid deterioration of the sub-grade, the final 150mm of excavation to formation level shall not be carried out until the Contractor is ready to place the sub-base material on the prepared formation.

The formation shall be finally shaped and regulated to the prescribed level parallel to the finished surface level of the road and thereafter it shall not be subjected to any constructional or other traffic until the road surfacing has been laid. The formation level surface shall be compacted by 4 passes of an 8-10 tonnes smooth wheeled roller or equivalent.

Where the completed formation is not immediately covered with sub-base material, it shall be protected by a membrane of 500 gauge impermeable plastic sheeting with 300mm laps set to prohibit ingress of moisture or by other approved protection. The Contractor shall arrange for the rapid dispersal of water, shed on the earthworks and completed formation during construction or that which enters into roadworks from any source, and when practicable the water shall be discharged into the permanent outfall for the pipe drainage system.

The Contractor shall provide where necessary and at his own expense temporary watercourses, ditches, drains, pumping or other means of maintaining the roadworks free from water. Such provision shall include carrying out the work forming the cuttings and embankments in such a manner that their surfaces have at all times a sufficient minimum crossfall and where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

Where indicated on the drawings or where poor ground conditions are known to exist, a geotextile membrane (Terram 1000 or approved equivalent) shall be placed on the formation level.

1.10.6. C.B.R. of sub-grade and thickness of sub-base

- 1.10.6.1 The strength of the sub-grade shall be assessed on the California Bearing Ratio (C.B.R.) scale. The C.B.R. test is described in B.S. 1377. However, unless the C.B.R. has been determined by a soil survey and analysis the values of C.B.R. shown in the following table which are related to soil types and plasticity indices shall be adopted in assessing the strength of the sub-grade.

Estimated laboratory C.B.R. values for Irish Soils compacted at the natural moisture content			
Type of Soil	Plasticity index (per cent)	CBR (per cent)	
		Depth of water-table below formation level.	
		more than 600mm	600mm or less
Heavy clay	70	2	1
	60	2	1.5
	50	2.5	2
	40	3	2
Silty clay	30	5	3
Sandy clay	20	6	4
	10	7	5
Silt	--	2	1
Sand (poorly graded)	non-plastic	20	10
Sand (well graded)	non-plastic	40	15
Well-graded sandy gravel	non-plastic	60	20

- 1.10.6.2 (a) The thickness of sub-base to Flexible Carriageways shall be as shown on the drawings or otherwise shall be determined from the C.B.R. value of the sub-grade in accordance with following table:-

Flexible Carriageways - Minimum Sub-base Thickness (mm)	
C.B.R. of Sub-grade (%)	Minimum thickness of Sub-base (mm)
Less than 2	600
2	450
3	350
4	270
5 or greater	250

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- 1.10.6.3 (b) The thickness of sub-base (i.e. base) to Concrete Carriageways shall be as shown on the drawing but shall be 150mm minimum thickness.

If the sub-base to concrete carriageways is likely to be used by construction traffic it shall be strengthened by increasing its thickness of 150mm minimum (see above) to 230mm minimum.

1.10.7. Sub-base material

The material used in the construction of the sub-base shall consist of crushed rock, from an approved source. It shall be consistent in quality and free from rubbish, dirt and other foreign material.

The material shall be in accordance with Clause 804 Granular Material Type B, of the of the "Specification for Road Works" (NRA) and also comply with Clause 1.2.28.

Materials in accordance with the above grading will have a C.B.R. value in excess of 30% and therefore C.B.R. testing of the material is unnecessary.

1.10.8. Construction of sub-base

The sub-base material shall be placed and spread evenly over the formation in such a manner as to avoid damage to the prepared formation. Spreading shall be undertaken either concurrently with placing or without delay.

Compaction shall be carried out in accordance with Clause 802 of the "Specification for Road Works" (NRA). Compaction shall be completed as soon as possible after the material has been spread. Material shall be compacted in accordance with the following table depending on the type of compaction plant used and the thickness of layers laid:

Compaction Requirements for Granular Sub-base Material				
Type of compaction plant	Category	Minimum number of passes for layers not exceeding the following compacted thickness		
		110mm	150mm	225mm
Smooth- wheeled roller	<u>Mass per metre width of roll</u>			
	2700 - 5400kg	16	Unsuitable	Unsuitable
	more than 5400kg	8	16	Unsuitable
Pneumatic-tyred roller	<u>Mass per Wheel</u>			
	4000 - 6000kg	12	Unsuitable	Unsuitable
	6000 - 8000kg	12	Unsuitable	Unsuitable
	8000 - 12000kg	10	16	Unsuitable
	more than 12000kg	8	12	Unsuitable
Vibratory roller	<u>Mass per metre width of vibrating roller</u>			
	700 - 1300kg	16	Unsuitable	Unsuitable
	1300 - 1800kg	6	16	Unsuitable
	1800 - 2300kg	4	6	10
	2300 - 2900kg	3	5	9
	2900 - 3600kg	3	5	8
	3600 - 4300kg	2	4	7
	4300 - 5000kg	2	4	6
	more than 5000kg	2	3	5
Vibrating plate compactor	<u>Mass per m² of base plate</u>			
	1400 – 1800	8	Unsuitable	Unsuitable
	kg/m ²	5	8	Unsuitable
	1800 – 2100 kg/m ²	3	6	10
	more than 2100 kg/m ²			
Vibro tamper	<u>Mass</u>			
	50 - 65kg	4	8	Unsuitable
	65 - 75kg	3	6	Unsuitable
	more than 75kg	2	4	10
Power rammer	<u>Mass</u>			
	100 – 500kg	5	8	Unsuitable
	more than 500kg	5	8	12

1.10.9. Roadbase to flexible carriageways

The roadbase to flexible carriageways shall be constructed to the thickness as shown on the drawings of either

- 1.10.9.1 Dry bound macadam; or
- 1.10.9.2 Wet-mix macadam; or
- 1.10.9.3 Dense bitumen macadam, or
- 1.10.9.4 Lean mix concrete.

Unless noted otherwise on the drawings or Pricing Document the roadbase shall be constructed of wet mix macadam and shall be 110mm in thickness.

The above alternative types of roadbase shall be constructed as follows:

1.10.9.1 Roadbase of dry-bound macadam

The dry-bound macadam shall consist of coarse aggregate complying with either the 50mm or the 40mm nominal sizes of B.S. 63 and the fine aggregate shall all pass the 5mm B.S. sieve size. The fine aggregate shall be dry on arrival at site and if stockpiled it shall be kept dry by being sheeted until required for use.

The coarse aggregate shall be laid in layers by mechanical plant to a thickness within the range 75mm to 100mm and compacted by being given two passes by a smooth wheeled roller having a mass per metre width of at least 2500 kg on at least one roll.

The fine aggregate shall then be spread on each layer of coarse aggregate to a thickness of approximately 25mm by a suitable spreading machine and vibrated into the voids of the coarse aggregate by a vibrating plate compactor having a mass per m² of the base plate of at least 1400 kg/m² or a vibrating roller having a mass per metre width of roll of at least 1800kg.

The operations of spreading and vibrating the fine aggregate shall be repeated as necessary until no more will penetrate into the layer of coarse aggregate and no hungry patches are visible on the surface, when it shall be brushed to remove the excess fines and leave the coarse aggregate standing 3mm to 6mm proud. The layer shall then be rolled with a smooth wheel roller having a mass per metre width of at least 5000 kg on at least one roll.

The above operations shall be repeated as necessary to provide the full-specified thickness of roadbase.

1.10.9.2 Roadbase of wet-mix macadam

The wet mix macadam shall consist of crushed rock lying within the grading limits set out in the following table.

Wet Mix Macadam - Range of Aggregate Grading		
B. S. Sieve Size		Percentage by mass passing
50	mm	100
37.5	mm	95 - 100
20	mm	60 - 80
10	mm	40 - 60
5	mm	25 - 40
2.36	mm	15 - 30
600	microns	8 - 22
75	microns	0 - 8

The particle size shall be determined by the washing and sieving method of B.S. 812: Part 10.3. The moisture content of the wet-mix macadam shall be the optimum $\pm$ 0.5% as determined in accordance with the Vibrating Hammer Method Test in B.S. 1377: Part 4 and without drying out or segregation.

The material shall be laid and compacted in layers in accordance with the table shown in Clause 1.10.8 which depends on the type of compaction plant used and the thickness of layers laid. Compaction shall be completed as soon as possible after the material has been spread.

Any areas of compacted material having a loose surface deficient in fines due to segregation or otherwise shall be made good by having it removed and replaced with properly graded material.

The surface of the compacted wet-mix macadam should be sealed at the end of each day's work in order to prevent the ingress of rainwater with cationic bitumen emulsion (70% bitumen) sprayed at a rate between 1.1 and 1.4 lit/m², covered with 6mm chippings at a rate of spread of 6 to 8 kg/m² and lightly rolled.

1.10.9.3 Roadbase of dense bitumen macadam

The dense roadbase bitumen macadam shall be composed of coarse aggregate consisting of hard clean crushed rock 28mm nominal size complying with the requirements of B.S. 4987: Part 1. The fine aggregate may be crushed rock or sand or a mixture thereof. The quality of the fine aggregate shall comply with the requirements of B.S. 4987: Part 1.

The binder shall be petroleum bitumen of 100 pen grade complying with the specification issued by the National Roads Authority / Department of the Environment as appropriate. Laying and compaction shall be carried out in accordance with the "Specification for Road Works" (NRA).

1.10.9.4 Roadbase of lean mix concrete

The Lean Mix Concrete Roadbase shall consist of either coarse and fine aggregate batched separately or an all-in aggregate with a maximum nominal size not exceeding 40mm.

The overall grading of the aggregate shall be within the limits shown in the following Table.

Range of Aggregate Grading for Lean Mix Concrete Roadbase	
Aggregate Grading B. S. Sieve Size	Percentage by mass passing
75 mm	100
37.5 mm	95 - 100
20 mm	45 - 80
5 mm	30 - 40
600 microns	8 - 30
150 microns	0 - 6

The average 28 day strength of groups of three cubes shall be such that not more than one in any consecutive five such averages is less than 10 N/mm² nor more than 20 N/mm². If however, the overall average of any consecutive five groups of three cubes (i.e. fifteen cube strengths) falls below 11 N/mm² or exceeds 20.5 N/mm² at 28 days or if the average range of five consecutive groups exceeds 50% of the overall average strength of the fifteen cubes, the Employers Representative shall require the use of different materials or mix proportions.

The average 7 day strength of groups of three cubes should be not less than 7 N/mm² and not more than 14 N/mm² and if more than one of the 7 day average strengths of groups of three cubes in any consecutive five such averages are below 7 N/mm², or above 14 N/mm², the cement content shall be altered to such a value as may be approved by the Employers Representative and the making of cubes shall be continued at the same rate as at the start of the work until the results show that a satisfactory material is being produced. The ratio by mass of cement to aggregate expressed in terms of its saturated surface dry condition shall be sufficient to produce average crushing strengths as specified above.

The lean mix concrete roadbase shall be placed and spread evenly in a single layer. Compaction shall be carried out until the surface is closed and the density of the compacted base throughout the full depth of the layer shall be not less than 95% of the theoretical dry density of material as compacted to zero air content calculated from the specific gravities determined in accordance with B.S. 812 and the nominal proportions of the constituents including the water. If more than one average dry density in any consecutive five such averages fails to meet this requirement the Employers Representative may require to have the particular layer replaced. The maximum period of time between mixing of the material and final compaction of any given material shall be 2 hours. The surface of the lean mix

concrete roadbase shall on completion of compaction be cured by spraying on an approved aluminised curing compound or by covering with impermeable plastic sheeting adequately secured from being blown off the surface with joints overlapped at least 300mm and set to prohibit egress of moisture.

In frosty weather, newly completed lean mix concrete road bases shall be protected for a period of seven days with straw or other acceptable insulating material. Vehicular traffic shall be kept off the lean concrete road base for seven days after laying and thereafter admission of traffic shall be at the discretion of the Employers Representative.

1.10.10. Surfacing to flexible carriageways

Surfacing to flexible carriageways shall consist of either two-course bituminous construction (i.e. base course and wearing course) or single course bituminous construction. Three types of surfacing are specified below, however unless noted otherwise on the drawings or Pricing Document the surfacing to all roads shall be Type "A" surfacing as specified hereunder. The above three alternative types of surfacing shall be constructed as follows:

Type "A" surfacing

Type "A" surfacing shall consist of a basecourse, 50mm thick, and a wearing course, 40mm thick.

The Basecourse shall be 20mm size Dense Basecourse Bitumen Macadam laid in a single layer. It shall consist of hard clean crushed rock complying with Clauses 4.2 and 6.5 respectively of B.S. 4987: Part 1. The method of mixing, transport, laying and compaction shall be in accordance with B.S. 4987: Parts 1 and 2.

The freshly mixed materials on analysis for aggregate grading binder content and grade shall comply respectively with Tables 15 and 16 of B.S. 4987: Part 1. The mixing temperatures shall comply with Table 41 of B.S. 4987: Part 1.

The temperature of the mixed material as delivered to the laying site and at time of rolling shall be in accordance with Table 4 in Appendix "A" of B.S. 4987 Part 2.

The Wearingcourse shall be 14mm Close Graded Wearing Course Bitumen Macadam laid in a single layer. It shall consist of hard clean crushed rock complying with Clauses 4.2 and 7.3 respectively of B.S. 4987.

The method of mixing, transport, laying and compaction shall be in accordance with B.S. 4987 Parts 1 and 2.

The freshly mixed materials on analysis for aggregate grading, binder content and grade shall comply respectively with Tables 23, 24 and 25 of B.S.: 4987 Part 1 with Traffic Category "B". The mixing temperature shall comply with Table 41 of B.S. 4987: Part 1.

The temperature of the mixed material as delivered to the laying site and at the time of rolling shall be in accordance with Table 4 in Appendix "A" of B.S. 4987: Part 2.

Where joints between laying widths or transverse joints have to be made in the wearingcourse the material shall be fully compacted and the joint made flush in an approved manner. All joints in the wearingcourse shall be offset at least 300mm from parallel joints in

the basecourse.

The wearingcourse shall be laid within seven days of the basecourse being laid unless the Employers Representative directs otherwise.

Type "B" surfacing

Type "B" surfacing shall consist of a single course 60mm thick.

The singlecourse surfacing shall be of Dense Basecourse Bitumen Macadam laid in a single layer. It shall consist of hard, clean, crushed rock 20mm nominal size complying with the requirements of Clauses 4.2 and 6.5 respectively of B.S. 4987 Part 1 and 2.

The method of mixing, transport, laying and compaction shall be in accordance with B.S. 4987: Parts 1 and 2.

The freshly mixed materials on analysis for aggregate grading, binder content and grade shall comply respectively with Tables 15 and 16 of B.S. 4987: Part 1. The mixing temperature shall comply with Table 41 of B.S. 4987: Part 1.

The temperature of the mixed material as delivered to the laying site at time of rolling shall be in accordance with Table 4 in appendix "A" of B.S. 4987: Part 2.

Where joints between laying widths or transverse joints occur the material shall be fully compacted and the joint made flush in an approved manner.

Type "C" surfacing

Type "C" surfacing shall consist of a single course 35mm thick.

The Singlecourse surfacing shall be of Close Graded Wearing Course Bitumen Macadam laid in a single layer. It shall consist of hard clean crushed rock 10mm nominal size complying with the requirements of clauses 4.2 and 7.4 respectively of B.S. 4987: Parts 1 and 2.

The method of mixing transport, laying and compaction shall be in accordance with B.S. 4987: Parts 1 and 2.

The freshly mixed materials on analysis for aggregate grading, binder content and grade shall comply respectively with Tables 26, 27 and 28 of B.S. 4987: Part 1 with Traffic Category "B". The mixing temperature shall comply with Table 41 of B.S. 4987: Part 1.

The temperature of the mixed material as delivered to the laying site and at the time of rolling shall be in accordance with Table 4 in Appendix "A" of B.S. 4987: Part 2. Where joints between laying widths or transverse joints occur, the material shall be fully compacted and the joint made flush in an approved manner.

1.10.11. Surface dressing (provisional)

Surface dressing of roads where required, as shown on the drawings or as directed by the Employers Representative shall be carried out generally in accordance with the Department of the Environment publication entitled "Surface Dressing", except where superseded by the requirements below.

The surface to be dressed shall be dense and brushed clean of dust and any deleterious matter. All ironwork in the roadway (i.e. hydrant covers, manhole covers, gully gratings etc.) shall be coated with heavy oil or grease to prevent adherence of the surface dressing and shall be unmasked before the road is opened for use. Kerbs and channels shall likewise be protected before spraying of the binder is commenced and the surface as a whole shall be dry and damp areas shall be completely free of standing water.

The binder used shall be either cutback bitumen to B.S. 3690 with 100 sec. viscosity (145°C - 160°C spraying temp.) if it is applied in June, July and August and 50 sec. viscosity (130°C - 150°C spraying temp.) if it is applied during the rest of the year or Cationic Bitumen Emulsion to B.S. 434, spray grade with 70% nominal bitumen content.

An approved adhesive agent shall be incorporated either in solution applied to the aggregate or contained in the binder, the percentage content and manner of application being as stated in RRL Road Note 14.

The chippings shall be hard, tough, clean crushed rock of 6mm nominal size in accordance with B.S. 63 for single sized chippings.

The binder shall be applied evenly to the road surface by means of a distributor complying with B.S. 1707. Hand spraying will only be permitted in locations inaccessible to the distributor.

A double layer of surface dressing shall be applied consisting of 6mm crushed rock chippings at a rate of 9-12kg/m² and cationic bitumen emulsion at rate of 1.3-1.6 l/m² on 14mm crushed rock chippings at a rate of 12-15 kg/m² and cationic bitumen emulsion at rate of 1.2-1.6 l/m². The chippings shall be applied immediately to the spray coat. They shall be uniformly spread over the binder film by a mechanical spreader except where its use is impracticable. Immediately after being spread the coated chippings shall be rolled by a rubber-tyred roller, or a steel tyred roller, weighing not more than 8 tonnes until a uniform compact surface is obtained. Excess chippings shall be swept off and traffic shall not be permitted on the dressed surface until the binder has reached its preliminary set.

1.10.12. Testing of materials used in road construction

The Contractor shall arrange for the testing as directed at a laboratory to be approved by the Employers Representative of the various aggregates, bituminous mixtures and their component materials to measure all or any of the characteristics required by the specifications with which they shall comply. The tests shall be carried out on samples taken either before or after laying the materials or mixtures. Sampling and testing shall be carried out as frequently as the Employers Representative may deem necessary to satisfy himself that the mixtures and materials comply with the appropriate specification.

1.10.13. Surface levels of carriageway courses

The levels of carriageway courses and formation shall be determined from the true finished road surface, which shall be the surface of the wearing course for flexible carriageways or of the slab for concrete carriageways, calculated from the vertical profiles and crossfalls as

shown on the drawings. The vertical depth below the true carriageway surface of any point on the constructed surface of the formation or intermediate courses shall be within the following tolerances:

Formation	+ 20mm - 30mm
Sub-base	+ 10mm - 30mm
Road-base	± 15mm
Basecourse	± 6mm
Road Surface	± 6mm

The surface level of the laid wearing course or concrete slab shall not deviate vertically at any point from the true carriageway surface by more than $\pm 6\text{mm}$. However the combination of permitted tolerances in different carriageway levels shall not result in a reduction in the thickness of the wearing courses by more than 5mm or a reduction in the thickness of the whole carriageway, excluding the sub-base, by more than 15mm from the specified thickness.

The laid roadway carriageway surface and the basecourse surface shall be tested with a 3 metres straight edge parallel to the centre line of the road and shall have no greater depression under the straight edge than 3mm and 6mm respectively.

Where any tolerance is exceeded the Contractor shall rectify the defective surface in the following manner:

(a) Formation level

If the surface is too high it shall be trimmed and properly recompacted. If the surface is too low the deficiency shall be corrected by the addition of fresh suitable material of the same classification and properly compacted, at the Contractor's own expense.

(b) Roadbases and sub-bases

The top 75mm of the defective area shall be scarified, reshaped, with added material as necessary and properly recompacted at the expense of the Contractor.

(c) Basecourse and wearing courses

These shall have level or tolerance measurements made while the material is still warm and rectification, where necessary, carried out immediately. Otherwise the Employers Representative may require the full depth of the layer removed over the defective area and replaced with fresh material properly compacted at the expense of the Contractor.

(d) Concrete slabs

Testing of the concrete surface for compliance with tolerances shall be carried out as soon as practicable and after the final pass of the finishing machine. Rectification of the surface shall where practicable be done by the finishing machine. Otherwise high places shall be ground down to within tolerance, and low places rectified by cutting out the surface to a depth not less than 50mm and replacing with concrete to an approved specification and method of replacement, both surfaces being textured to match adjacent finishes.

1.10.14. Concrete carriageways

(a) General

Concrete carriageways shall be laid on a 150mm thick base. The material for the base shall comply with Clause 1.10.7 and shall be laid and compacted in accordance with Clause 1.10.8.

Concrete carriageways shall be of reinforced concrete having a finished compacted thickness of 200mm unless shown otherwise on the drawings or Pricing Document. The concrete shall be Mix "E" as specified in Section 1.2 of this specification - 40 N/mm² @ 28 days with 20mm maximum size aggregate and maximum water cement ratio of 0.55 by mass. The requirements of Section 1.2 of this specification shall be deemed to apply to concrete carriageways as well as the following.

(b) Waterproof underlay

Before placing the concrete carriageway the base shall be covered with 1000 gauge heavy duty polythene sheeting lapped 300mm at joints. Water shall not be allowed to gather on the underlay.

(c) Air content

Where it is shown on the drawings or Pricing Document or where requested by the Employers Representative that air-entrained concrete shall be used in concrete carriageways to increase the frost resistance of the finished concrete then it shall be provided in the following manner. The concrete used in the construction of at least the top 50mm of concrete carriageways shall contain an approved air entraining agent added in such quantity as will obtain $4\frac{1}{2} \pm 1\frac{1}{2}$ per cent entrained air by volume of the mix and frost resistant aggregate shall be used. In addition to other requirements elsewhere in this Specification, the following procedure shall be followed when air entrainment is used prior to any concrete being poured on site and these shall apply to each load delivered to site:

- The percentage air entrainment dosed shall be checked at the batching plant by a supervisor and the supervisor signature present on the batching docket brought to site. No pours may commence until the batching docket has been handed over to the Employer's Representative on site.
- The slump of the concrete shall be checked on site by the supplier in the presence of the Employer's Representative. in accordance with IS EN 12350

pt(s) 1 & 2.

- The percentage air in the concrete shall be tested on site by the supplier in the presence of the Employer' Representative in accordance with BS EN 12350-7:2009.

(d) Limit of workability

The concrete shall be of suitable workability for full compaction without undue flow to be obtained with the plant used.

The compaction factor shall be determined in accordance with B.S. 1881. When its optimum value has been determined and approved by the Employers Representative for the mix and plant being used that value shall be maintained within a tolerance of ± 0.03 .

Alternatively the slump test in accordance with B.S. 1881 shall be used when the average slump of the concrete so determined is equal to or greater than 40mm. In this case the slump shall be maintained within a tolerance of ± 25 mm from the optimum approved by the Employers Representative.

(e) Steel reinforcement

Steel reinforcement to concrete carriageways shall be rectangular long mesh fabric weighing 3.41 kg/m² B.S. Ref. No. C385 unless shown otherwise on the drawings or Pricing Document.

The reinforcement shall have 60mm cover from the surface. The reinforcement shall be placed with the main bars longitudinally. The reinforcement shall terminate at least 40mm and not more than 80mm from the edge of the slab and from all joints.

At the transverse overlaps of reinforcing mats the first transverse wire of one mat shall be within the last complete mesh of the previous mat and the overlap shall be not less than 450mm. No overlap will be required longitudinally between mats.

Trimmer bars 2 No x 12mm diam x 500mm long, in high yield steel shall be placed 1 No top and 1 No bottom diagonally across each corner of the concrete slab where manholes, gullies etc. occur in roadways. 2 No x 12mm diam (h.y.s.) links shall be placed 1 No top and 1 No bottom in the concrete slab over the manhole walls. For further information see our Standard Road Details drawing.

(f) Side forms

Side forms for the construction of concrete carriageways shall be accurately set to line and level and so supported that they remain rigid at all times. They shall be drilled as required for dowel bars. Forms shall be cleaned and oiled immediately before each use.

For machine laid concrete side forms shall be of broad base steel construction rigidly set on hardened concrete base and so jointed that there is no discontinuity and that the finished slab surface level is nowhere more than 3mm out of vertical alignment. Wheels of finishing and spreading machines shall not run directly on the top surface of the side forms but on rails either attached to the forms or separately supported. Side forms shall be removed not less than 12 hours after the completion of construction of the

carriageway slab. The concrete and projecting tie rods shall not be damaged in any way during the removal of the forms.

(g) *Placing, compacting and finishing of concrete*

Placing, compacting and finishing the concrete shall be carried out as rapidly as possible and operations shall be so arranged that in any transverse section the concrete shall be fully compacted throughout the whole depth of the slab and finished within 2 hours from the time of the completion of the mixing of the first batch of concrete in that transverse section to the time of spraying of the curing membrane.

Concreting shall be continuous up to prescribed transverse joints and intermediate construction joints shall only be permitted in the event of mechanical breakdown or adverse weather. Should it be necessary to stop concreting at an intermediate point, the concrete shall be finished off vertically on a transverse line to full depth. When work is resumed against a surface which has set, the surface shall be scabbled and loose or porous concrete removed; the surface shall then be wetted to saturated surface dry condition before placing the new concrete.

A layer of concrete shall be spread and struck off to such regulated surcharge as will give the required thickness after compaction to ensure a top cover to reinforcement of 60mm. The mesh reinforcement shall then be placed in position by hand, or by approved mechanical means and shall be covered immediately with concrete which shall be spread and struck off at the appropriate surcharge and compacted true to finished levels so as to form a monolithic slab. The concrete shall be compacted by one or more passes of an approved hand guided mechanical vibrating beam.

Immediately after the final pass of the finishing beam the surface of the concrete shall be brushed transversely with a stiff broom to remove surplus mortar, expose aggregate and give a uniform lightly striated finish. Brushing must be carefully carried out when the concrete has stiffened but before initial set has taken place. Alternatively a long narrow straight edge may be used to lightly tamp the fresh concrete surface and produce a shallow ridged finish.

(h) *Curing concrete carriageways*

Immediately the concrete surface has been finished it shall be cured by spraying on an even coating of approved aluminised curing compound. Alternatively it shall be cured by covering it with hessian or similar material which shall be kept damp.

(i) *Spacing of joints in concrete carriageways*

The spacing of joints in concrete carriageways shall be as follows unless shown otherwise on the drawings or Pricing Document.

Contraction joints shall be formed transversely in the carriageway at 15.0 m maximum spacing.

Expansion joints shall be formed transversely in the carriageway at 45.0m maximum spacing (i.e. every third transverse joint shall be of the expansion type).

Longitudinal joints shall be formed in carriageways at 4.5 metre maximum spacing except that in the case of carriageways with a finished width not wider than 5.5 metres

no central longitudinal joint will be required.

(j) Contraction joints

Contraction Joints shall consist of a triangular timber fillet crack inducer 50mm high x 50mm base set rigidly in a straight line at the bottom of the carriageway with 20mm diameter mild steel dowel bars 500mm long at 300mm centres placed at mid slab depth centrally about the joint. The half of each dowel bar projecting away from the concreting operation shall be coated with a thin film of approved type bond-breaking compound.

A surface groove 20mm wide by 30mm deep located vertically over the fillet shall either be formed in the plastic concrete or sawn after the concrete has set. Sawing shall be completed as soon as possible within 8 hours after the final compaction of concrete laid before noon and within 18 hours after the final compaction of concrete laid after noon.

The grooves shall have truly vertical and parallel sides with the arrises rounded to about 6mm radius. The grooves shall be cleaned of all dirt and loose material prior to sealing.

The grooves shall be sealed not less than 28 days after lying of the concrete with hot poured rubber bitumen compound complying with the requirements of B.S. 2499. The finished surface of the joint sealing compound shall be 5mm below the surface level of the concrete carriageway.

(k) Expansion joints

Expansion joints shall comprise of a 25mm wide softwood joint filler rigidly set in a straight line with holes accurately bored for the dowel bars to slide through and extending from the bottom of the slab to within 30mm of the top. The softwood filler shall be immersed in water for 48 hours and kept damp until concrete is placed around it.

Mild steel dowel bars 25mm diameter x 650mm long shall be provided at 300mm c/c and placed at mid slab depth so that they project a distance of 350mm from the centre line of the joint away from the concreting operation. The length of dowel bar projecting away from the concreting operation shall be coated with a thin film of approved type bond breaking compound and provided with a closely fitted sleeve 100mm long of waterproof cardboard or other approved material. The end of the sleeve will be charged with a plug of compressible material such as cotton to a depth of 25mm.

A surface groove 30mm wide and 30mm deep (i.e. down to the top of the filler) shall either be formed in the plastic concrete or sawn after the concrete has set. Sawing shall be completed as soon as possible within 8 hours after the final compaction of concrete laid before noon and within 18 hours after the final compaction of concrete laid after noon. The grooves shall have truly vertical and parallel sides with the arrises rounded to about 6mm. The grooves shall be cleaned of all dirt and loose material prior to sealing.

The grooves shall be sealed not less than 28 days after lying of the concrete with hot poured rubber-bitumen compound complying with the requirements of B.S. 2499. The finished surface of the joint sealing compound shall be 5mm below the surface level of the concrete carriageway.

(l) Longitudinal joints

Longitudinal joints shall consist of a triangular timber fillet crack inducer 50mm high x

50mm base set rigidly in a straight line at the bottom of the carriageway with 12mm diameter mild steel dowel bars 1 metre long at 600mm centres placed at mid slab depth centrally about the joint.

A surface groove 5mm wide x 25mm deep located vertically over the fillet shall either be formed in the plastic concrete or sawn after the concrete has set. The grooves shall have truly vertical and parallel sides with arrises rounded to about 6mm radius. The grooves shall be cleaned of all dirt and loose material prior to sealing.

The grooves shall be sealed not less than 28 days after lying of the concrete with hot poured rubber-bitumen compound complying with the requirements of B.S. 2499. The finished surface of the joint sealing compound shall be 5mm below the surface level of the concrete carriageway.

(m) Joints in carriageways at manholes, gullies etc.

Manhole frames, road gully gratings and other cast iron surface boxes shall be housed in separate small slabs, which shall be of the size of the exterior of the shaft or chamber. Where practicable the slabs shall have sides parallel to the main longitudinal and transverse joints in the carriageway slab and shall be cast after the main carriageway slab.

The joints shall be of the expansion type all as previously specified under sub-clause (k) except that the joint filler shall be 20mm wide and the surface groove shall be 20mm wide by 20mm deep.

(n) Stone sett string courses (provisional)

Where shown on the drawings or Pricing Document or where directed by the Employers Representative, a row of granite setts shall be laid at the end of a concrete carriageway where it meets one of different construction.

The setts shall be not less than 100mm deep by 150mm wide laid on a 150mm x 150mm foundation of Class "C" concrete. They shall be bedded and jointed in 1:3 cement sand mortar with their surfaces flush with the surface of the concrete.

(o) Traffic over finished concrete surfaces

While concrete surfaces are being placed, finished and cured, they shall be completely protected against any damage and no vehicular traffic whatsoever shall be allowed on the finished surface within 20 days of the completion.

1.10.15. Cambers and gradients

Unless shown otherwise on the drawings or directed by the Employers Representative the camber or crossfall in a roadway shall lie between 1 in 48 and 1 in 36. Likewise the longitudinal gradient of roadways and the falls of paved areas shall lie between 1 in 200 and 1 in 20.

1.10.16. Footpaths

Concrete footpaths

Concrete footpaths shall be laid on a bed of hardcore of 65mm max size and thoroughly compacted with a 2.5 tonne roller to a minimum consolidated thickness of 100mm, or higher depths if indicated on the drawings, and blinded with fine material. The footpath surfacing shall consist of 100mm of Mix "B" concrete laid to a crossfall of 1 in 36 falling towards the carriageway. At gate entrances and for a distance extending 1.0 metre beyond the gate width the thickness of concrete shall be increased to 150mm.

Joints shall be formed in concrete footpaths at a maximum spacing of 3 metres and each joint shall include a double thickness of bituminous roofing felt complying with I.S. 36 (Type 1F) for the full depth of the joint.

Bitumen macadam footpaths

Bitumen macadam footpaths shall be laid on a bed of hardcore of 65mm max size and thoroughly compacted with a 2.5 tonne roller to a minimum consolidated thickness of 100mm and blinded with fine material.

The footpath surfacing shall consist of a 40mm thick single course of 10mm size Close Graded Wearing Course Bitumen Macadam to Clauses 4.2 and 7.4 of B.S. 4987.

The specification for materials, method of laying etc. shall be as described in Clause 1.10.10 of this specification.

The footpath shall be laid to a crossfall of 1 in 36 falling towards the carriageway.

1.10.17. Precast kerbs

Precast concrete kerbs shall be hydraulically pressed and shall comply with I.S. 146. Purpose made radius kerbs shall be used for all radii of 10 metres and less with the radius clearly marked on one of the unexposed faces.

Flexible carriageways

Flexible carriageways shall have rectangular precast kerbs 125mm wide x 250mm high with half battered section laid on a Mix "A" concrete foundation 300mm wide x 100mm thick. Bed and joint kerbs in 1:3 cement / sand mortar and haunch on the back face to half their heights in Mix "A" concrete as shown on the drawings.

The kerbs shall project 125mm over finished road surface. Any units of kerbing deviating more than 3mm from line and level at either end shall be made good by lifting and relaying.

The reduction in height of kerbing at vehicular entrances shall be effected in a length not less than 1 metre.

Concrete carriageways

Concrete Carriageways shall have section kerbs 150mm wide x 125mm high half battered laid directly on the carriageway slab and bedded on 12mm to 25mm of 1:3 cement / sand mortar.

Provide 2 No. 12mm mild steel dowels 150mm long to each length of kerbs and set 75mm into the carriageway slab while it is still green. Haunch the kerbs on their back face with mix

"A" concrete as shown on the drawings.

Joints in the precast kerbs shall match the joints in the concrete carriageway. Any unit of kerbing deviating more than 3mm from line and level at either end shall be made good by lifting and relaying.

The reduction in height of kerbing at vehicular entrances shall be effected in a length not less than 1 metre.

1.10.18 In-situ kerbs

In-situ kerbs shall be cast to the dimensions shown on the drawings or Pricing Document in Mix "C" concrete on a foundation 300mm wide x 100mm thick of Mix "A" concrete.

The kerbs shall be dense with regular sides, edges, arrises and chamfers finished to a fine surface free from blowholes and dragging and shall be impervious.

Kerbs shall remain firmly secure on the surface on which they are laid and shall be cut and moulded whilst green to form joints at 3m intervals. In concrete carriageways the joints in kerbs and roads shall coincide.

The joints shall be filled with 10mm thick approved preformed joint filler and sealed with an approved joint sealing compound 12mm deep.

Haunching to in-situ kerbs as required shall be in accordance with the details shown on the drawings.

The reduction in height of kerbing at vehicular entrances shall be effected in a length not less than 1 metre.

1.10.19. Road gullies

The road gullies shall be provided where directed and shall be either trapped or untrapped as specified elsewhere in the Contract Documents. The gully grating shall be heavy duty ductile iron type dished and hinged, 450mm x 300mm clear ope, 150mm deep as supplied by approved manufacturers. The frame shall be set in cement mortar. The catch pit shall be 450mm x 300mm internal x 750mm deep with walls 225mm thick solid concrete block. The floor shall be 150mm thick Mix B concrete slab. The outlet pipe shall be at least 375mm above the floor of the catch pit. The outlet pipe shall be 150mm diameter P.V.C., concrete or stoneware drain pipe and shall discharge into a sewer or a soak pit as directed by the Employers Representative.

Precast concrete gullies complying with BS EN 1917 or similar approved may be used as an alternative to those described above. The precast concrete gully chambers shall be laid on and surrounded with 150mm thickness of Mix "B" concrete which shall be brought up to the underside of the frame or flush with the top surface as required.

1.10.20. Resurfacing of existing flexible pavements

The existing surface shall be improved by hot or cold planing. Defective areas i.e. potholes,

trenches, etc. shall be repaired by cutting the surface and excavating down to formation and coating with a tack coat of bitumen and filling with dense basecourse macadam. Major inequalities of profile, depressions, etc. shall be remedied using a regulating layer of 45mm minimum compacted thickness and 20mm max size aggregate of Dense Basecourse Bitumen Macadam to Clause 6.5 of B.S. 4987: Part 1: 1988 laid in a single layer on a tack coat of bitumen emulsion complying with the requirements of paragraph 4.5.1 of B.S. 4987: Part 2: 1985 applied to the clean and planed substrata. After application the emulsion shall not be permitted to collect in hollows and shall be allowed to "break" (turn from brown to black) before the coated macadam is laid. This regulating layer shall be laid to form falls, dishes etc. to drainage take-off points (i.e. gullies). If sufficient road gullies are not already present they shall be provided as necessary, at a rate overall of not less than 1 gully per 200 sq. metres of paved surface. All manhole and other access covers for underground services shall be raised to the new finished levels.

Single course resurfacing shall be 40mm minimum compacted thickness of 14mm size Close Graded Wearing Course Bitumen Macadam to Clause 7.3 of B.S. 4987: Part 1 laid in a single layer, otherwise all as per Clause 1.10.10 of this Specification.

1.10.21. Repair of potholes

Potholes in roads shall be repaired as follows:

The hole shall be thoroughly cleaned out until the bottom and sides consist of sound well-compacted material. The hole shall be trimmed to a uniform depth and a regular shape. The sides shall be cut as close to vertical as possible. The sides and bottom of the hole shall be primed with a cationic bitumen emulsion containing 60 per cent of bitumen. The hole shall be filled with a bitumen macadam of 10 mm nominal size. If the hole is over 50 mm deep, the bitumen macadam shall be laid and compacted by tamping in layers not more than 50 mm thick. Upon completion, the compacted patch shall be about 3 to 6 mm above the level of the surrounding road surface to allow for further compaction by traffic. Compaction shall be carried out by heavy hand compactors, mechanical rammer or, where the size of the patch is large enough, vibrating plate compactors. Where compaction is by hand compactor, the compaction of the final layer shall be completed by rolling with the wheel of a loaded lorry.

1.10.22. Ball courts and hard play areas

Ball court / hard play area surfacing shall consist of 40mm min compacted thickness, of Dense Wearing Course Bitumen Macadam to Clause 7.5 of B.S. 4987: Part 1. It shall consist of hard, clean, crushed rock 6mm nominal size complying with the requirements of B.S. 4987: Part 1. The freshly mixed materials on analysis for aggregate grading, binder content and grade of binder shall comply respectively with Tables 29, 30 and 31 of B.S. 4987 : Part 1, mixing temperature shall comply with Table 41 of B.S. 4987: Part 1.

The Bitumen Macadam shall be laid on a bed of hardcore of 75mm max size and thoroughly compacted in accordance with Clause 1.10.8 of this Specification to a minimum consolidated thickness of 150mm and blinded with fine material. The hardcore material used in this construction shall consist of crushed rock, from an approved source. It shall be consistent in

quality and free from rubbish, dirt and other foreign material. The material shall be within the grading limits set out in Clause 1.10.7 of this Specification.

Where joints between laying widths or transverse joints have to be made the material shall be fully compacted and the joint made flush in an approved manner.

The method of mixing, transporting, laying and compaction shall be in accordance with B.S. 4987: Parts 1 and 2.

SECTION 2.1: GENERAL CONTRACT PROVISIONS

2.1.1 Scope of Works

This project, titled Cliffernna Group Water Scheme - Network Upgrade, is designed for the upgrade of the existing distribution main, which provides service in the townlands south of Cliffernna, Co. Cavan and includes the following works:

- (a) Construction of approximately 2,485m of 110mm O.D. PE100 SDR11 distribution main by a combination of trenchless techniques such as Horizontal Directional Drilling and open dig methods;
- (b) Construction of approximately 350m of 63mm O.D. PE100 SDR11 distribution main by a combination of trenchless techniques such as Horizontal Directional Drilling and open dig methods;
- (c) Construction of new consumer service connections onto the new main and connect to existing meter boxes;
- (d) Construction of new consumer service connection pipelines onto new mains and connect to new consumer meter boxes;
- (e) Ancillary fittings, connections, valve chambers, crossings etc. on the proposed mains;
- (f) Disposal of excavated material in accordance with the Waste Management Acts 1996-2003 including obtaining all approvals and licences, all in accordance with Clause 2.1.12 of this Specification;
- (g) Provision of temporary and permanent road reinstatement as Clause 2.3.12, 2.3.13, 2.3.14 and 1.5.15, 1.6.31, 1.6.32, 1.6.33 and 1.6.34 of this Specification;
- (h) Any other works that may be required.

2.1.2 Tender Drawings & Documents

The Tender documents are comprised of:

- Instructions to Tenderers
- Volume A: Works Requirements consisting of:
 - Volume A1: Book of Drawings
 - Volume A2: Specification for Civil Engineering Works
- Volume B: Form of Tender and Schedules
- Volume C: Pricing Document
- Volume D: Conditions of Contract & Model Forms
- Volume E: Information Pack
 - Volume E1 - Preliminary Safety and Health Plan
 - Volume E2 - Site Investigation Report

- Volume E3 - Existing Utility Services

- Pre-Qualification Questionnaire

Where conflict arises in Volume A2 between Section 2 – Particulars of the Works and Section 1 – General, of the Specification, Section 2 – Particulars of the Works shall take precedence.

The following drawings form part of the Contract Documents and should be read in conjunction with the Specification and the Works Requirements:

Drg Title	Drg Nr.
Key Plan	26011 - TJOC - XX - XX - DR - C - 130
Proposed Watermain Layout	26011 - TJOC - XX - XX - DR - C - 450
Proposed Watermain Layout	26011 - TJOC - XX - XX - DR - C - 451
Proposed Watermain Layout	26011 - TJOC - XX - XX - DR - C - 452
Proposed Watermain Layout	26011 - TJOC - XX - XX - DR - C - 453
Proposed Watermain Layout	26011 - TJOC - XX - XX - DR - C - 454
Bedding Details for Pipes	26011 - TJOC - XX - XX - DR - C - 500
Valve Chamber Details	26011 - TJOC - XX - XX - DR - C - 501
Trench Reinstatement Details	26011 - TJOC - XX - XX - DR - C - 502
Miscellaneous Details 1	26011 - TJOC - XX - XX - DR - C - 503
Miscellaneous Details 2	26011 - TJOC - XX - XX - DR - C - 504

2.1.3 The Pricing Document

The Pricing Document has been prepared based on a basic Schedule of Rates. A copy of the Pricing Document shall be forwarded to each tenderer. This copy shall be submitted by the tenderer, fully priced and extended which shall serve as a schedule of rates for the Works. The rates and amounts shall be filled in by the tenderer in ink. Attention is drawn to the Preamble to the Pricing Document and to the Instruction to Tenderers, which should be read before pricing the Pricing Document.

The Contractor shall note that rock is defined as per Item 5 of the Preamble and Clause 2.3.16 of this Specification.

The measurement convention for calculating trench widths and quantities in the Pricing Document is stated in Item 12 of the Preamble and also stated in the Pricing Document item headings and descriptions.

2.1.4 Insurances

Insurance Policies as specified in the Conditions of Contract pertaining to the Works shall be taken out and maintained by the Contractor. The Contractors public and employer's insurance policies shall include indemnity for Cavan Co. Co. and the GWS.

Copies of the Contractor's insurance policies together with receipts for current premiums must be submitted to the Employers Representative within 2 working days of a request to do so and before commencement of any work on site.

The Contractor's attention is drawn to the level of excesses permitted in the various policies either as stipulated in the Schedule to the Form of Tender.

2.1.5 Ground Investigation Report

The ground investigation report provided in Vol. E2 sets out the records and results of ground investigation carried out at the site on behalf of the Employer.

The data provided is given without any guarantee that the conditions as shown are representative of the entire site. It merely shows the results of the soil investigations at the indicated locations. The provision of this information does not absolve the Tenderer from responsibility for making his own interpretation and judging the completeness of the information given or from carrying out such additional site investigation work, which he deems necessary, subject to obtaining all necessary approvals for carrying out such work.

2.1.6 Temporary ESB and Water Supply

The Contractor shall make all necessary arrangements with the ESB for the provision of a temporary power supply at the site for his work and shall pay all necessary connection charges and bills. The GWS will accommodate a connection to their supply for the temporary provision of a water supply for the site. The Contractor will be required to complete all civil works associated with the supply.

2.1.7 Not Used

2.1.8 Attendance on the Resident Engineer

The Contractor shall provide such labour as set out in the Pricing Document as is necessary to attend to the cleaning of the instruments and to assist the Resident Engineer in measuring, supervising, checking, testing and examining the Contractor's work in any way at any time of day or night for the duration of the contract and shall be deemed to have included for the same in the Contract Sum.

2.1.9 Method Statements / Quality Assurance / Quality Control / Design

1. The following documents are required to be submitted a minimum of 10 working days, prior to any course of action: Method Statement – A full method statement detailing the proposed works, methods of construction, materials to be used, suppliers, resources, details of sub-contractor proposed, plant, equipment, control measures, inspections and any other relevant information,
2. Risk Assessment – A full risk assessment shall be completed for the proposed action

identifying all associated hazards and risks, and where necessary, after applying the Principles of Prevention, the control measures to be implemented and the person responsible for implementing the control measure.

3. Temporary Works Design – Detailed calculations for all temporary works shall be submitted. Once the PSDP has no further objection on these, a completed Temporary Works Design certificate shall be completed and submitted. The submission shall include all designers risk assessment sheets demonstrating compliance with the General Principles of Prevention.
4. A Quality Plan shall be developed by the Contractor and include sections detailing how the permanent works Quality Control is implemented on the Project. This section shall include as a minimum the measures and assigned roles within the organisation, a log of all internal testing completed along with results, a log of all site inspections completed along with results, a log of all external testing completed along with results and the noise/vibration settlement monitoring results. The section shall also include a log of all deliveries to site along with a log of the quantity and quality/classification of all loads brought onto or off site. In order to ensure Quality Control is maintained, it is a requirement of the Contract that all test results shall be submitted to the Employer's Representative no more than 7 days after being completed, unless shorter periods are stated elsewhere in this Specification.

Before backfilling any pipe trench or other excavation the Contractor shall provide an accurate detailed GPS and AutoCad record of all pipes, services and other obstructions and conditions encountered in the excavation and of the as constructed works as specified in Clause 1.1.34 herein.

2.1.10 Time for Completion of Works

The Time for Completion of the Contract shall be as stated in the Form of Tender and Schedules.

2.1.11 Continuous Working

Should the Contractor wish to work outside of normal working hours or at weekends, he shall obtain the approval of the Employers Representative, before so working but there are no guarantees that approval will be given. The extra cost of overtime authorised by the Employers Representative at the request of the Contractor shall be included in the Contract Sum.

2.1.12 Surplus Excavated Material/Waste Management

The Contractor shall make arrangements for the disposal of surplus spoils, unless otherwise directed by the Employers Representative and shall be deemed to have included for this in his rates.

Contractors are obliged to deal with any waste arising in accordance with the requirement of the Waste Management Acts 1996-2013 and the associated Regulations. Cavan County Council, Environment Protection Sections require contractors to prepare a Waste Management Plan prior to the commencement of work on site. This plan will detail the measures to be taken by the Contractor to deal with all waste arising during the course of the contract. The Waste Management Permit Regulations state that a Permit is required to reuse inert waste (soil, clay, stone) for the purposes of land reclamation. This material is classified as waste when it is surplus to the requirements of the contract and is required to be disposed off-site. The Waste Management

(Collection Permit) Regulations 2007 require that the transporter of waste (including inert waste) obtains a Collection Permit. These permits are issued by the County Councils. Waste arising during the course of the works which is required to be disposed or recycled should only be transferred to a person who holds a valid Waste Collection Permit.

The Contract Sum shall be deemed to include for all costs associated with disposal and for obtaining all approvals and licences including any contaminated spoil (including bituminous materials and coal tar) that might be encountered.

The Contractor's tender shall be deemed to include for all costs associated with disposal and for obtaining all approvals and licences including any contaminated spoil that might be encountered.

2.1.13 Control of Water

The Contractor shall keep all excavations irrespective of location clear of water. The Contractor shall provide, operate and maintain to the satisfaction of the Employers Representative, a system of temporary drains, sumps, well points and de-watering equipment as may be necessary to keep water out of the excavations. Water shall be conveyed from the works in such a manner as to avoid any nuisance or injury.

All temporary works for the control of water shall be sited clear of the works, except where temporary sub-drains under the Works are approved by the Employers Representative. Should permission be given for the laying of these drains, the pipes shall be laid with a 75mm surround of gravel, the top surface of which shall be covered with a tarred felt cloth or other approved material. Unless otherwise directed by the Employers Representative all temporary drains and sub-drains shall be finally sealed with concrete at intervals to the Employers Representative's satisfaction.

If the Contractor employs sump pumping, well point de-watering etc., to remove water from the works he shall provide at his own expense filters on the suction side of the pump and a silt trap on the delivery side to avoid the removal of soil particles and the deposition of fines in any waterway. Where well point dewatering is being used, the rate of dewatering shall be monitored and controlled in order to avoid causing distress to adjacent structures and properties.

The cost for complying with this clause shall be deemed to be included in the Contract Sum.

2.1.14 Programme

The Employers Representative shall require a Contract Programme to be submitted prior to commencement of works. If the Employers Representative shall consider the programme unsatisfactory it will be revised and resubmitted within a period of 5 working days from the date of the request to revise by the Employers Representative.

The Contractor's attention is drawn, amongst others, to the specific requirements of Clauses 2.1.15, 2.1.17, 2.1.18 and 2.3.5 of this Specification when compiling his programme.

The Contractor shall comply with any requirements, which the Local Authority may have as regards the transport of materials to the site and in the construction of the Works.

The Contractor shall allow for all expenses in corresponding with other contractors working on the site and for coordinating his activities with such contractors.

During the detailed consideration of a tender, the Contractor may be asked to submit a preliminary works programme to the Employers Representative outlining the order in which he proposes to execute the Works.

The Contractor shall produce a detailed traffic management plan for the works which shall be submitted to the Employer, the Gardai and the Employers Representative for approval in advance of any commencement of the works.

The traffic management plan shall include details for the provision, maintenance and removal on completion of temporary pedestrian pathways and signage around the works area as well as proposals for any traffic diversions, temporary one-way systems, etc. The plan shall be submitted to the Engineer, the Gardai and the Employer for approval in advance of any works.

2.1.15 Limits of and Access to Site

Where works are in the public road and private road, the limits of the site shall be the limits of the public road, inclusive of public road verges. Where pipelines and appurtenant works are not in public roads, the limits of the site, unless otherwise shown on the drawings, shall be in accordance with the terms of the particular wayleave agreements obtained. The limits of the working width shall be adequately marked before any work starts and the markings retained until the Site is temporarily reinstated.

The Contractor shall ensure that proper and adequate pedestrian and vehicular access is maintained to all private dwellings and commercial properties and to any areas or properties where access is required at all times during the works.

The Contractor's attention is drawn to the fact that:

- (a) Much of the proposed works will take place in narrow rural roads, with restricted access along its length and this may restrict the Contractor's activities depending on the chosen method of working. Access to houses and properties along the road shall be maintained at all times. However, some of the works shall also take place on a busy Regional Road and careful planning will be required to implement the works.
- (b) Where chambers or new connections are to be made to the existing watermain, the existing watermain shall be kept live as long as possible with interruptions to supply kept to an absolute minimum.
- (c) No consumer shall be left without a water supply outside the specified Contract working hours.

Any alteration or relaxation of the above restrictions on construction and access shall be made only with the prior approval of the Employers Representative.

The Contractor shall be required to leave the sections of the site in a safe manner where work is

prohibited during the above restriction periods and shall be deemed to have included for these restrictions in his tender. No additional payments will be considered in respect of any of the restrictions listed herein.

2.1.16 Photography

Accurate records, both written and photographic, shall be kept of the site and of the condition of road surfaces and adjoining structures and properties along the length of the proposed Works before, during and after construction. The Contractor shall ensure that all such photographs and records of existing conditions are completed prior to commencement of the Works. A complete photographic record of all properties/structures and road condition shall be completed along the route of the proposed works before, at monthly intervals during and after all works are completed and be submitted to the Employer's Representative in soft copy format and two photos per page hard copy format within two days of being completed. All photographs shall be recorded with date displayed.

2.1.17 Consents and Approvals and Road Opening and Road Closure Licences

The Contractor shall observe all regulations laid down by all statutory Authorities, including Cavan County Council and Transport Infrastructure Ireland. The Contractor shall be responsible for negotiating and obtaining all necessary consents and approvals from the appropriate Authorities, to enable the works to be carried out.

The Works shall be carried out in public roads in County Cavan.

The Contractor's attention is drawn to the need to obtain a Road Opening Licence (ROL) for pipeline works in public roads in advance of any works from both Councils and Transport Infrastructure Ireland.

The procedure used by the Road Authority for managing the processing, issuing and finalising of road opening licences, is based on the "T" model and is used in the MapRoad Roadworks Licencing (MRL) system. The required T1 and T2 Licences must be applied for through the Road Management Office (RMO) website: www.rmo.ie. The Contractor shall be responsible for complying with all aspects of the 'T' Model Licencing Process and for submitting all relevant details associated with the T1 Notification and the T2 licence(s).

The Contractor shall apply for all licences, including providing copies of maps, insurance requirement, drawings and specification of works to be done, etc., for which there is a set administration fee/Application Charge, which shall be deemed to be included by the Contractor in the Contract Sum, or in the item provided for in the Pricing Document.

The Long Term Impact Charges (LTI) on this project shall be paid directly by the GWS to the RMO/CCC.

Items are provided in the Pricing Document for the Contractor to price for RoL fees. No additional payments will be considered in respect of any additional costs that may be incurred by the Contractor due increases in the final amounts charged by RMO/CCC.

If the applicant causes any road damage during the execution of the works and does not make good the affected area, the Councils may carry out any necessary repairs and amounts for repair may be deducted from the Contract Sum.

Responsibility for the excavation and the permanent reinstatement remains with the Licensee for a maintenance period of twenty four months. Any remedial works required during this maintenance period shall be carried out by the Licensee to the requirements of the County Councils. The maintenance period shall be extended for a period of twenty four months from the date of a Defects Notification, or the date of remedial works, whichever being the later. A Notice of Commencement of the Maintenance Period will be issued by the Councils following a satisfactory joint inspection by the Area Engineers and the Licensee. The Maintenance Period cannot commence until this inspection has been carried out.

As part of RoL application, the Contractor shall compile and submit all required insurances, Method Statements, Traffic Management Plans, Risk Assessments etc.

Given the extent of pipelaying works to be constructed, it is recognised that temporary road or partial road closures may be required, but the Contractor shall price for no road closure being permitted. Roads must be kept open at all times unless a temporary closure order has been granted. The Contractor shall comply with the requirements of the Department of the Environment, Heritage and Local Government and the Local Authority as regards temporary closure of lanes with specific emphasis being placed on traffic management in such applications. The Contractor shall be responsible for full and complete compliance with all conditions, qualifications and restrictions imposed upon or attached to the said consents and approvals. The Contractor shall pay all road opening licence and road closure application charges.

2.1.18 Keeping Roads Open, Traffic Management and Safeguarding the Works

The Contractor shall prepare a traffic management plan for his proposed methods of working in each section of the works and shall submit this for the approval of the Employer, Employers Representative and the Gardai. Once approved, the Contractor shall adhere to and implement the measures in the plan. The traffic management plan shall give details of the establishment, maintenance and removal of all signage, protection and temporary works and shall take account, inter alia, of the following:

- (a) Where it is necessary to close the road to enable delivery of plant or materials to the Works or to enable the Works to be properly constructed, the Contractor shall provide and maintain free pedestrian passage and access to premises on both sides of the roads and streets at all times.
- (b) Where it is necessary to close certain the roads to enable delivery of plant or materials to the Works or to enable the Works to be properly constructed the Contractor shall follow all Statutory Requirements of State Authorities and the Local Authorities. In this event the Contractor shall arrange for suitable diversions through alternative routes. The routes shall be agreed with the Employers Representative, the County Council and the Garda Authorities before commencement of the Contract. Where it will be found necessary to restrict the passage of traffic or to close the road the Contractor shall ensure that no unnecessary delay shall occur in executing the Works. In this regard attention is drawn to the recommendations contained in the publication entitled Guidance for the Control & Management of Traffic at Road Works published by the Department of Transport and the National Roads Authority and the National Roads Authority Specification for Road Works, which recommendations shall be

adhered to by the Contractor where traffic flow shall be disrupted in any way by the carrying out of the Works, and the cost of complying with these recommendations shall be deemed to have been included either in the rates for items of works requiring such services or in the appropriate item in the Contract Sum. Should single file traffic flows be maintained, any materials, which would cause obstruction to public transport, shall be carted to a temporary store and the Contractor shall provide at his own expense a suitable temporary store for such materials.

- (c) The Employer shall use his own personnel to keep the public informed of progress and programming of the Works and the Contractor shall supply all necessary information as may be requested by the Employers Representative or the Employer in this respect. All costs incurred by the Contractor in supplying such information, attending weekly meetings, etc. shall be deemed to be included in his contract sum.
- (d) Where traffic flow is maintained the Contractor shall employ flagmen or traffic lights as necessary to maintain an acceptable traffic flow at all times and shall be deemed to be included in his contract sum.

The Contractor shall not use any excavating, transporting or other machine, which would seriously impede public transport by reason of its size or its manner of working.

The Contractor's attention is drawn to the fact that no tracked excavating machinery will be permitted to travel or operate on roadways. Any damage to roadways or other surfaces caused by the Contractor's plant or machinery shall be repaired by him at his own expense.

Any damage to roadways or other surfaces caused by the Contractor's plant or machinery shall be repaired by him at his own expense.

When pricing the Works the Contractor shall bear in mind that compliance with this clause will be strictly enforced and any undue delay in the execution of such repairs will result in the work being carried out by the Employer. The cost of any such work executed by the Employer will be deducted from money due or becoming due to the Contractor.

- (e) Should the road remain open to traffic, all excavations associated with the Works and any trench excavation either on, or crossing a public roadway shall be protected with as a minimum temporary fencing in accordance with Clause 1.1.26 (vi) and (viii) together with reflective tape, lighting, road signs, etc. in accordance with Guidance for the Control & Management of Traffic at Road Works published by the Department of Transport and the National Roads Authority and with the requirements of the National Roads Authority Specification for Road Works. Where roads are closed barrels, planking, reflective tape and road signs in accordance with Guidance for the Control & Management of Traffic at Road Works published by the Department of Transport and the National Roads Authority and with the requirements of the National Roads Authority Specification for Road Works shall be erected. Where pedestrian access is being maintained adjacent to or through the public roadway, as a minimum, works shall be protected by temporary fencing as described in Clause 1.1.26 (viii).

- (f) Should a road closure licence be sought and permitted, the Contractor shall erect such advance warning signs in both the Irish and English languages as necessary to ensure a safe and continuous traffic flow is maintained. These shall include but not be limited to electronic variable messaging signs.

Where roadways are kept open they shall be cleared of any materials deposited during the course of the work, at the end of each day's work. Failure to comply with any of the above requirements by the Contractor will result in the Employer executing the work and the cost of any work carried out by the Employer will be deducted from any monies due, or which may become due to the Contractor. The Contractor shall keep approaches to the site clear of mud and any other debris. The Contractor shall note that adherence to this clause shall be strictly enforced.

2.1.19 On-Site Publicity Signs

The Contractor shall erect on-site temporary publicity signs to warn of ongoing works at either end of each road where mains are being replaced. The sign shall state the GWS name and advise that the works are essential network upgrade works. Further fixed signs shall be erected on all approaches to the works in advance of the actual works area in accordance with the Traffic Management Plan agreed with the County Councils.

The Contractor shall be deemed to have included for these works in his Contract Sum.

2.1.20 Vibration and Other Monitoring of Existing Structures

Vibration Monitoring shall be carried out in accordance with Section 2.2.4 of the Specification to assess the impact of construction of the Works in terms of proposed methods of construction etc., on existing structures and properties adjacent to the works and elsewhere as deemed appropriate by agreement between the Employer's Representative and the Contractor. The cost of carrying out all such monitoring shall be borne by the Contractor and he shall supply detailed particulars of this monitoring to the Employer's Representative for approval. At least one separate monitor shall be provided at the location of all operations or more than one if several properties/structures affected not located beside each other.

Monitoring reports shall be submitted weekly and the results included in the QA system. Tell tales shall be provided at all cracks identified prior to work commencing in any area with visual cracks. These shall be identified in the pre-construction photographic surveys. The Contractor shall allow for a total of 20 tell tales to be installed, monitored weekly and removed at the end of the Contract.

2.1.21 Quality of Materials and Finishes

All proposed materials such as pipes, valves, fittings, bedding, backfill, concrete, reinforcement etc. shall have independent third party certification by NSAI or BSi and be manufactured within the EU. The Contractor shall include in his tender for the cost of bringing the Employer's Representative and Resident Engineer to the proposed manufacturing facility of any proposed material/product if an inspection is required by the Employer's Representative.

All works shall be finished to the highest standard and all works left blemish free and completed in accordance with the latest applicable British or European Standard. All surface works shall be completed in accordance with BS8500 and all works shall be completed by tradesmen with the relevant qualifications for the task undertaken.

2.1.22 Health and Safety Regulations

The Employer shall appoint the Contractor as Project Supervisor (Construction Stage) under the Safety Health and Welfare at Work (Construction) Regulations 2013 and the Contractor shall consent to such appointment. If so appointed, the Contractor, or a competent and authorised agent or representative approved of by the Employer (which approval may at any time be withdrawn), shall carry out the duties of Project Supervisor (Construction Stage) in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2013 and of any amendment or replacement thereof. The responsibility of the Project Supervisor (Construction Stage) shall extend to all Works on the Site. An item is included in the Pricing Document to allow the Tenderers to separately price the obligation to accept the appointment as Project Supervisor (Construction Stage).

The Contractor shall comply with all current Directives, Acts, Regulations, HSA Codes of Practice and Guidelines and any other relevant publications as well as having a Safe System of Work in place. In order to ensure that all work is being constructed in a safe manner the Contractor/PSCS shall be required to complete a fortnightly joint audit of the entire site with the Employer's Representative. The Employer's Representative will then issue a report on the joint inspection and any action identified to comply with current Regulations shall be complied with by the Contractor.

As part of the Contractor's scope he will be required to submit both Temporary and Permanent Design submissions. In order to ensure Co-Ordination of all designers on the Project, a monthly site meeting will be held between the PSDP, PSCS, Employer's Representative, Contractors and all Contractor's permanent and temporary works designers and the Contractor is deemed to have included for this requirement in the Contract Sum. It is intended that this meeting would be held on the same day as the monthly site progress meeting.

2.1.23 Prevention of Obstructions, Pollution, etc.

The Contractor shall ensure at all times: -

- (i) that the Site and the approaches thereto are not obstructed or made congested.
- (ii) that no nuisance, unreasonable noise or disturbance is created that might affect the site or environs.
- (iii) that no pollution is caused to watercourses,
- (iv) that none of the workmen commit trespass.

The Contractor shall ensure that there is no spillage of oil or other pollution into any watercourses. Before commencing any work which could involve spillage of oil into these waters, the Contractor shall consult the Employers Representative and provide anti-pollution measures as may be required to prevent such spillage. The Contractor shall meet all costs, damages and expenses including Third Party Claims incurred as a result of any pollution of the receiving water arising as a result of the construction and maintenance of the Works.

The Contractor shall ensure that all personnel employed by him or under his control are made fully aware of the measures to be taken and that these are meticulously observed.

The Contractor shall ensure, through the use of water tankers for regular damping down or through any other appropriate measures, that dust and wind blown debris shall not be a nuisance or hazard within the Works or in the surrounding area. The Contractor shall be deemed to have included for same in his rates and shall damp down areas as necessary or as instructed by the Employers Representative. The Contractor shall implement a regular road sweeping schedule during the hours of work and shall make available such road sweeping plant as may be deemed necessary to ensure that the public road is kept free from all debris, mud, etc.

2.1.24 Employers Representative's Office

The Contractor shall establish, maintain and remove on completion of the Permanent Works and for a period of 6 weeks thereafter the accommodation, services and equipment as described below. They shall be accommodated at the location shown on the drawings or alternatively at such other central location as the Contractor shall make available which shall be acceptable to the Employer. Storage areas for materials and such like required by the Contractor shall be obtained separately by the Contractor and shall not be allowed on the site identified by the Employer.

Equipment and Store

Separate equipment store area of 10m² along with following equipment:

- (a) 1 nr. 30m steel measuring tape.
- (b) 1 nr. 30m linen tape.
- (c) 2 nr. 8m retractable steel tapes.
- (d) 2 nr. steel tipped ranging poles.
- (e) 1 nr. maximum and minimum thermometer c/w lockable cabinet for same to Meteorological Service specifications in place at external approved site location.
- (f) Vernier callipers.
- (g) 1 nr. Digital camera, minimum 12 megapixel standard, 8GB external memory card, built in flash, built in rechargeable battery and carry case.
- (h) In addition, when required, a GPS setting out unit shall be provided for use by the employer's Representative.

Attendances

- (a) Labour surveying attendances on the Employer's Representative and his staff as detailed in the Pricing Document.
- (b) Engineering technician attendances for materials testing additional to specified requirements as detailed in the Pricing Document.

Protective Clothing

- (a) The Contractor shall supply and maintain during the course of the Contract two complete sets of protective clothing comprising heavy duty reflecting raincoats c/w hoods, reflecting vests, donkey jackets, overalls, knee length rubber safety boots, safety boots which shall have steel toe caps with puncture resistant sole and oil

resistant finish, steel toe capped and steel mid-sole / puncture resistant sole and oil resistant boots and safety helmets, and protective eyewear and / ear defenders (where appropriate) for the sole use of the Employer's Representative and his assistants.

- (b) Three additional safety helmets, reflecting vests and pairs of rubber safety boots of various sizes shall be provided for visiting personnel entitled authorised to be on the Site.

2.1.25 Duties and Taxes

The Contractor shall be deemed to have covered in his rates and prices for all Import and Export Duties, Value-Added and other taxes applicable for the duration of the Contract.

2.1.26 Currency

The currency in which Tenders are to be priced and in which payments are to be made to the Contractor shall be in Euros. No extra payment will be allowed to the Contractor in respect of any changes in the rate of exchange between the Euro and any other currency.

2.1.27 Contract under the Law of the Irish Republic

This Contract shall be a contract entered into under the law of the Irish Republic and shall be interpreted in accordance therewith.

2.1.28 Bar-bending Equipment

The Contractor shall provide and maintain suitable bar bending and cutting equipment during the Contract Period which shall be available to facilitate amendments to steel reinforcement as instructed by the Employers Representative.

2.1.29 Contractor's Staff

The Contractor shall provide an Agent and sufficiently experienced supervisory staff who are to give their whole time to the supervision of the Works to ensure that the Works are expeditiously executed.

2.1.30 Contractor's Offices, Stores, etc.

The Contractor shall establish such offices and other temporary buildings and car parking as he may require. He shall provide his own site for the purpose of materials stores, sheds, etc., When the Contract has been completed all temporary buildings and stores shall be removed and the site restored to their original condition. The Contractor shall install such offices, office equipment, welfare facilities, stores etc. as he considers necessary for the implementation of the contract.

2.1.31 Co-operation with Other Contractors and Specialists

Should there be other contractors on site concurrently carrying out work at any point along the route of this Contract or otherwise, then the Contractor is required to co-operate with such other contractors as necessary.

2.1.32 Not Used

2.1.33 Clear Sites

On completion, the whole Site shall be cleared and left perfectly free of builder's rubbish and other material deposited during the construction for the Works. Any temporary reinstatement shall be left in a perfect state on completion of the Works and shall be thus maintained during the Period of Maintenance or until permanent reinstatement is carried out, whichever is earlier.

The Contractor shall confine his operations to the minimum area required for the Works and shall reinstate or make good the surface of ground disturbed by his operations, restore fences, reinstate temporary accesses and make good damage of any kind to the satisfaction of the Employers Representative. He shall be responsible for any damage to property due to his failure to carry out such restoration, reinstatement or making good, or due to the negligence of personnel employed by him.

2.1.34 Public Relations

The Employer shall use his own staff for the duration of the contract works to carry out duties which shall include the supply of information for the preparation of advice leaflets, etc. regarding the works and its progress for local distribution as well as dealing with local issues of concern when and if these should arise. The Contractor shall be required to liaise and assist the appointed persons as well as distribute any prior notification leaflets prepared by the Resident Engineer and shall be deemed to have included the cost of such works in the relevant item in his Contract Sum. Every house/business along the route of the proposed works shall be visited in advance of any works commencing to notify them of the planned interruptions.

2.1.35 Not Used

2.1.36 Not Used

2.1.37 Preliminary Safety File

The Contractor shall provide promptly in writing on a continuous basis such information to the Project Supervisor Construction Stage (PSCS), who in turn passes the information on to the Project Supervisor Design Stage (PSDP), as would be necessary for the PSDP to prepare the Safety File for hand-over to the Employer.

This information to be provided to the PSDP for inclusion in the Safety File shall include but not be limited to the following:

- Maintenance procedures and requirements for the works.
- Product literature for all materials used on the scheme.
- All test results.
- Manuals, certificates, etc. produced by specialist contractors for the completed works.

- Details of the location and nature of utilities and services encountered
- Detailed drawings of the works as constructed in AutoCad Format in accordance with Clause 1.1.35 above.

The above information shall be provided within a layout/format as agreed with the Employer's Representative. The issuing of the Substantial Completion certificate shall be conditional on the submission of a draft version of all necessary information to the PSDP for the purposes of completing the Safety File. Payment of the Final Account due to the Contractor shall be conditional on the submission of all necessary information to the PSDP for the purpose of completing the Safety File.

A Preliminary Health & Safety Plan is included in the tender documents. Following his appointment and on a continuous basis during the progress of the Works the PSCS shall develop the Safety & Health Plan for the project. The Contractor shall provide such information as is necessary to the PSCS to maintain and develop the Safety Plan.

The Safety Plan shall include the requirements of Schedule 2 of the Safety Health and Welfare at Work (Construction) Regulations 2013 including the following:

- Description of the Project
- Communications and management of the works
- Arrangement for controlling significant site risks
- Safe system of work plans

2.1.38 Not Used

2.1.39 Traffic Co-ordination

The Contractor shall note that responsibility for traffic co-ordination shall be his to undertake and any liaison requirements to achieve such co-ordination shall be deemed to be included in his Contract Sum.

2.1.40 Specialists

The Contractor shall be required to engage Specialists for the works as indicated below.

The Contractor shall include in his Contract Sum for all attendances (general and specific) required by the individual Specialists, all contractual terms the Specialist is looking for, security, protection, insurance or any other requirements that may require. In addition the Contractor shall allow in his Contract Sum for all costs associated with co-coordinating, liaising and administering the selected Specialists over the duration of the Contract and during the Defect Period.

2.1.40.1 Specialists Required

The table below lists the Specialists who are required to be employed under this contract. The Contractor shall in his tender identify the firms which he proposes to employ as Specialists. The minimum eligibility criteria listed below shall be satisfied for each specialist chosen by the Contractor. Sub-contract terms between the Contractor and the selected Specialist shall be a matter between the Contractor and the Specialist. The Contractor shall include in the Contract

Sum for all attendances (general and specific) required by the individual Specialists, all contractual terms the Specialist is looking for, security, protection, insurance or any other requirements that the Specialist may require for the duration of the Contract and during the Defects Period as and when required. The Contractor shall provide an office of 12m² area for the sole use of the Specialists and shall be deemed to have included for all costs associated in the Contract Sum. No payments will be made for the services provided by a Specialist until the report/results of the work for which payment has been sought has been submitted to the Employer's Representative.

Specialist Type	Minimum Eligibility Requirements
Independent Concrete/materials Testing Authority	- Shall be a specialised independent testing lab, and - Be accredited by INAB or UKAS to ISO/IEC 17025:2005.
Independent Polyethylene Testing and Weld Inspection Authority	- Hold a City and Guild Polyethylene Welding certificate, and - Have 7 years minimum relevant experience, and - Be accredited by INAB or UKAS.

2.1.40.2 Scope of Works for Specialists

The scope of works required to be provided by the Specialists listed above is defined as follows:

2.1.40.2.1 Concrete / Materials independent Testing Authority

The services of an independent concrete/materials testing authority, meeting the minimum eligibility requirements above, shall be retained for the duration of the Contract to complete any testing specified by the Employer's Representative. The testing required shall be as provided for in the Specification to demonstrate that the concrete / materials used meet the Specification requirements. All test results shall be reported directly to the Employer's Representative. The cost of providing all testing required shall be included in the relevant item in the Grand Summary. The Contract Sum submitted shall be deemed fully inclusive of all costs including any travel and subsistence costs incurred in the taking of samples or delivery of samples to the lab or attendance on the lab or Employer's Representative over the Contract Period. The following is a list of the Contract Testing requirements to be provided for in the Contract Sum:

Item	Description	No.
1	Compaction testing of 804 as Specification Clause 1.10.6 and NRA Specification.	3
2	Grade testing for 804 material NRA Specification.	2
3	Manufacture and testing of test cubes as Specification clause 1.2.10, 1.2.11 and 1.2.12.	2
7	Testing of bituminous material to determine grading and binder content; as Specification clause 1.10.10 and 1.10.11 and 1.10.9.3 and 1.10.9.4.	2

8	Testing of materials, sieve analysis of aggregate as Specification Clause 1.2.2, 1.2.3, 1.2.4, 1.7.15 and the NRA Specification.	4
9	Load testing of blocks and bricks as Specification clause 1.4.2.9	2

Polyethylene independent Testing and Weld Inspection Authority

The services of an independent polyethylene material testing and site welding inspection authority, meeting the minimum eligibility requirements above, shall be retained for the duration of the Contract to (a) complete any pipe or sample weld testing specified in the Contract, and (b) to complete a total of 2 days inspection and reporting on the welding procedures being undertaken on site. One days shall be completed prior to the welding of any pipes and a further one day during the Contract Period. The Polyethylene pipe testing specified shall be as provided for in the Specification. All test results shall be reported directly to the Employer's Representative. The cost of providing all testing and site welding inspections required shall be included in the relevant item in the Grand Summary. The Contract Sum submitted shall be deemed fully inclusive of all costs including any travel and subsistence costs incurred in the taking of samples or delivery of samples to the lab over the Contract Period.

The following is a list of the requirements to be provided for in the Contract Sum:

Item	Description	No.
1	Tensile testing of electrofusion weld samples	6
2	Pipe dimension testing	2
3	Pipe material tensile testing	2
4	2 days inspection and subsequent reporting to confirm that site welding practices comply with Specification.	2 days on site plus reporting

SECTION 2.2 – ENVIRONMENTAL CONTROL / MONITORING

2.2.1 General

Particular attention shall be given by the Contractor to the requirement of avoidance of nuisance due to noise, dust, vibration, as well as air and water pollution. The Contractor shall take particular account of the sensitive location of this site from a location point of view.

2.2.2 Noise control

The Contractor shall employ the best practical means to minimise noise produced by his operations, including plant maintenance, and shall comply with the recommendations in BS5228:1997, Noise and Vibration Control on Construction and Open Sites and with the recommendations in Chapter 1 of Part 5 (Control of Noise at Work) of the Safety Health and Welfare at Work (General Applications) Regulations SI 299 of 2007 and any amendment thereof and with another conditions imposed by the local authority.

All vehicles and mechanical plant used on the works shall be fitted with effective exhaust silencers and shall be maintained in good and efficient working order for the duration of the works in compliance with BS5228. Machines in intermittent use shall be shut down in the periods between work or throttled down to a minimum. The Contractor shall remove from the works any item of plant which in the opinion of the Employers Representative is ineffectively silenced. All compressors shall be “sound reduced” models fitted with properly lined and sealed acoustic covers shall be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools shall be fitted with mufflers or silencers of the type recommended by the manufacturers. Pumps and mechanical static plant shall be enclosed by acoustic sheds or screens where appropriate.

Any plant such as generators and pumps which are required to work outside the hours of 0800 hrs to 1800 hrs shall be surrounded by an acoustic enclosure to the approval of the Employers Representative which shall restrict the noise level to not less than 5 dB(A) below levels quoted hereunder.

The Contractor shall ensure that, at all properties outside the site boundaries the sound levels arising from activities do not exceed the following levels:

	Mean Value (1 hr.) dB (A)	Peak dB (A)
a) Mon – Fri 0800 – 1800	70	85
b) Mon – Fri 1800 – 2200	60	65
c) Saturdays, Sundays and Bank Holidays 0900 - 1600	60	65

At all other times the sound level of 50 dB(A) L10 (18hr) and a maximum noise level of 55 dB(A) shall not be exceeded unless the existing ambient noise levels are higher. In such cases the ambient noise level can be exceeded by 5 dB(A).

Sound levels shall be monitored by methods set out in Appendix B of BS5228. Sound levels shall be monitored by methods set out in Appendix B of BS5228. All measurements shall be made 1m outside the façade of each building using a sound level Type 2 meter (Quest, or approved equivalent) conforming to BS EN 61672:2003.

2.2.3 Dirt and Dust Control

The Contractor shall be responsible for keeping the whole of the site, i.e. the site or sites on private property or along public roads, passageways or public open spaces, in a clean and tidy condition.

The Contractor shall take every precaution to prevent dirt, mud or other material being dropped or spread by traffic associated with the work on roads being part of the works which are made available for public use by the Contractor, whether such traffic is the Contractor's own vehicles, the subcontractor's or his suppliers or vehicles hired by any of the above. The Contractor shall clean roadways at his own cost of any such dirt, mud or other materials to or from the site in connection with the works, whether such traffic belongs to the Contractor, his subcontractors or his suppliers. Where roads are kept open during pipelaying works, as a minimum, on each working day or at such other frequency as may be necessary to maintain roads in a clean manner the Contractor shall employ a road suction sweeper to clean all public roads within a distance of 500m of the site. Such cleaning operations shall be carried out notwithstanding road cleaning work being carried out by the Employer or other Contractors to the Employer. If the Contractor fails to keep roads and other public areas clean to the satisfaction of the Employers Representative, the Employer shall be entitled to do the work and deduct the cost from any sums due to the Contractor.

The Contractor shall take particular care to avoid damage to roads, footpaths, grass margins and other surfaces outside the authorised site and shall be liable for the cost of repairing, to the satisfaction of the Employers Representative and owner, all such damage caused by his operations. He shall take precautions to prevent spillage of diesel fuel or other solvents. He shall also prohibit the use of tracked plant on road surfaces. Any damages so caused shall be made good by the Contractor at his own expense.

The Contractor shall ensure that existing river, watercourses and drains within and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.

In the event of any spoil or debris from the construction works being deposited on adjacent land or riverbed or any silt washed down to any area, then such spoil shall be immediately removed and the affected areas restored to their natural state.

In circumstances where weather conditions result in the emission of dust from the site, the Contractor shall provide for damping facilities by means of the spraying of water or such other

means as may be appropriate to prevent nuisance and shall be deemed to have included for this in his rates. The Contractor shall note that no hosing down of construction plant and delivery trucks is permitted on public roads or on paved areas. Such operations will have to be completed by the Contractor at an alternative approved location.

2.2.4 Vibration Control

The Contractor shall employ the best practical means to minimise vibration produced by his operations, including plant maintenance, and shall comply with the requirements of BS5228:1997, Noise and Vibration Control on Construction and Open Sites and with the recommendations in Chapter 2 of Part 5 (Control; of Vibrations at Work) of the Safety, Health and Welfare at Work (General Applications) Regulations 2007, S.I. No. 299 of 2007 and any amendment thereof.

Without diminishing the Contractors responsibility to prevent damage arising from his construction activities, he shall ensure that at a distance of 1 metre from any building façade or structure, the vibration level from activities do not exceed a maximum peak particle velocity (ppv) in any plane of 10mm/sec for intermittent activities and 5mm/s for continuous activities (applicable to a frequency range of 10-50 Hz) in accordance with BS 5228 and Table 1 of BRE Digest 403 – Damage to Structures from Ground-Borne Vibration (1995). These limits shall be reduced where the Specialists Structural Survey reveals buildings or structures to have significant defects of a structural nature. The Contractor shall be responsible for the determination of the condition of all vibration sensitive buildings and structures and reduce the vibration limits as appropriate.

Measurement of the vibration shall be in accordance with BS7385:1990, Evaluation and Measurement for Vibration in Buildings. The Contractor shall take cognisance of the nature and sensitivity of the properties, structures and businesses in planning and execution of all operations.

2.2.5 Settlement

Without diminishing the Contractor's responsibility to prevent damage arising from his construction activities, he shall ensure that any movements of the ground and adjacent buildings are kept with the following specified limits:

- i) Ground movements (vertical and horizontal) resulting from all operations shall be less than 15mm.
- ii) Vertical and horizontal building and structure movements resulting from all operations shall be less than 3mm.

The Contractor shall be responsible for the determination of the condition and sensitivity of all underground services, buildings and structures in the vicinity of his construction operations and shall reduce the settlement limits as appropriate.

2.2.6 Monitoring

The Contractor shall be required to monitor the following:

(a) Vibration

The Contractor shall monitor the vibrations produced on site from his construction activities and shall make the results of such monitoring available to the Employers Representative on a regular basis.

(b) Settlement

The monitoring programme shall include surface and building monitoring. The extent of monitoring to be employed shall be decided by the Contractor.

The treatment and pumping of sub-surface water shall be managed so that no damage occurs to surrounding properties. The Contractor shall undertake to demonstrate that any water draw down resulting from sub-surface pumping is minimised and shall not cause any surface settlement in surrounding areas which is likely to lead to damage to properties.

(c) Noise

The Contractor shall monitor the noise levels onsite to ensure that the levels of acceptable noise already identified are not exceeded.

2.2.7 Prevention of Obstructions, Pollution, etc.

The Contractor shall ensure at all times: -

- (i) that the Site and the approaches thereto are not obstructed or made congested.
- (ii) that no nuisance, unreasonable noise or disturbance is created that might affect the site or environs.
- (iii) that no pollution is caused to watercourses,
- (iv) that none of the workmen commit trespass.

The Contractor shall ensure that there is no spillage of oil or other pollution into watercourses. Before commencing any work which could involve spillage of oil into these waters, the Contractor shall consult the Employers Representative and provide anti-pollution measures as may be required to prevent such spillage. The Contractor shall meet all costs, damages and expenses including Third Party Claims incurred as a result of any pollution of the receiving water arising as a result of the construction and maintenance of the Works.

The Contractor shall ensure that all personnel employed by him or under his control are made fully aware of the measures to be taken and that these are meticulously observed.

The Contractor shall ensure, through the use of water tankers for regular damping down or through any other appropriate measures, that dust and wind blown debris shall not be a nuisance or hazard within the Works or in the surrounding area.

SECTION 2.3 PIPELINES

2.3.1 Schedule of Pipelaying Works

The following table gives a schedule of all proposed watermain to be constructed:

Pipeline Section	Service Type	Length (m)	Notes
Stradone Road	110mm PE 100, SDR 11, 16 bar, polyethylene watermain	675m	
	63mm PE 100, SDR 11, 16 bar, polyethylene watermain	350m	
Bailieborough Road	110mm PE 100, SDR 11, 16 bar, polyethylene watermain	540m	
Derryhum Road	110mm PE 100, SDR 11, 16 bar, polyethylene watermain	1270m	

The Contractor may elect to simultaneously work on different sections at the same time, but shall only do so with the agreement of the Employer's Representative. All costs associated with sequencing the works as described above shall be deemed to be included in the Contract Sum.

2.3.2 Pipeline Details

The proposed watermain shall be constructed using blue, 110mm and 63mm O.D., PE100, SDR11, 16 bar polyethylene pipes as supplied by an approved, certified supplier. Polyethylene (PE) piping systems for potable water supply shall comply with EN 12201 "Plastic piping systems for water supply-polyethylene (PE)" and independent certification shall be provided confirming compliance. The pipes shall be supplied in 100m long coils to minimise the required number of on site welded joints.

The Contractor's attention is drawn to the specific risks associated with the pipelaying operations planned under this Contract. These include unloading of pipe deliveries, use of drilling pipe coil trailers, work in excavations, etc. With regard to the use of coiled pipes, this can cause the release of stored energy during the unwinding of the pipe. Uisce Eireann have prepared a specific Safety Alerts on a coiled pipe incident. Safety Alerts for other risks have also been prepared by them and the Contractor is referred to their portal where all Safety Alerts are available for the Contractor to review, <https://www.water.ie/contractor-portal/safety-videos> . The Contractor shall incorporate all identified lessons learnt into their Safe Systems of Work for this Contract.

Pipes to be laid using trenchless technique method such as Directional Drilling, shall be constructed and in accordance with Section 2.4 below. The Contractor shall mobilise all necessary HDD drilling equipment and pipeline insertion installation equipment to site for the full duration of the Contract, as stated in Clause 1.1 of Vol. B - Form of Tender & Schedule. The mobilised equipment employed shall have the capacity to carry out the Horizontal Directional Drilling, as Specification Clause 2.4 and shall be suitable to drill through the ground conditions encountered and described in Vol. E2: Site Investigation Report.

Where pipes are to be laid in the roads by open dig trench excavation, the minimum permitted trench widths and depths of cover shall be as shown on Drawing Nr. 26011-TJOC-XX-XX-DR-C-0502. However, the Contractor shall allow for greater widths as required as per his method of construction and also to accommodate compaction equipment, as per Section 6.5 of the Guidelines for the Opening, Backfilling and Reinstatement of Openings in Public Roads (April 2017). The Contractor shall be deemed to have included for all costs associated with trench widths in his Contract Sum. The excavation equipment employed for open dig shall have the capacity to carry out trench excavation in the ground conditions encountered and described in Vol. E2: Site Investigation Report. The Contractor shall also maintain on site suitable excavation equipment to remove any boulders encountered during directional drilling operations. All costs incurred by the Contractor in providing and operating excavation equipment for, and the removal of, boulders shall be deemed to be included in his contract sum.

All pipes laid in trenches, or constructed by HDD shall be constructed with not less than 1000mm cover except where indicated on the drawing. The method of excavation, laying, jointing, bedding, surrounding and backfilling trenches for open trench construction shall be as specified in Section 1.6 of this Specification and all pipelines shall be tested as specified in Section 1.8. All excavations shall be filled in at the end of each day. No excavations shall be left exposed overnight.

All proposed materials, pipes, fittings and valves, shall have independent third party certification by NSAI, BSI or EU Equivalent and be manufactured within the EU. All pipes and fittings shall be stamped with the relevant Institute Certification inscriptions.

2.3.3 Water Stops in Pipe Trenches

Where pipes are laid on a granular bed or with a granular backfill, clay dams 300mm long shall be provided across the full width of the trench and for the complete depth of the bedding and fill at intervals not exceeding 50m. Fine grained clay soil, arising out of the excavation, shall be used for forming dams. The material shall be consolidated in an approved manner. Where suitable excavated material is not available, approved fine grained clay soil shall be imported as directed by the Employers Representative.

2.3.4 Pipelaying in Restricted Areas

The Contractor shall include in his rates for constructing the watermain in areas with restricted workspace or access, or with restrictions imposed by the narrow lane widths and no claim for extra payment for these items shall be entertained.

2.3.5 Maintenance of Existing Water and Sewerage Systems

The Contractor shall ensure that his work will not interfere with the operation and maintenance of existing storm water, foul drainage and watermain systems. Where according to the Contract, the flows from existing sewers or watermains and services shall be directed into the new sewer or watermains, the flows from the existing sewers or watermains or services shall be maintained during the construction of facilities for diversion of flows into the new mains, until such time as the new mains are operational and ready to receive flows from the existing mains and the Contractor shall be deemed to have included for this work in his rates. Before final connections are made, the Contractor shall ensure that the Contract Works are complete in all respects, the pipes, channels, sumps etc., are all cleaned and tested. The Contractor shall note the requirements of this Clause with respect to his programme to be submitted pursuant to Clause 2.1.14 of this Specification.

It is envisaged that in certain areas, the new pipeline will have to be constructed along the line of the existing watermain. In such instances where the Engineer considers this to be the case, the Contractor shall be required to provide for overground temporary watermains to facilitate the construction of the new pipelines whilst maintaining flows at all times. The Contractor shall base his rates for such overground services on the assumption that the existing pipe may be flowing full during certain periods whilst this facility is required.

The Contractor shall be aware that there is existing concrete drainage pipes on either side of the road in places, along the proposed watermain route.

The Contractor shall be aware that there are underground storm drainage which must be maintained during the works and reinstated following completion of the works at the Contractor's expense. Examples of existing storm collections system are in the vicinity of Chainage 0m and 950m on the McConnors section.

2.3.6 Location of Pipelines, Manholes etc.

The approximate route and line of the proposed mains has been shown on the contract drawings. The location of pipelines, manholes, shafts, chambers etc. indicated on the drawings may be varied locally on Site by agreement between the Contractor and the Employers Representative to avoid any existing pipes and services in the light of information obtained from the trial excavations, etc., conducted and made known to the Employers Representative by the Contractor. The Contractor shall propose / set out his preferred route for all pipelines and the selected routes of

pipelines and the location of manholes and chambers shall be agreed on site between the Contractor and the Employer's Representative. However, any agreed changes shall not result in an increase to the Contract Sum.

2.3.7 Pipelines Adjacent to or Under Structures

Where the use of sheet piling is required for trench or pumping station excavation in poor ground or adjacent to structures, the Contractor shall supply to the Employers Representative details of the methods of construction which he proposes to adopt and such calculations of stresses, strains and deflections that will arise in the Permanent Works or structures adjoining the Temporary Works during construction from the use of such methods. All joints between sheet piles shall be sealed with an appropriate sealant in order to reduce seepage to a minimum.

The Contractor shall include in his tender for the safeguarding of existing structures which have to be tunnelled under, or adjacent to which pipes have to be laid. Where it is permissible to demolish a structure such as a fence, wall, etc., prior to the laying of the pipelines, the structure shall be rebuilt using either the original or matching materials and shall be built in such a way as to match the original or adjoining structure. The Contractor shall include in his rates for the crossing for the cost of reinstatement of pipes, ducts or structures which become damaged during pipelaying.

2.3.8 Protection of buried bolted joints

All fixing bolts, nuts and washers used in jointing buried pipes shall be zinc coated. In addition, all bolted joints such as flanged joints, V.J. couplings, flange adaptors shall be encased in an approved hot-poured bitumen compound, shall be wrapped with tape or shall be surrounded with Mix A concrete. Hot poured bitumen shall not be used with PVC or other plastic pipes.

The encasing shall be done before the pipeline has been tested. The bitumen compound shall be cast in purpose made moulds in accordance with the instructions issued by the supplier.

Before wrapping with tape the item to be encased shall be enclosed with an approved mastic or inert putty-like filler which shall be moulded by hand so as to provide a smooth surface for the tape.

The tape shall be tightly spirally wrapped with 25mm overlaps so as to enclose the whole of the item and a minimum of 150mm pipe lengths on each side. The enclosure shall be firmly pressed out to prevent air being trapped under the wrapping. If a concrete surround is used it shall provide cover of not less than 75mm to the joint being encased.

2.3.9 Filling Disused Sewer or Watermains

Any disused sewers or pipelines are to be solidly sealed at both ends by Mix "A" concrete over a length of 600mm from the open end of the pipe unless otherwise shown in the drawings. These works shall not be carried out until after completion of all other contract works.

Disused manholes are to have all pipes plugged with lean mix concrete. The roof slab is to be removed and disposed off site and the cover and frame taken to the Employer's store. The manholes are to be filled with imported fill which complies with clauses 2.3.12 and 2.3.13.

2.3.10 Underground Services

The locations of underground services along the lines of the Works, insofar as they have been made known to the Employers Representative, are provided on the services drawings as supplied by the relevant service provider. The services indicated on the drawings are watermains, sewers, E.S.B, Telecoms, and Broadband cables. The Contractor shall be deemed to have included in his tender for laying the new sewers and watermains past, or under these services or any other services encountered. The Contractor shall also correspond with and serve notice to the various authorities in charge of these services. He shall provide attendance on any flagmen or supervisors employed by the utility providers to supervise the work in the vicinity of these services or to divert any service to avoid the work and shall be deemed to have included for such attendance in his rates. Otherwise the Contractor shall be deemed to have included in his price for any diversions or other works necessary to such services. In the case of sewers (including culverts), watermains and the like all necessary diversions, alterations etc. shall be carried out by the Contractor but in the case of all other services, such work shall be carried out by the authority in charge of the service or the Contractor where agreed with the service provider.

The Contractor shall note that the position of existing services insofar as they are known to the Employers Representative and as shown on the drawings may not be accurate and merely indicate their presence in the working area. Existing services other than those shown may also exist. The Contractor shall be fully responsible for locating the exact position of these and all other services on the Site, and shall also contact the respective authorities for the most up-to- date information before commencing the Works. The Contractor shall complete his own survey along the pipeline route and determine the existing crossings and include for these within the Contract Sum.

2.3.11 Excavating Machinery on Roadways

The Contractor's attention is drawn to Clause 2.1.18 of this specification and the fact that no tracked excavating machinery will be permitted to travel or operate on roadways.

Any damage to roadways or other surfaces caused by the Contractor's plant or machinery shall be repaired by him at his own expense.

The Contractor should note that the use of dump trucks on roads shall not be permitted under any circumstances.

When pricing his tender the Contractor shall bear in mind that compliance with this

Clause will be strictly enforced and any undue delay in the execution of such repairs will result in the work being carried out by the Employer. The cost of any such work executed by the Employer will be deducted from monies due or becoming due to the Contractor.

2.3.12 Temporary Road Reinstatement

Temporary reinstatement of public road surfaces and reinstatement of road base and sub-base shall be carried out by the Contractor in the accordance with the provisions of Clauses 1.6.31 to 1.6.38 of the Specification and in accordance with the requirements of Drawing Nr. 26011-TJOC-XX-XX-DR-C-0502 and the “Guidelines for Managing Openings in Public Roads” published by the Department of Transport, Tourism and Sport, Second Edition (Rev 1), dated April 2017, with the drawing and the guidelines taking priority. The requirements of the Local Authorities shall also be fully complied with, including those over and above the Drawing and this Specification.

The Contractor shall note that reinstatement shall be required to be carried out to pipe runs which have been tested successfully and backfilled in sections no greater than 500m in length and / or at two-weekly intervals and that compliance with this requirement shall be strictly enforced. The Contract Sum quoted by the Contractor shall be deemed to include for this provision.

Breaking up and temporary reinstatement of public roads and footpaths shall include neatly cutting the edge of all excavations with a mechanical saw, breaking the surface and reinstatement of road base and surface as described in Clause 1.6.31 and 1.6.32 of the specification. Reinstatement shall include for completing the joint between the existing and newly reinstated surface by painting the joint with 50 or 70 pen. hot bitumen or cold applied thixotropic bitumen compound of BS 4987 Part 2 1988 A2 sealant. It shall also include for maintenance of the surface, including topping up with bituminous material in the case of any subsidence or pot holing and attendance by a suitable workman during weekends and holiday periods to maintain the surface as necessary. The backfilling for restoration of base and temporary surface shall be completed within one month of the pipes having been laid and successfully tested. The Contractor shall blind and maintain all backfilled surfaces until such time as the temporary reinstatement is completed such that the backfilled surface remains in an even and smooth condition and level with the surrounding surfaces.

The temporary surface shall be designed to last for a minimum of six months and must seal and maintain the area of backfill and provide a safe and serviceable surface for vehicles and other road users.

When pricing the contract the Contractor shall bear in mind that compliance with this clause will be strictly enforced and if there is any undue delay in restoring either base or surface the Employer is empowered to and will enter upon the site and carry out the restoration and the cost of doing so will be deducted from monies due or becoming due to the Contractor.

2.3.13 Permanent Road Reinstatement

Permanent reinstatement of public road surfaces and reinstatement of road base and sub-base shall be carried out by the Contractor in the accordance with the provisions of Clauses 1.6.31 to 1.6.38 of the Specification and in accordance with the requirements of Drawing No. 26011-TJOC-XX-XX-DR-C-0502 and the “Guidelines for Managing Openings in Public Roads” published by the Department of Transport, Tourism and Sport, Second Edition (Rev 1), dated April 2017, with the drawing and the guidelines taking priority. The requirements of the Local Authorities shall also be fully complied with, including those over and above the Drawing and this Specification.

Surface Dressing shall be completed over the full width of the roads where work takes place in the carriageway.

Permanent Reinstatement of public roads shall be carried out by the Contractor. The permanent reinstatement shall be carried out not less than 3 months after completion of the temporary reinstatement and prior to the end of the Maintenance period. The rate for permanent shall include for completing the joint between the existing and newly reinstated surface by painting the joint with 50 or 70 pen. hot bitumen or cold applied thixotropic bitumen compound of BS 4987 Part 2 1988 A2 sealant.

When pricing the contract, the Contractor shall bear in mind that compliance with this clause will be strictly enforced and if there is any undue delay in restoring either base or surface the Employer is empowered to and will enter upon the site and carry out the restoration and the cost of doing so will be deducted from monies due or becoming due to the Contractor.

All costs associated with road reinstatement shall be deemed to be included by the Contactor in the Contract Sum or in the items provided for in the Pricing Document.

2.3.14 Temporary & Permanent Reinstatement of Footpaths

The Contractor shall carry out temporary and permanent reinstatement of all footpaths where works have been carried out. The reinstatement shall be in accordance with the details shown in the ‘Guidelines for the Opening, Backfilling and Reinstatement of Trenches in Public roads’ published by the Department of the Environment and Local Government, Revision 2 Amendments dated September 2005.

2.3.15 Imported fill for trenches

The Contractor shall excavate and cart away to spoil any unsuitable material encountered below the final surface. In such circumstances the bottom and sides of the excavated trench below the final surface shall be lined with a geotextile material up to the pipe invert level as directed by the Employers Representative. All trenches shall be backfilled to final surface levels with Clause 804 or Leanmix depending on the road classification. Trenches and excavations for pits, chambers etc. shall be

backfilled above final surface level with the materials indicated on the drawings and in accordance with the requirements of Clause 1.6.21.

In general, excavation and filling shall be carried out in accordance with "Specification for Road Works" (DOE) and BS 6031 "Code of Practice for Earthworks". Filling shall be spread and levelled in 250mm (maximum) loose layers and be so placed that water may freely drain from exposed surfaces. The Contractor shall not change the source of filling without the prior approval of the Employers Representative.

Filling material shall be compacted in accordance with Clause 609 of the "Specification for Road Works" (DOE).

The type of test to be executed will be Test 15 as detailed in B.S. 1377. The Contractor shall be deemed to have included in his rates for filling and compaction for any delays encountered due to the execution of these tests.

Should compaction be found to be inadequate as a result of this testing, then the contractor will be required to carry out further compaction to the specified unless in the opinion of the Employers Representative the inadequate compaction was through no fault of the Contractor.

2.3.16 Rock Excavation

The Contractors attention is drawn to the fact that excavation may involve excavation of hard rock. Blasting of this rock will not be permitted. The material excavated shall be disposed of by the Contractor.

Furthermore, the use of rockbreakers shall not be allowed where the Employers Representative considers that adjoining structures would be endangered. The Contractor shall be deemed to have allowed for this in his contract sum.

2.3.17 Built in Pipes

At all points where pipes are to be built into concrete walls or decks, care shall be taken to ensure that the joint between the pipe and the concrete is watertight. If found to be otherwise the concrete shall be cut away and the joint made good. In addition to the requirements of Clause 1.6.25, where a pipe is built into a structure and will be underground there shall be two flexible joints adjacent to the structure. The first shall be not more than one pipe diameter from the outside face of the structure, subject to a minimum of 150mm if a socket faces the structure. The protruding pipe shall be supported from the structure by means of a 150mm thick concrete bed and surround which shall as far as possible be monolithic with the structure. Care must be taken to preserve the flexibility of this joint. The length of the next pipe (rocker pipe) away from the structure shall not exceed 0.75m for pipes up to 450mm nominal bore, 1m for pipes 450mm to 750mm nominal bore and 1.25m for pipes over 750mm nominal bore.

2.3.18 Service Connections

Service connections shall be formed on the new watermain to replace existing house connection services, as shown on the drawings, or as directed by the Employers Representative and shall include for saddle, bends, service pipe. The new service pipes shall be connected to the existing boundary boxes. The existing mains and service connections shall be kept live until the Contractor connects service connections to the new mains. Once the connection is made to the main, it shall be protected and backfilled around the full circumference of the pipe to completely cover any exposed areas. All existing boundary boxes and stop cocks shall be retained. Where new boundary boxes and stop cocks are required, these shall be in accordance with Specification Clause 2.3.30.

2.3.19 Existing Supply and Connections to Existing Pipework

The Contractor shall ensure that his proposed method of construction of the new pipelines causes the minimum amount of disruption to supply from the existing network. Where the Contractor is required to make connections to the existing network, he shall make all reasonable attempts to that no damage is caused to the existing sewer. If damage should occur, the Contractor shall make good such damage to the satisfaction of the Employers Representative at his own expense.

He shall be required to maintain the existing pipe network fully operational until such time as the new pipework is commissioned for use.

2.3.20 Identification Tape

Identification tape shall be placed over all pipelines and cable ducts in accordance with the provision of clause 1.6.30 of this specification.

2.3.21 Pipelaying Adjacent to Open Bodies of Water

A requirement exists for the carrying out of works and the laying of pipework adjacent to open bodies of water at river and stream crossings. These crossings shall be constructed in accordance with details shown on the Drawings.

2.3.22 Hydrants

The proposed hydrants shall be certified as complying with BS 750:1984 screw down type and shall meet the following minimum requirements:

- Spindle Cap – A cast iron square spindle cap shall be provided and shall be securely fixed to the spindle so that it remains fixed in position during normal use.
- Outlet Cap – The flanged 65mm round thread outlet shall be completely

covered with a cap of suitable material attached to the hydrant by a chain.

- Surface box – The clear opening of hydrant surface boxes at ground level shall not be less than 300mm × 380mm.
- Hydrant cover – Hydrant covers shall be clearly marked by having the words Fire Hydrant or initials FH cast into the cover. The underside of the hydrant box covers shall be fitted with a 75mm circular white plate bearing in black 20mm lettering the word OPEN and a black arrow indicating the direction of opening of the valve.
- Marker plate – each fire hydrant shall be clearly indicated by a marker post and plate in accordance with BS3251 affixed to a wall or a concrete post nearby in a conspicuous position. The marker plate shall indicate the size of main in millimetres on the upper part of the plate and the distance from the marker plate to the hydrant on the lower part of the plate in metres. The letter H shall be provided in black on a canary yellow background. In addition, the letters GTGWS shall be included on the plate.
- Frost valve – All hydrants shall be fitted with a frost valve on the outlet side.
- Depth of Outlet – The depth of the hydrant spindle shall not exceed 200mm below finished ground level.

All proposed materials shall have independent third party certification by NSAI, BSI or EU Equivalent and be manufactured within the EU. All pipes and fittings shall be stamped with the relevant Institute Certification inscriptions.

2.3.23 Thrust Blocks

Thrust blocks consisting of mix 'A' concrete shall be installed at as detailed on the drawings.

2.3.24 Testing of Watermains

All watermains including service connections shall be successfully tested as specified in Clause 1.8.2. The Contractor shall be required to carry out testing of the pipelines such that no more than a maximum of 500m of pipelines including connections has been constructed at any point in time without having been satisfactorily tested.

The Contractor should note that payment for pipelaying works shall only be considered for certification on production of satisfactory test results.

2.3.25 Repairs to Existing Watermains

During the construction of the works, existing watermains and consumer service connections which are being retained as part of the overall network may require some minor repair works in order to permit their continued usage and these minor works shall be deemed to be included for in the Contract Sum.

2.3.26 Valves

Sluice valves, Scour valves and Air valves shall comply with the requirements of Clause 1.7.13. Scour valves shall comply with the same requirements as sluice valve. All sluice and scour valves are to be '**Clockwise Opening**'.

The Contractor shall have deemed to include for up to 10m of 50mm scour pipe to the outfall location at all proposed scour valves. The outfall shall consist of a 300mm × 300mm × 300mm mix 'A' concrete support structure along with an anti-vermin mesh placed over the end of the outfall pipe.

All proposed materials shall have independent third party certification by NSAI, BSI or EU Equivalent and be manufactured within the EU. All pipes and fittings shall be stamped with the relevant Institute Certification inscriptions.

2.3.27 Valve Chambers and Surface Boxes

Unless otherwise specified the materials, dimensions and finishes shall be as specified on the drawings. All new valves shall be provided with marker plates and indicator posts. Marker plates to BS 3251 shall be provided. Where possible the marker plates are to be fixed to convenient adjacent walls or if not to approved indicator posts set in a Mix "B" concrete block of 0.05m³. The marker plate shall indicate the size of main in millimetres on the upper part of the plate, the distance from the marker plate to the valve on the lower part of the plate and the direction of closing for the valve. In addition, the letters GTGWS shall be included on the plate.

2.3.28 Transport and Storage

The handling, transportation and storage of pipes and fittings shall be done in accordance with the manufacturer's recommendations and in accordance with the following: - Unplasticised PVC Pipe ... Recommendation SR3 published by I.I.R.S.

During loading, unloading, stacking and general handling of pipe on site care shall be taken to avoid damage to all materials and in particular the coating/wrapping of iron or steel pipes and fittings. During transportation pipes shall be adequately supported for their length on a flat surface.

All pipes shall be lifted with approved slings to prevent damage.

Pipe fittings and appurtenances shall be stored on a secure level site in a neat and orderly manner. Only those items required for immediate use shall be deposited along pipeline route.

2.3.29 Bulk Meters

Electromagnetic flowmeters shall be fitted at location as shown on the drawings and shall be a 2" Siemens 5000 mains powered, or approved equivalent. They shall be installed in chambers as per the online meter chamber detail on Drawing 0501, including all fittings. A drain shall be provided to a nearby ditch within a distance of 10m. A weatherproof kiosk (minimum dimensions 0.3m × 0.5m × 1m high) shall be provided beside the installation with its legs cast into a concrete base (minimum dimensions 0.5m × 1.0m × 0.3m deep) along with the necessary ducting from the flowmeter chamber to the kiosk. The Contractor shall complete all commissioning required to provide the meter readings within the kiosk.

All new bulk meters shall be provided with marker plates and indicator posts. Marker plates to BS 3251 shall be provided. Where possible the marker plates are to be fixed to convenient adjacent walls or if not to approved indicator posts set in a Mix "B" concrete block of 0.05m³. Marker plates shall show the specific pipe size and distance from the marker plate at each location.

Data loggers shall be provided at each flowmeter to send the flow back to the GWS monitoring system. The loggers shall be compatible with existing GWS IPL telemetry system and the Contractor shall connect all new meters to this existing telemetry system.

The type of connections to the existing pipes including fittings and methods of work shall be submitted to the Engineer for approval. Connections shall be robust, durable, water-tight and in accordance with current best practice.

The Contractor shall be responsible for making good any services damaged by him during the installation of the meter.

Permanent reinstatement shall be carried out in accordance with the Specification.

2.3.30 Boundary Boxes & Service Connections

The Contractor shall install new service connections to consumers. The Contractor shall connect the new service pipelines to the new consumer boundary boxes and consumer meters supplied and installed under this contract. The new service pipes shall be 25 mm O.D. PE 100 SDR 11 laid from the new mains to the meter boxes.

All service pipelines shall be reinstated in accordance with the above reinstatement requirements.

The new consumer meters boxes shall be Talbot boxes, or approved equivalent and the new consumer meter boxes shall be Arid LoRaWAN®-based smart water to match other fittings on the scheme.

Where new service connections are required, new boundary boxes shall be installed with cast iron lids to Grade B and plastic fittings, if installed within a carriageway or footpath. However, if the Contractor proposes to install a box within the grass verge or off trafficked areas then a plastic lid box may be permitted with the consent of the Employer's Representative.

The new meter boxes shall be located as shown on drawings, with the precise locations to be agreed with Employer's Representative in advance of installation.

All boundary box components shall be constructed of corrosion-resistant materials which are compatible with being buried for prolonged periods whilst retaining their dimensional and structural characteristics. The boxes shall:

- (i) Comply with WIS 4-37-01, EN124:1994 & BS5834:1983;
- (ii) The height of the cover in relation to the main body of the box shall be capable of a vertical dimensional adjustment by convenient intervals of measurement to allow for minor variations in finished ground levels. The length of the guard tube shall be capable of a minimum adjustment of 150mm;
- (iii) Be watertight to Class 1 of WIS 4-37-01;
- (iv) Have a cast iron lid load tested to C250 of EN124.
- (v) Come complete with a stopcock and non-return valve;
- (vi) Have a design life of 50 years when subjected to normal operating and maintenance conditions;
- (vii) Have hydraulic head loss not greater than 3 meters of water when the whole box assembly, fitted with rotary piston meter complying with Class D of BS 5728: Part 7:1997 and having a nominal flow rate of $Q_n=1\text{m}^3/\text{hour}$, is operating at a flow of 25litres/minute;
- (viii) Integral non-return valve to be provided downstream of the meter.

If a special non-standard stopcock key is required, suppliers will include in their price for the provision of a key with each unit. If a special tool is required to open the box, suppliers will include in their quotation for the provision of a tool with each unit. The boundary box shall be supplied with a bridging piece to allow the lines to be flushed prior to the installation of the meter.

The box shall be constructed in accordance with the detail on the drawings. The base of the boundary box shall be 450mm x 450mm x 100mm thick and shall be constructed using either Grade C25 concrete or high strength (21N/mm²) concrete blocks. The base shall be laid on a 150mm deep compacted layer of Clause 804 bedding material. Compacted Clause 804 material shall also be placed around all sides of the box for a distance of 150mm. This material shall be laid and compacted up to a distance of 150mm below the top level of the box. A 150mm deep layer of concrete surround shall then be placed on the Clause 804 up to top of box level, again to a distance of 150mm around all sides of the box.

2.4 : HORIZONTAL DIRECTIONAL DRILLING (HDD)

2.4.1 Scope of Works

The detailed scope of works to be undertaken by the Contractor is listed hereunder and all of these works required are deemed to be included in the Contract Sum:

1. Undertake further geotechnical investigation as necessary,
2. Undertake further survey as necessary,
3. Locate existing services,
4. Undertake all design work necessary, including but not limited to:
 - Define target areas for pit locations and HDD hole size,
 - Develop site layout and define all construction plant required,
 - Provide calculations for expected maximum drive torque, thrust and other parameters during drilling, that may be expected during drilling and determine drill rig capacity to carry out the HDD. Include calculations on temporary structures required for installation of the HDD. If driving conditions are encountered which require a more powerful or different type of rig to be provided this shall be done at the Contractor's expense as the further geotechnical investigation required to be completed by the Contractor should have determined the correct rig to be used and/or the requirements for more than one type of rig.
 - Provide calculations and design drawing for drill rig footings,
 - Confirm that the nominated HDPE pipes that were selected for hydraulic reasons will fulfil the HDD installation requirements,
 - Determine drilling fluid quantity, supply, circulation, reclamation and disposal requirements,
 - Provide calculations on the pipe stresses due to soil overburden pressure that confirm the stresses do not exceed design code allowable stress values,
 - Provide calculations on the pipe stresses during pipe installation operations and the applicable minimum radii,
 - Provide calculations on the pipe to show that residual stresses on installed pipeline do not exceed the allowable limits specified in the nominated design code,
 - Detail temporary and permanent casing to support the bore and the installed pipe,
5. Prepare and issue for the Employer's Representatives approval Preliminary, For Construction and As-Built drawings showing the site arrangement, thrust and receiving pit chambers, rig set up and any supports required to complete the works.
6. Undertake construction including but not limited to:

- Mobilise all necessary HDD drilling equipment and pipeline insertion installation equipment,
 - Fabrication and site acceptance testing,
 - Certification and documentation necessary to install the pipelines,
 - Installation of the pipeline as detailed in the design including,
 - Excavation and removal of any isolated obstructions preventing progress,
 - Hydrostatic testing of completed pipelines.
7. Undertake excavation of additional pits to confirm pipeline cover: The Contractor shall excavate pits on completion of the installation of pipeline by HDD to provide confirmation that the required depth of cover to the pipeline has been achieved. The pits shall be excavated by hand at locations along the pipeline route selected by the Employer's Representative. The costs associated with the excavation, backfilling and reinstatement of pits shall be deemed to be included by the Contractor in the Contract Sum, or in the item provided for in the Pricing Document. Where the required depth of cover is found to be incorrect, the Employer's Representative may request the Contractor to relay pipeline at the Contractor's own expense.

2.4.2 Design

The Contractor shall confirm that the nominated pipe selections will withstand all temporary loads during installation and all permanent in-service loadings, which shall include but not limited to pre-installation loads, installation loads and post-installation and in-service loads. The pipe shall not be exposed to stresses more than those allowed by manufacturer's recommendation. The Contractor shall submit all the calculations that confirm the pipe selections.

The Contractor shall prepare and submit a Design Plan, which shall include the following:

- Design criteria and assumptions
- Detailed description of plant, equipment and personnel
- Statement of work method including calculations
- Depth of cover to be provided for the pipeline
- Any anticipated additional survey and geotechnical investigations
- Drilled Path Design showing the path and location in plan and elevations, entrance and exit angles, bend radius, setback distances and type and size of drill pipe to be used.
- Total volume and type and properties of drilling fluids to be used
- Method of disposal of excavated material and drilling fluids
- Detail of internal and external protective coatings
- Method of checking leakage
- Testing methods
- Quality assurance and quality control plans and procedures
- Safety plan
- Project time schedule
- Risk assessment plan
- Any other relevant design information.

2.4.3 Clearance

The Contractor minimum clearance from other assets and structures shall 500mm under waterways and existing services and under general surfaces shall be 1000mm.

2.4.4 Drawings

The Contractor shall prepare and submit preliminary design drawings for approval by the Employer's Representative. Following the approval of the Preliminary drawings, the Contractor shall amend as required following the review and submit the revised drawings For Construction. The drawings shall include, but not limited to:

- Details of launch and reception pits,
- Longitudinal sections including any amendments from the contract drawings,
- Locations of confirmed existing utility services and watercourses and confirmation that minimum clearances will be achieved,
- Pipe joint positions,
- Connection details to the open trench pipe.

2.4.5 Structural Survey

A photographic survey shall be undertaken of nearby structures in advance of the submission of the HDD design in accordance with Clause 2.1.16.

2.4.6 Work Plan and Drilling Plan

Along with the submission of the preliminary drawings, the Contractor shall submit a Work Plan and Drilling Plan for approval. These documents shall be comprehensive, realistic and based on actual working conditions for this particular project. These are in addition to the Safety Plan, Environmental Plan and Traffic Control Plan requested elsewhere in these documents.

The Work Plan shall detail the procedure and schedule to be used to execute the Works and shall include:

- Detailed programme,
- Schedule of work tasks,
- Safe work method statements for each work task,
- Risk assessment for each task.

The Drilling Plan shall contain a detailed description, as a minimum, of the following items:

- the layout of the working space and set-up at both the drill rig site and the pullback site,
- the proposed drilling rig, supporting equipment and list of personnel,
- maximum installation force on the pipeline,

- The calculated maximum tensile load permissible to be applied to the pipe during installation,
- the proposed tooling and the bottom hole assembly, soil formation and condition to be encountered,
- details of any temporary or permanent casing to support the HDD,
- diameter of pilot hole, angle of entry and exit,
- the proposed steering tool and surface tracking system, as applicable, frequency of readings to achieve the specified tolerance from grade or target, specified tolerance of locating system,
- type and size of reamers, and the proposed number of passes,
- the method and set-up for the installation of the new pipe into the reamed hole,
- the entrance and exit angles, bend radii, setback distances,
- the total volume, type and properties of drilling fluids to be used in the drilling,
- the circulation, containment, reclamation and disposal of drilling fluids,
- the total amount of excavated materials and its disposal,
- the removal of isolated obstructions preventing progress,
- the drilling log and any computer output data from steering and tracking systems,
- recovery of tools in case of obstruction or jammed cutting head,
- temporary works, retaining or supporting structures required for the installation of the pipework,
- the coordinates and reduced levels of the HDD at launch and receiving points,
- the location of underground services, which may be impacted by the pipelines,
- proposed drive lengths for HDD bores,
- specifications on material to be used including the pipe, fittings, drilling mud, encasing grout, drilling additives,
- hydrostatic test loads and earth overburden loads
- Risk table
- Contingency plan for spills, Frac-outs and fluid loss.

2.4.7 Receival and Launch Pits

The contractor shall minimise the number of receival and launch pits constructed. All excavations shall comply with the requirements for earthworks in Section 1 of the Specification. Pavement, lawns and other improved areas shall be thoroughly cleaned and left in the same standard or better as they were prior to works commencing. All grassed areas shall be restored with imported turf rolls. Reinstatement of pits shall be carried out in accordance with Clauses 2.3.12 and 2.3.13 of the specification. Receival and launch pits shall be expanded to remove/realign pipe where the drilling angle has resulted in the pipeline being below the minimum required cover specified in Clause 2.3.2. No pits shall be left open overnight.

2.4.8 Pipeline Tracer Wires

The pipelines installed by DHH shall be installed with an electrical continuous tracer wire on the above the crown of the pipe. It shall be 316 SS 1.2mm diameter welding wire, as a minimum.

2.4.9 Groundwater

Care shall be taken to control, contain and manage the effects of the ingress of any ground water to the HDD bore. Provisions shall be made for the remedial treatment of joints, fractures and any other defects in the strata in the event of drilling fluid loss.

Water pumped from excavations shall be discharged without damage to the environment. Groundwater shall not be discharged to the sewer and all discharge shall comply with the requirements of Clause 2.1.12. The contractor shall be responsible for dewatering of both entry and exit pits as a result of both inclement weather and/ or ground water ingress.

2.4.10 Drilling Fluid

Care shall be taken to control, contain and manage the effects of the ingress of any ground water to the HDD bore. Provisions shall be made for the remedial treatment of joints, fractures and any other defects in the strata in the event of drilling fluid loss.

Details of any drilling fluids proposed and the estimated volumes to be used shall be provided to Council prior to commencement of drilling. Drilling fluids, polymers and detergents used shall be environmentally sound and biodegradable.

Diesel fuel shall not be used as a drilling fluid.

All care shall be taken to prevent the loss of drilling fluids into the ground or the environment. Returned fluids shall be properly contained, reclaimed and recirculated. Precautionary measures shall be undertaken to minimise the impact of any inadvertent spillage of fluids on return or at exit of the HDD. If, at anytime during the drilling process a loss of drilling fluid occurs, the drilling process will be stopped immediately and the cause of the sudden loss investigated. Drilling will only recommence once the cause has been identified and a procedure put in place to prevent it reoccurring. At all times a full and complete spillage kit including vacuum truck should be available for the dealing of frac-outs or spillages.

It is the contractor's responsibility to manage, contain and dispose of all drilling fluids and cuttings.

2.4.11 Drilling Water

The contractor is responsible for transporting and storing any water required for drilling and hydrostatic testing. All water taken from Council mains, where permitted, shall be through a Council owned metered standpipe. Under no circumstance is the contractor to use its own standpipe or use unmetered water for the works.

2.4.12 Borehole Construction

Select borehole profile to avoid “frac-out” or discharge of drilling fluids along the drill path.

Changes in direction shall be sufficiently gradual to allow easy insertion of the product pipeline. The Contractor’s drilling system shall incorporate a survey system that will allow tracking of the drill head for the entire bore path. The system shall be capable of measuring line, level and gradient of the bore path.

The drilling system adopted shall ensure that all drill cuttings and additives are flushed from the borehole to the surface for collection and removal from site by the Contractor.

2.4.13 Drilling Procedure

Measures shall be taken to avoid damaging the product pipe during installation. The installation force shall be regulated to avoid overstressing the product pipe.

The Contractor shall:

- Work within the site as indicated on drawings, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor shall confine all activities to designated work areas.
- Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If the Contractor is using a magnetic guidance system, the drill path shall be surveyed for any surface geomagnetic variations or anomalies.
- The Contractor shall adhere to all safety regulations and all operations shall be conducted in a safe manner.
- Pipe lengths shall be connected together in one length, if space permits. Pipe shall be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.
- Pilot hole shall be drilled on bore path and recorded on a bore log detailing depth and alignment
- Upon successful completion of the pilot hole, the Contractor shall ream the bore hole to a minimum of 25% greater than the outside diameter of the pipe for straight pulls and 30% to 50% greater for curved or radius pulls using the appropriate tools. The Contractor shall have the option to pre-ream or ream and pull back the pipe in one operation if conditions allow. The Contractor shall not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.

- After successfully reaming the bore hole to the required diameter, the Contractor shall pull the pipe through the bore hole. A swivel shall be placed in front the pipe. Once pull-back operations have commenced, operations must continue without interruption until the pipe is completely pulled into the bore hole. During pull-back operations the Contractor shall not apply more than the maximum safe pipe pull force at any time. In the event that the pipe becomes stuck, the Contractor shall notify Council and advise the Contractors proposed corrective action. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, the Contractor shall cease operations and shall notify Council and advise the Contractors proposed corrective action.
- Appropriate encasing bentonite slurry shall be installed to completely fill the bored hole.

2.4.14 Bore Logs

HDD bore logs shall be kept, containing the dates, times and location, soil conditions, boring data such as depth, grade, alignment and rate of penetration and utility crossings. Information from these bore logs shall be recorded on the Works-As-Executed AutoCad Drawing.

Where applicable, the contractor shall also maintain computer data sheets from survey, guidance and control systems. The tracer wire shall be tracked at the entry point, at the exit point, and at a maximum of 10 metre intervals.

2.4.15 Disposal of Drilling fluids

The Contractor shall dispose of drilling fluids in accordance with Clause 2.1.12.

2.4.16 Pressure Testing

Hydrostatic pressure testing of the sections completed by HDD shall be completed in accordance with Clause 1.8.2 of the Specification. The tests shall be completed on the section drilled prior to connection to the pipe laid in open trench or to existing mains.

2.4.17 Digital As-Constructed Drawings

Final as-Constructed drawings shall be submitted in AutoCad immediately following the installation of a HDD section of main.