Shredded Wheat

Curtins Specification: Drainage

Curtins Ref: 066571

Document Ref: 066571-CUR-00-XX-SP-C-0015

Revision: C01

Issue Date: 13 April 2018

Client Name: Metropolitan Housing Trust

Client Address:
The Grange
100 High Street
London
N14 6PW

Site Address:
The Grange
100 High Street
London
N14 6PW

Curtins
40 Compton Street
London, EC1V 0BD
Tel: 020 7324 2240
www.curtins.com

Rev	Description	Issued by	Checked	Date
V01	Preliminary issue for comment	GT	AS	13/04/2018
C01	Issued for Stage 4 (Building Control)			
T01	Tender issue	LG	SC	22/03/2019

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
Georgia-Christina Tsampodimou **MSc** Graduate Engineer		13/04/2018

Reviewed	Signature	Date
Adam Smith **BSc(Hons)** Infrastructure Engineer		13/04/2018

Table of contents

Tables

1.0 General

1.1 Introduction

This Specification shall apply to all below ground foul and surface water gravity drainage systems.

This Specification does not apply to any pressure pipelines and process/chemical drainage unless specified by the Engineer.

The work is to be constructed strictly in accordance with the drawings (unless these have been modified by instructions from the Engineer) and is to be to the complete satisfaction of the Engineer.

Unless specified otherwise in this Specification the materials and workmanship shall comply with all relevant British Standards and Codes of Practices and associated Curtins Specifications, the principal of which are as follows:

Design Code	Description
BS EN 752:2017	Drain and Sewer Systems Outside Buildings
BS EN 12056:2000	Gravity Drainage Systems Inside Buildings Parts 1-5
BS 5911:2002	Concrete Pipes and Ancillary Products
BS EN 295 (all parts)	Vitrified Clay Pipes and Fittings
BS EN 1401 & BS 4660	Plastic Piping Systems for Non-pressure underground drainage and sewerage
BS EN 13598-1	Plastic Piping Systems for Non-pressure underground drainage and sewerage
BS EN 124:2015	Gully and Manhole Tops for Vehicular and Pedestrian Areas
BS EN 1433:2002	Drainage Channels for Vehicular and Pedestrian Areas
BS 437:2008	Cast Iron Pipes
BS EN 13101:2002	Manhole steps. Specification for galvanized ferrous or stainless steel manhole steps
Building Regulations 2010	Approved Document Part H – Drainage & Waste Disposal
Curtins Consulting Ltd	Specification for Earthworks

Table 1.1 – *Code of practice*

Items not covered by this Specification and items specifically to be adopted under Water Industry Act adoption agreements shall be carried out in accordance with 'Sewers for Adoption' (latest edition) by the Water Research Council (WRC) on behalf of the Water Authorities Association and as supplemented by any local Sewerage Authority specification and addendums.

1.2 Existing drainage invert levels

Before starting drainage work the Contractor shall check the location and invert levels of existing sewers at the connection positions with the new works and immediately advise the Engineer in writing of the levels found and any deviation in position.

1.3 Works on adopted/adoptable drainage systems

The Contractor must give adequate notice to the sewerage undertaker of the proposed works on existing adopted drainage systems and of new works which are to become adopted. The Contractor shall afford the sewerage undertaker access to inspect the works as required, and shall ensure that appropriate agreements are in place as in Section 6.0 of this specification.

1.4 Protection

The Contractor shall prevent discharges into the connecting existing system until the drainage system is complete and secure. In particular the Contractor should prevent overloading of pipes where final ground levels have not been made up and temporary covers to the drainage system should also be provided to prevent ingress of debris.

1.5 Use of the drainage system

The Contractor shall not be permitted to discharge foul water into the drainage system until all testing as specified in Section 8.0 has been satisfactorily completed.

The drainage system should also not be used for the wash-down of cementitious materials, and other wash-down activities should be approved by the engineer before implementing on site.

1.6 Health and safety

Laying drains is a hazardous operation. The Contractor must adequately plan the works to enable safe methods of work to be undertaken.

Nothing in this specification should be taken as an instruction to adopt working methods which contravene the CDM Regulations, and all Contractors/sub-Contractors etc are responsible for ensuring safe procedures which comply with the Regulations.

2.0 Materials

The materials used in the drainage works shall be in accordance with the following:

2.1 Pipes and fittings

Pipes and fittings are specified on the Engineers drawings. Pipes and fittings must comply with the following Standards:

2.1.1 Rigid Pipes and fittings

- Perforated vitrified clay pipes for land drainage to BS 1196.
- Concrete Pipes and Ancillary Products to BS 5911-1:2002+A2:2010 and BS EN 1916:2002.
- Vitrified Clay Pipes and Fittings to BS EN 295:2013 (all parts).
- Ductile Iron to BS EN 598:2007 & BS ISO 4179:2005.

2.1.2 Flexible pipes and fittings

- Plastic pipes for land drainage to BS 4962:1989.
- Plastic Piping Systems for Non-pressure underground drainage and sewage to BS EN 1401 & BS 4660 – Solid wall only, structured wall pipes are not acceptable for use in drainage systems unless agreed in advance with the Engineer.

2.1.3 Access chambers

- Precast concrete manhole units to BS EN 1917:2002.
- Plastic Inspection Chambers for Drains and Sewers to BS EN 13598-1:2010.

2.1.4 Other Fittings

- Gully and Manhole Tops for Vehicular and Pedestrian Areas to BS EN 124-2:2015.
- Drainage Channels for Vehicular and Pedestrian Areas to BS EN 1433:2002.

2.2 Other materials

All other pipes and fittings to Sewers for Adoption (including local water authority variations and addendums).

3.0 Excavation

Unless the requirements of Sewer for Adoption prevail for adoptable sewers, the excavation and backfill to drainage trenches shall be in accordance with the following and to the satisfaction of the Engineer.

3.1 Excavation for trenches

Excavation for pits and trenches shall be taken out to the levels and dimensions shown on the drawings or to such other levels and dimensions as may be directed dependent upon site conditions. Where the type of subsoil encountered at the pipe or invert level differs from that indicated on the Site Investigation, the Contractor must advise the Engineer immediately. Trenches shall be excavated true to line, level and gradient and specified trench width as noted on the drawings.

Any pockets of soft or loose material shall be removed and the pockets so formed filled to formation level with the same material as the permanent work which is to rest on that formation, properly compacted. Any void which results from over-excavation below formation level shall be refilled in the same manner.

3.2 Supports for excavations

The sides of all excavations shall be adequately supported by timbering, trench sheeting, piling or other suitable means. Where ground conditions permit, trench support should not extend below the top of the pipe bedding to avoid disturbance of the bedding materials.

All materials used for supporting excavations shall be removed as the work proceeds unless otherwise directed by the Engineer.

3.3 Water in excavations

Water shall not be allowed to accumulate in the trenches and where necessary adequate pumping shall be provided. Care shall be taken to ensure that pumping operations do not disturb the stability of adjacent soils and structures.

If the water is considered to arise from unexpected groundwater not anticipated from previous site investigations, the Engineer should be notified to allow the situation to be considered.

3.4 Disposal of surplus materials

All surplus excavated materials shall be deposited on the site in areas to be agreed or, if directed, shall be removed from the site.

3.5 Undermining adjacent structures

The Contractor shall take due regard of existing and proposed structures during the planning and execution of trench excavations in order to prevent undermining of foundations. No excavation shall take place within the 45 degree spread below any foundation without written approval of the Engineer.

3.6 Combined trenches

For trenches containing pipes at different levels, the whole trench width must be excavated to the depth of the lower pipe unless agreed in advance with the Engineer. Refer to the Engineer's details for backfilling to trenches which are not deemed to be narrow.

4.0 Laying and Bedding

4.1 General

All construction shall be in accordance with the working drawings and carried out to the satisfaction of the Engineer.

After excavation, trench bottoms shall be accurately formed to levels and gradients, care being taken to ensure a uniform profile along the length of the pipe. Local excavation is required for the sockets so that the pipe will be fully supported along the barrel.

If rock, large stones, or other local hard spots are present, or where concrete beds or granular materials are required, the trench bottom shall be over-excavated to accommodate the granular or concrete bed as appropriate.

Pipes shall be laid true to line and to even falls with sockets facing upstream, each pipe being boned between sight rails.

Alternative methods such as laser or ultrasonic beams may be used subject to the Engineer's approval. All setting out references of whatever form shall be clearly marked.

4.2 Granular bedding materials

The class of pipe bedding is specified on the Engineers' drawings.

Granular material to be used for bedding of pipes of Class S, B and F shall comply with one of the requirements set out below. The greater the proportion of fines in the material the greater is the care needed in compaction.

4.2.1 Building Regulation standard, unadoptable drainage

BS EN 1610 Annex B Table B.15		
Nominal Pipe Diameter (mm)	**Graded Aggregate Ranges (mm)**	**Single Sized Aggregate Sizes (mm)**
Up to 100	10 – 5	10
150	14 – 5	14
150 – 600	20 – 5	20
600 and greater	40 – 5	40

Table 4.1 – *Granular Materials to BS EN 1610 Annex B Table B.15*

Compaction factor 0.3 for Class N & B and 0.15 for Class F

All aggregate to be rounded unless agreed in writing by the Engineer.

Granular material to be used for bedding of pipes of Class N and T shall comply with one of the requirements set out below.

BS EN 1610 Annex B Table B.16 and B.17		
Nominal Pipe Diameter (mm)	**Table B.16 Limits**	**Table B.17 Nominal Sizes (mm)**
Not exceeding 140	Overall Limits	10
Exceeding 140 but not exceeding 400	Overall Limits	10 or 20
Exceeding 400	Overall Limits	10, 20 or 40

Table 4.2 – *Granular Materials to BS EN 1610 Annex B Table B.16 and 17*

All materials to be rounded aggregate unless approved in writing by the Engineer.

4.2.2 Sewers for adoption adoptable drainage

Granular beddings and pipe surround to be in accordance with Sewers for Adoption and guidance note IGN-4-08-01.

4.3 Laying pipes on trench formation

When the pipe is to be laid directly on the formation any necessary adjustments to level after the formation has been prepared shall be only made by raising or lowering the formation. Adjustments shall never be made by local packing.

Where the formation is low and does not provide continuous support, it shall be brought up to the correct level by placing and compacting suitable material.

Socket and joint holes shall be as short as practicable, scraped or cut in the formation and deep enough to give a minimum clearance of 50mm between the socket and the formation.

4.4 Laying pipes on granular beds

The granular bedding material shall be placed to invert level and shall extend to the full width of the trench unless otherwise shown on the drawings. A shallow depression shall be formed for the barrel of the pipe and socket holes formed at each joint position. These should be deep enough to prevent the weight of the pipe bearing on the socket or coupling and leave a minimum depth of 50mm of granular bedding material beneath the joint.

The pipes shall be laid directly on the granular bed and adjusted to correct line and level. All temporary pipe supports shall be removed as the work proceeds and prior to completing the pipe surrounds. Side

fill of either granular material or selected backfill material, depending upon the class of bedding specified, shall be placed evenly on either side of the pipe taking care not to disturb the line and level. Bedding material shall not be compacted in the socket holes. It is sufficient that they be filled as a result of the general placing of side fill.

4.5 Laying pipes with concrete bed, haunch, and surrounds

The level of formation shall allow for at least 100mm of concrete under the pipe barrel or as otherwise indicated on the drawings. The pipes shall be supported clear of the trench bottom by means of blocks or cradles of compressible material placed under the pipes immediately behind each socket. Expanded polystyrene or impregnated fibre building board are examples of suitable material that will yield under load sufficiently to permit the barrel of the pipe to rest uniformly on its bed after normal setting shrinkage of the concrete has occurred. Alternatively, rigid temporary supports such as purpose made folding wedges may be used but these shall be removed as the concrete bed is placed. The concrete bed shall extend at least 100mm on each side of the pipe for pipes up to 300mm diameter in size, unless otherwise shown on the drawings. Haunching and surround shall not be placed until the Engineer has been given the opportunity to inspect the pipework.

Where flexible joints are employed the overall flexibility of the drain shall be maintained by the provision of flexible joints in the concrete. These shall be formed through the full cross section of the concrete by providing compressible materials such as expanded polystyrene or impregnated fibre building board at the face of each pipe socket or sleeve.

The concrete shall be so placed that the pipes or lateral construction joints in the concrete are not displaced and the flexibility of the joint not impaired. All concrete shall be laid and compacted in accordance with Curtins Specification (Specification No. 1 or No. 2).

Wherever possible total concrete encase should be avoided and protective slabs provided over granular surrounds as a primary method of protection. This option as an alternative must be discussed and agreed with the engineer prior to commencement if total encasement is specified on the drawing as additional approvals may be required.

5.0 Jointing

5.1 Flexible joints

Flexible joints shall be made to conform to the pipe manufacturer's recommendations using the sealing ring supplied by the manufacturer. Where a lubricant is required it shall also be used in accordance with the manufacturer's recommendations. The jointing surface and sealing rings shall be clean and dry prior to any application of recommended lubricant.

To allow for telescopic movement, a small gap shall be left between the spigot end and adjoining socket, or between pipe ends.

Care shall be taken to avoid disturbance of the bedding when placing and jointing the pipes.

Where small diameter pipes can be jointed by hand the pipe being laid shall be pushed into the socket of the previous pipe. Where a winch or other pulling device is necessary its anchorage shall be so placed to avoid disturbance of the pipes already laid, e.g. on the remote end of the pipeline.

Pipes of 225mm nominal bore or less can be adjusted true to line after jointing, but larger pipes shall be correctly aligned before jointing as they may be difficult to move afterwards.

During the making of rolling-ring joints the rings should roll evenly, and to facilitate this the axes of the two pipes shall be aligned. With rolling-ring types of joints the pipe shall be temporarily restrained to avoid the ring rolling back and forcing the spigot of the last pipe out of its socket.

5.2 Rigid joints for flexible pipes

When rigid joints are used with flexible pipes, such as plastics and pitch fibre, the manufacturer's jointing recommendations shall always be carefully followed and care taken to avoid entry of jointing material into the pipe. If any solvent from a plastic pipe joint is spilled in the trench the polluted bedding shall be removed immediately and disposed of appropriately, otherwise the pipe may be attacked and weakened. Clean bedding material shall then be placed.

5.3 Rigid joints for rigid pipes

Clay pipe joints shall be filled with a 1:3 mix of cement sand mortar.

Concrete pipes shall have a ring of tarred yarn inserted into the correctly centred socket and driven home by a suitable caulking tool. The yarn in its final position shall occupy not more than one quarter of the depth of the socket which shall then be completely filled with 1:2 cement mortar, well rammed in and finished off with a neat fillet, levelled off from the outer rim of the socket to the barrel of the inserted pipe.

Cast iron joints shall be formed with approved gaskets and bolted flanges. Bolts, nuts and washers shall be protected by grease after making the joint. Cast iron pipes with open sockets shall be jointed with properly caulked lead wool.

5.4 Cutting pipes

Where it is necessary to cut rigid pipes this shall be done with a suitable pipe cutter to leave a clean end square to the axis of the pipe. Pitch fibre pipes can be cut with a coarse-tooth saw and plastic pipes with a fine-tooth saw. When required by the pipe manufacturer cut spigots shall be chamfered.

5.5 Jointing pipes and fittings of different materials

Where it is necessary to make joints between different materials a special adapter shall be used. Most pipe manufacturers supply suitable adapters.

6.0 Connections

6.1 Connection to an inspection chamber or manhole

Where a connection is made either direct, or by a drop-pipe to an open channel, the benching shall be carefully cut away and a suitable channel branch bend inserted, preferably three-quarters section, or an insitu entry channel formed. The incoming flow shall enter at the top of the channel in the direction of the main flow and without causing turbulence or backing up in the main or other branches. The benching shall be reinstated.

Where the connection is to a sealed system it shall be necessary to break out and replace the access fitting unless it already has a suitable spare branch.

6.2 Connection by a junction

In order to maintain a pipe continuity only sufficient length of pipe shall be removed to enable the junction to be inserted in the pipeline. Whether socketed or sleeved joints are used they shall be appropriate to the pipeline. Ensure accurate centring and concentricity about the pipe ends and provide an effective seal. The junction shall be fixed at the appropriate angle to receive the incoming branch drain.

Where this method is used for connection into a public sewer a Section 106 application/approval must be in place prior to commencement and the installation carried out in accordance with the local sewage undertakers standard connection requirements.

Where a junction is provided for future use it shall have an effective removable seal and its position shall be accurately measured and recorded.

6.3 Saddles

The pipe shall be cut into by the cautious enlargement of a small hole or by trepanning or, where practicable, by the use of a suitable saw and purpose-made template, taking care to prevent any materials from entering the pipe. The hole shall be accurately trimmed so that the saddle fits with at least half of the width of its shoulder bearing on the pipe over the whole circumference of the shoulder. The saddle shall be of the correct size for the pipe and connection and be secured by a method appropriate for the pipe material.

Where this method is used for connection into a public sewer a Section 106 application/approval must be in place prior to commencement and the installation carried out in accordance with the local sewage undertaker's standard connection requirements.

If specialist proprietary adaptors are used (Fabekun etc) should be agreed in advance of a Section 106 application.

7.0 Backfill

7.1 General

Backfilling to trenches shall be carried out strictly in accordance BS EN 752 and as indicated on the drawings. Care and attention is required to the placing and compaction of backfill particularly where it forms part of a load supporting system.

7.2 Selected backfill material

Selected excavated backfill material may be used subject to approval by the Engineer. It should preferably consist of uniform soil and can be readily compacted. It shall not include stones retained on a 40mm sieve, clay lumps larger than 75mm, tree roots, organic matter, rubbish and frozen soil. Cohesive soil that has been allowed to dry out on a spoil heap is not readily compactable and shall not be used.

For trench backfill material requirements above pipes laid within adoptable highways refer to drawings for specific requirements of fill material.

7.3 Side fill and initial backfill

The specified bed or surround shall be first laid with placement and compaction by hand tamping.

As soon as possible after completion of the bed or surround place the initial backfill with hand compaction in 100 mm thick layers to give 300 mm of compacted material above the pipe crown.

The initial backfill material shall be as specified on the drawings.

7.4 Main backfill

The main backfill shall be placed above the 300 mm of compacted material above the pipe crown by mechanical compaction.

The main backfill material shall be as specified on the drawings.

The method of compaction of the main backfill shall comply with the Specification for the Highway Works.

8.0 Testing of drains

The drains shall be tested after laying and jointing and after sufficient surround (to mid-height) is placed to adequately support the pipe.

8.1 Testing sequence

The testing of drains shall generally be carried out in two stages.

First stage testing shall be carried out to locate and remedy any defects in soundness that may exist at the time of construction. Such tests shall take place immediately before the work is covered up so as to facilitate replacement of any faulty pipes or pipe fittings or to rectify any joint defect. Drains shall be tested in sections (from manhole to manhole). Inspection of the pipeline will reveal any defects in the support and bedding. The method of testing shall be in accordance with Clauses 8.4 or 8.5 or 8.6 or 8.7.

Second stage testing and inspection shall take place immediately before hand over when all relevant works have been completed. The method of testing shall be in accordance with Clauses 8.4 or 8.5 or 8.7.

8.2 Pre-test procedures

Before any tests are applied attention shall be given to the safety of the operatives and other persons involved in the testing operation. It is essential that proper means of access shall be provided to the area of work, and the sides of any trench or excavation in which work is to be tested should be adequately supported and free from hazards.

Where a water test is to be applied, drain stoppers and bags shall be properly secured in position and provision made for the final removal of the stopper or bag from surface level by means of a strong cord attached to the inlet ferrule.

All obstructions, debris and superfluous matter shall be removed from sections of pipeline inspection chambers, manholes, or similar underground chambers and they shall be flushed out before testing.

Care shall be taken when a chemical cleaning agent is used to remove deposits of cement mortar from the surfaces of benchings and channel inverts. Protective clothing, including gloves and eye shields, shall be provided for operatives using or handling the chemicals. On completion of the work all treated surfaces shall be thoroughly hosed down.

8.3 Checking the bore

Where required by the Engineer and before any tests are applied, a disc or ball type profile testing device shall be passed through all drains and private sewers between inspection chambers, manholes or other suitable points of access and through all accessible branch drains.

8.4 Water test

Gravity drains and sewers up to and including 300mm diameter shall be tested to an internal pressure of 1.5m head above the invert of the pipe at the high end of the line and not more than 4m head at the lower end.

Testing shall be carried out between inspection chambers, manholes or other suitable points of access and through any accessible branch drains. Where the test head of water is in excess of 4m at the lowest point of the pipeline under test (including the minimum test head of 1.5m), the pipeline may be tested in sections by means of appropriately placed test branches. The test branches may be extended up to the finished surface with a suitable termination and used as additional points of access.

Solvent welded UPVC pipelines shall be allowed to stand for 1 to 2 hours before applying the test and shall be suitably anchored to prevent flotation when the test is applied before backfilling the trench.

Where cement mortar joints are used they shall be left for at least 24 hours before testing.

The test procedure shall be as given in items (a) to (f) below:

a. Fit expanding plugs or bag stoppers, suitably secured to resist the full hydrostatic head, at the lower end of the pipe and in any branches as necessary.
b. Fit a similar plug or bag stopper into the top end of the pipeline together with a stand pipe or flexible tube leading from a container connected to the plug or bag.
c. Fill the pipeline with water making sure that there are no pockets of trapped air.
d. Fill the stand pipe or other test apparatus to a height of 1.5m above the pipe or channel invert.
e. Allow the pipeline to stand for 2 hours for absorption, topping up as necessary.
f. After 2 hours, measure the loss of water from the pipeline by noting the quantity of water needed to maintain the test head in the apparatus over a period of 30 min.

The test will be considered satisfactory if the rate of water loss does not exceed 1 litre/hour per metre diameter per linear metre run of pipe. For various pipe diameters this rate of loss over a 30 min period may be expressed as follows:

100mm nominal bore pipe 0.05 litres per metre run;

150mm nominal bore pipe 0.08 litres per metre run;

225mm nominal bore pipe 0.12 litres per metre run;

300mm nominal bore pipe 0.15 litres per metre run;

Leaking or other defects which may be revealed during the test shall be made good and the test repeated until the pipe run proves satisfactory.

8.5 Air test

All pipes shall be initially air tested after laying and placement of bed and surround.

The air test shall be carried out by inserting expanding drain plugs or inflatable canvas or rubber bags in the upper and lower ends of the pipeline and pumping air in under pressure. Where cement mortar joints are used the joint shall be left for at least 24 hours before testing. Solvent welded UPVC pipelines shall be allowed to stand for 1 hour to 2 hours before applying the test.

The test procedure shall be as given in items (a) to (e) below:

a. Fit expanding plugs or inflatable canvas or rubber test bags into the ends of the pipeline and of all associated branches.
b. Connect a glass 'U' tube gauge (manometer) to one of the sealing plugs and a means of applying the air pressure to another sealing plug or stopper inserted in the section of pipework under test. The manometer and air pressure source shall be located at opposite ends of the pipework under test.
c. Apply pressure either by mouth or hand pump to achieve a pressure of slightly more than 100mm water gauge for pipelines, or where gullies and/or ground floor appliances are connected of slightly more than 50mm water gauge.
d. Allow 5 min for stabilisation of air temperature.
e. Adjust air pressure to 100mm or 50mm water gauge as necessary.

The drain run shall be considered satisfactory if, without further pumping, the head of water shall not fall by more than 25mm in a period of 5 min for a 100mm gauge test pressure and 12mm for a 50mm water gauge test pressure.

Should an air test not prove the run acceptable then a water test shall be carried out as described in Section 8.4.

8.6 Smoke test

Both ends of the drain shall be sealed and either smoke pumped in from a suitable smoke making machine or smoke bombs activated in the line. If any joints show an escape of smoke they shall be made good and retested.

8.7 Cleaning

Immediately before CCTV inspection, lift all manhole covers, inspection chamber covers and access point covers and remove all debris. Thoroughly flush the entire drainage system with water to remove all silt and check for blockages. Rod pipelines between access points to remove any debris and obstructions, which have not been removed by flushing.

Securely replace all covers after cleaning

8.8 CCTV inspection

All pipes of the drainage system are to be CCTV inspected immediately prior to handover.

CCTV equipment shall be of a type to satisfactorily record the condition of the drainage system using self levelling cameras and adequate illumination.

Immediately prior to camera entry all pipes must be flushed with water to enable backfalls in the system to be identified.

No flows will be permitted into the system during inspection.

The Engineer must be afforded access to inspect the CCTV inspection from a suitable monitor during the site inspection. If site attendance is not possible the Engineer shall be given sufficient time to inspect CCTV footage before handover of the works.

The Contractor shall provide 3 copies of the CD of the CCTV inspection with each pipe length and chamber references on the DVD tape.

A written report shall accompany the CD's identifying any defects of the system.

Any defect identified on the CCTV system must be rectified by the Contractor and subsequent CCTV inspection undertaken to prove the defect has been rectified.

Three copies of all video tapes to be provided on completion.

8.9 Laser Line Profile and Level Testing

Where the specific pipe material dictates that laser line, profile and level testing is required for drainage systems adoptable under Water Act adoption agreements, the testing shall be carried out strictly in accordance with the relevant Sewage Undertakes requirement.

8.10 Connectivity

Dye testing shall be undertaken by the Contractor to prove that no inter-connectivity between the foul and the surface water system is present.

9.0 Tolerances

All pipe inverts must be laid within +/- 20 mm of the specified drawing levels providing that no pipe shall have a reverse gradient, and that no ponding occurs within any length of pipe. Any pipe outside the above tolerance must be re-laid correctly.

Any pipe which does not meet the above tolerances must be re-laid to achieve the specified tolerances.

10.0 Access chambers

Manholes and catchpits shall be constructed in accordance with the drawings.

10.1 Brick manholes

Brick manholes shall be constructed in engineering brick Class B English bond, using 1:3 Portland Cement mortar, on a base of Grade C20 concrete in accordance with Sewers for Adoption. Each brick shall be well flushed and jointed up before mortar for the next course is spread. A sulphate-resisting cement shall be used where there is a danger of sulphate attack and where indicated on the drawings.

The ends of pipes shall be built into manholes with watertight joints. A single brick-on-edge arch shall be formed over all pipes exceeding 150mm in diameter.

Where the depth of the manhole exceeds 900mm double width galvanised step irons to BS EN 13101, shall be built into each third course, commencing at not more than at 750mm below the manhole cover.

Main channel inverts shall, wherever possible, be purpose made half round channels of the same material as the outgoing pipes from the manholes.

Side branches shall, where practicable, be brought into the main channel by the use of half section or three quarter section channels. The channels shall be bedded in 1:1 cement mortar and connected to the main channel so that the discharge from the branch drain is in the direction of flow in the main channel. The benching shall rise vertically from the edge of the channel pipe to a height of not less than that of the soffit of the outgoing sewer and shall be sloped upwards from that point to meet the wall of the manhole at a gradient of not less than 1 in 6. It shall be floated to a smooth hard surface.

Connect branches to the channel at half pipe level, with staggered connections so that discharge flows smoothly in the direction of the main flow, without turbulence.

Connect branches with a greater than nominal size of 150 m with the soffit level to that of the main drain.

Where the connecting angle (with the main channel) is greater than 45°, a three quarter section branch should be used. Channels and branches should be benched up to at least the top of the outgoing pipe at a slope of 1 in 12.

Where channels are formed insitu, they shall be formed to the required profile in concrete Grade C25 and shall be rendered in 1:2 cement mortar trowelled smooth.

Where specified on the drawings sulphate resisting cement shall be used for the benching and rendering.

Cover slabs when required shall be reinforced concrete Grade RC35 with rebates where required for the cover frames.

10.2 Precast concrete manholes

Precast concrete manholes shall be supplied with precast inverts shaped to accommodate incoming drains or cast in-situ inverts of concrete Grade C25. Joints shall be made in a mortar mix having a 1:3 cement sand ratio.

Where required for sewers adoptable under Water Industry Act adoption agreements, bases are to be formed as shown on the drawings using channel pipes and granolithic benching on Grade C20 concrete bases in accordance with Sewers for Adoption (including local sewage undertake variations and addendums). The use of preformed pre-cast bases for adoptable sewers should be approved by the Engineer and adopting sewage undertaker before commencement of works

The precast concrete manholes shall be provided with a surround of concrete Grade C20 of minimum thickness 150mm (unless Sewers for Adoption local variations and addendums dictate otherwise e.g. Severn Trent Water).

Any joints in concrete surrounds shall be staggered with the manhole construction joints.

Where specified on the drawings sulphate resisting cement shall be used for precast concrete manholes, their benching, rendering and surrounds.

Step irons to BS EN 13101 or ladders to BS EN 14396 shall be provided as detailed on the drawings.

10.3 Catchpits

Brick catchpits shall be constructed in common brickwork 225mm or 115mm thick as indicated on the drawings and laid in 1:3 Portland Cement mortar on a base of Grade C20 concrete.

Concrete catchpits shall be constructed in precast rings to BS 5911 as indicated on the drawings generally in accordance with a standard precast ring manhole with a sumped section replacing the usual channelled invert.

PVCu catch pit chambers shall be formed using preformed plastic inspection chamber parts as indicated on the drawings with the based formed of Grade C20 concrete

The silt trap section of the catchpit shall be formed and sized as shown on the drawings.

10.4 Inspection chambers

Inspection chambers shall be constructed as indicated on the drawings.

Where the depth of chamber exceeds 1.2 metres the access cover shall be fitted with a 350mm diameter restrictor as shown on the drawings to prevent man access.

Where PVCu chambers are located in vehicular areas the top of the chamber shaft shall be concrete surrounded in accordance with the drawings and fitted with a vehicle loading cover as shown.

10.5 Rodding Eyes

Rodding eyes shall be formed using the relevant pipe materials and fittings as detailed on the drawings.

Where rodding eyes are located in vehicular areas the top of the pipe riser shaft shall be concrete surrounded and fitted with the correct vehicle loading cover in accordance with the drawings.

10.6 Covers & Gratings

Covers and gratings shall be to the dimensions and gradings as shown on the drawings.

Internal manholes shall be double sealed air tight units to prevent the ingress of odours, as shown on the drawings and as detailed by the Architect to suit their floor finishes.

11.0 Surface water attenuation structures

11.1 Installation

The attenuation structure shall be installed in accordance with the product manufacturer's recommendations.

11.2 Waterproof Membranes

The Contractor shall ensure no damage arises to the waterproof membrane with particular care during backfilling operations.

11.3 Loading

The maximum imposed load, which can safely be accommodated by the attenuation structure, must not be exceeded during the works

The Contractor must confirm the maximum safe load with the Engineer.

11.4 Cleanliness

The Contractor must prevent all debris/silt entering the attenuation structure during the works.

12.0 Testing of manholes and catchpits

12.1 Test head

Inspection chambers and manholes less than 1.5m in depth to invert shall be filled with clean water to the underside of the cover and frame located at ground or surface level. Where the depth to the channel invert is 1.5m or greater the test head shall not be less than 1.5m. The test head for petrol interceptors, suction wells and similar underground chambers shall be not less than 0.5m above the invert of the highest connection to the chamber.

Where the chamber is located in ground subject to pore water pressure, the test head shall be the mean water table level based on seasonal variations or test heads previously specified, whichever is the greater.

12.2 Test procedures

Tests shall not be carried out until the structures have reached sufficient strength to sustain the pressure from testing.

Open channel manholes, inspection chambers and other free surface water containing structures shall, whenever possible, be tested independently of any drain or sewer.

The external faces of a structure shall not normally be backfilled or concrete surrounded before the chamber is filled with water to the specified test level. Adequate stability shall be ensured during the period of test and subsequent concrete placement and backfilling.

For the tests, a bag stopper shall be fitted in the outlet of the inspection chamber or manhole and expanding plugs or bag stoppers in all other connections. All plugs and stoppers shall be to resist the full hydrostatic head and means provided of safely removing the outlet bag stopper from the surface.

The inspection chamber, manhole, etc shall be filled with clean water to the required test level and allowed to stand for up to 8 hours for absorption, topping up the level as necessary. The tests shall be carried out as rapidly as possible.

The criterion for acceptance shall be that the water level remains constant for 30 minutes. Where water can be observed issuing from the outside face of the structure at an identifiable point or points, such leakage shall be made good.

12.3 Tests for surface water attenuation/storage tanks

Complete all filling to tank base and walls

Fill tank to top water level and leave 24 hours until stable level has been achieved. Thereafter record levels over 48 hours, where the drop should not exceed 50 mm. If a drop in water level exceeds 50 mm investigate leakage and repair and re-test until a satisfactory result is achieved.

13.0 Compaction factor test for bedding and surround material

13.1 Apparatus

a. Open-ended cylinder, 250mm long and 150mm + 10mm,-5mm internal diameter (150mm diameter pitch fibre or PVC pipe is suitable).
b. Metal rammer with striking face of 40mm diameter and mass 0.8kg to 1.3kg.
c. Rule.

13.2 Procedure

Obtain a representative sample more than sufficient to fill the cylinder (about 10kg) by heaping about 50kg of the proposed material onto a clean surface and dividing it with a spade down the middle into two halves. Divide one of these and repeat this procedure until the required mass of sample is left. In the sieving, clumps of material that break up under light finger pressure may be helped through the sieve, but considerable force must not be used to squeeze over-size clumps through the mesh. It is important to ensure that the moisture content of the sample does not differ significantly from that of the main body of material at the same time of its use in the trench.

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

Measure down from the top of the cylinder to the surface of the compacted material. This distance, in millimetres, divided by the height of the cylinder (250mm) is referred to as the compaction factor.

13.3 Suitability of compaction factor for use

Suitability of the compaction factor for use is as follows:

Compaction Factor	Suitability for Use
0.15 or less	Material suitable
Between 0.15 and 0.3	Material suitable but requires extra care in compaction. Not suitable if the pipe is subject to waterlogged conditions after laying.
Over 0.3	Material unsuitable

Table 13.1 – *Suitability of the compaction factor for use*

14.0 Land drains

14.1 Pipe Materials

The type of land drain shall be in accordance with the drawings.

14.2 Filter and bedding material

Unless otherwise specified, the filter material surrounding the pipe shall consist of hard, clean, crushed rock, crushed slag or gravel having a grading within the limits shown in the Table below. The aggregate crushing value of the material as determined by the tests in BS EN 933-1:2012 shall not exceed 30 per cent. The material passing the 10mm sieve shall be non-plastic when tested in accordance with BS 1377-1:2016.

B.S. Sieve Size	Range of Grading Percentage by Weight Passing
63mm	100
37.5mm	85 – 100
20mm	0 – 20
10mm	0 – 5

Table 14.1 – *Filter materials shall be to DoT Filter Drain Material Type B (cl.505)*

14.3 Joints

Where pipes with unsealed joints are specified, a gap of 10mm shall be left between the end of the pipe and the inner end of the socket. The pipe shall be supported with tarred rope yarn or other suitable flexible jointing material within the socket over at least the lower third of the circumference so that there are no vertical steps between one pipe and another.

Where perforated or porous pipes are specified, the joints shall be prepared as recommended by the pipe manufacturer. Perforated pipes shall be laid with the perforations facing downwards.

15.0 Grouting of redundant pipes

15.1 Reference should be made to The Building Regulations Part H appendix H1-B for classification of pipes to be grouted.

15.2 Pipes to be grouted shall be filled with a grout consisting of one of the following:

- Class G3 grout to consist of 1:10 cement:sand - mixed with the minimum amount of water to ensure fluidity.
- Class G4 grout to consist of 1:10 cement:pfa - mixed with the minimum amount of water to ensure fluidity.

15.3 The grout shall be introduced at the higher end of the length of sewer being filled. Grouting operations shall proceed such that no length of sewer shall be filled until all upstream communicating lengths have been completed.

15.4 The seals at the lower end of each run of sewer shall be fitted with a flexible breather pipe, fixed at the soffit of the sewer and turned vertically upwards to a height of 600mm above the soffit level of the higher end of the relevant sewer length.

15.5 The head of existing sewer lengths “cut-off” and exposed during excavations for new works shall be suitably sealed and a 150mm flexible injection pipe constructed through the seal at the soffit of the sewer. This shall be turned vertically and extended upwards for at least 1 metre.

15.6 On completion of grouting operations the injection pipe shall be sealed with a plug of concrete at least 150mm deep and having 150mm bearing outside the injection pipe.

15.7 Surplus water shall be disposed of without causing a nuisance.

15.8 The shafts of manholes on abandoned sewers shall be broken down to a level of 1 metre below finished ground level and the remaining void filled with GEN0 concrete.

16.0 As built records

The Contractor must identify any as-built changes to the Engineer’s drawings. The Contractor must provide marked up copies of the Engineer’s drawings indicating any changes to invert levels, pipes, manholes etc prior to Practical Completion.

Birmingham
2 The Wharf
Bridge Street
Birmingham
B1 2JS
T. 0121 643 4694
birmingham@curtins.com

Bristol
Quayside
40-58 Hotwell Road
Bristol
BS8 4UQ
T. 0117 302 7560
bristol@curtins.com

Cambridge
50 Cambridge Place
Cambridge
CB2 1NS
T. 01223 631 799
cambridge@curtins.com

Cardiff
3 Cwrt-y-Parc
Earlswood Road
Cardiff
CF14 5GH
T. 029 2068 0900
cardiff@curtins.com

Douglas
Varley House
29-31 Duke Street
Douglas
Isle of Man
IM1 2AZ
T. 01624 624 585
douglas@curtins.com

Dublin
39 Fitzwilliam Square
Dublin 2
Ireland
T. 00353 1 507 9447
dublin@curtins.com

Edinburgh
1a Belford Road
Edinburgh
EH4 3BL
T. 0131 225 2175
edinburgh@curtins.com

Glasgow
Queens House
29 St Vincent Place
Glasgow
G1 2DT
T. 0141 319 8777
glasgow@curtins.com

Kendal
28 Lowther Street
Kendal
Cumbria
LA9 4DH
T. 01539 724 823
kendal@curtins.com

Leeds
Rose Wharf
Ground Floor
Leeds
L29 8EE
T. 0113 274 8509
leeds@curtins.com

Liverpool
Curtin House
Columbus Quay
Riverside Drive
Liverpool
L3 4DB
T. 0151 726 2000
liverpool@curtins.com

London
40 Compton Street
London
EC1V 0BD
T. 020 7324 2240
london@curtins.com

Manchester
Merchant Exchange
17-19 Whitworth Street West
Manchester
M1 5WG
T. 0161 236 2394
manchester@curtins.com

Nottingham
56 The Ropewalk
Nottingham
NG1 5DW
T. 0115 941 5551
nottingham@curtins.com

Registered in England and Wales number: 2054159
Registered office: Curtin House, Columbus Quay, Riverside Drive, Liverpool L3 4DB