

Master Specification

Part RD-DK-C1

Installation of Stormwater Drainage

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RD-DK-C1 Installation of Stormwater Drainage

1 General

- a) This Master Specification Part specifies the requirements for the installation of stormwater drainage infrastructure, including concrete pipes, box culverts, concrete drainage structures, subsoil drainage and miscellaneous stormwater drainage works. It also includes the installation of pipes and box culverts installed for purposes other than drainage. This includes:
- i) the documentation requirements, as set out in section 2;
 - ii) the materials requirements, as set out in section 3;
 - iii) the excavation requirements, as set out in section 4;
 - iv) the installation of pipes and box culverts requirements, as set out in section 5;
 - v) the backfill of trenches and reinstatement of existing pavements requirements, as set out in section 6;
 - vi) the excavation at inlets and outlets requirements, as set out in section 7;
 - vii) the cast-in-place and precast concrete drainage structures requirements, as set out in section 8;
 - viii) the minor access and junctions requirements, as set out in section 9;
 - ix) the subsoil drainage requirements, as set out in section 10;
 - x) the existing drainage connections requirements, as set out in section 11;
 - xi) the sedimentation requirements, as set out in section 12;
 - xii) the test procedure requirements, as set out in section 13;
 - xiii) the Hold Point requirements, as set out in section 14;
 - xiv) the measurement requirements, as set out in section 15; and
 - xv) the verification requirements and records, as set out in section 16.
- b) “Unsuitable Material” has the meaning defined in RD-EW-C1 “Earthworks”.
- c) Concrete, reinforcing, and formwork used in drainage works must comply with the Master Specification structures concrete requirements set out in ST-SC-S1 to S7 and ST-SC-C1 to C7.
- d) Drainage work under new pavement must be completed prior to the construction of new pavement.
- e) The installation of stormwater drainage infrastructure must comply with the Reference Documents, including:
- i) AS 1289 Methods of testing soils for engineering purposes;
 - ii) AS/NZS 1554.1 Structural steel welding, Part 1: Welding of steel structures;
 - iii) AS 1597.1 Precast reinforced concrete box culverts, Part 1: Small culverts (not exceeding 1200 mm span and 1200 mm height);
 - iv) AS 1597.2 Precast reinforced concrete box culverts, Part 2: Large culverts (exceeding 1200 mm span or 1200 mm height and up to and including 4200 mm span and 4200 mm height);
 - v) AS 1646 Elastomeric seals for waterworks purposes;
 - vi) AS 2758.1 Aggregates and rock for engineering purposes, Part 1: Concrete aggregates;

- vii) AS 3610 Formwork for concrete;
- viii) AS 3972 General purpose and blended cements;
- ix) AS 3996 Access covers and grates;
- x) AS/NZS 4058 Precast concrete pipes (pressure and non-pressure);
- xi) AS 4139 Fibre-reinforced concrete pipes and fittings;
- xii) AS 4198 Precast concrete access and maintenance chambers for sewerage applications;
- xiii) AS/NZS 4671 Steel for the reinforcement of concrete;
- xiv) AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles;
- xv) AS/NZS ISO 9001 Quality management systems - Requirements;
- xvi) Department Standard Drawings (available from https://dit.sa.gov.au/standards/standards_and_guidelines); and
- xvii) Department Test Procedures (available from https://dit.sa.gov.au/standards/test_procedures).

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

- a) for large box culverts, where loading the base slab with vehicular or other traffic, full calculations demonstrating that the concrete has sufficient capacity in accordance with section 5.6b); and
- b) for formwork where it is proposed that concrete is cast against the ground, evidence that the ground is stable and will stand vertically without any distress or contamination of the concrete, in accordance with section 8.3a).

2.2 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

- a) the verification requirements and records specified in section 16; and
- b) a successful protocol compliance test certificate where the communications interface is said to be compatible with a given protocol.

2.3 Warranty

A warranty in accordance with the requirements of PC-CN3 “Construction Management” must be provided for all materials and construction for a period of 2 years from the Date of Completion.

3 Materials

- a) Concrete pipes, box culverts and precast drainage structures must comply with RD-DK-S1 “Supply of Pipes and Culverts”.
- b) Mortar must comprise of one part cement (complying with AS 3972 General purpose and blended cements) and 3 parts sand (complying with the requirements for fine aggregate in AS 2758.1 Aggregates and rock for engineering purposes, Part 1: Concrete aggregates).

4 Excavation

4.1 General

- a) Excavation must comply with RD-EW-C2 "Trench Excavation and Backfill". Any clearing and grubbing in the line of the drain, including cutting back of any tree branches, must conform to the requirements of PC-ENV2 "Environmental Protection Requirements".
- b) Over-excavation, taken below the levels specified, must be filled with the specified bedding material placed in accordance with section 5.3 except that for large box culverts, over-excavation must be filled with Grade 10 concrete.

4.2 Support of Utility Services in excavations

Where Utility Services are encountered in an excavation, the Contractor must comply with the requirements of PC-US1 "Utility Services", which includes liaising with the appropriate Utility Service Authority to obtain any requirements for support of the Utility Services and comply with those requirements.

4.3 Redundant culverts and drainage structures

- a) Where pipe / box culverts or drainage structures become redundant, the Contractor must ensure that the Works cannot be damaged in the future by water leaking from the redundant culverts / structure and entering the earthworks. Unless specified otherwise, the following treatments must be applied at a minimum:
 - i) removal of any redundant culverts / structure which are encountered during excavation and backfill in accordance with RD-EW-C2 "Trench Excavation and Backfill"; or
 - ii) where indicated on the Design Drawings that redundant existing culverts / structures are to be retained in their existing location:
 - A. the redundant existing culvert / structure must be entirely filled in-situ with 3 MPa controlled low strength material (CLSM) in accordance with RD-EW-C4 "Controlled Low Strength Material";
 - B. culvert ends are to be plugged with Grade N20 concrete to completely seal the ends of the culvert;
 - C. the CLSM must be placed in a manner that allows all air to be displaced as the CLSM fills the structure; and
 - D. at no time after final set of the CLSM must any vertical cross section of the filled void be less than 98% of the total void filled with CLSM.
- b) Where specified in the Contract Documents (including the Design Drawings), the Contractor must remove any other existing pipes, culverts, and drainage structures (outside of the area of excavation) and backfill the resultant voids in accordance with section 6.

4.4 Excavated material

Material excavated for drainage construction must be treated in accordance with the requirements of RD-EW-C1 "Earthworks".

4.5 Inspection after excavation

- a) Following completion of excavation, a **Hold Point** must apply. Installation of the stormwater drainage infrastructure related to the excavation must not continue until the Hold Point has been released.
- b) If foundation preparation concrete is not used, the Contractor must undertake proof rolling to verify the strength of the subgrade and identify any Unsuitable Material in accordance with the following:

- i) for pipes, small box culverts and drainage structures, 2 passes of a vibrating plate compactor (Wacker Model BPU 3750 or similar) must be used;
 - ii) for large box culverts, a roller with a minimum weight of 1 t must be used; and
 - iii) where foundation preparation concrete is to be placed, proof rolling will not be required.
- c) The Contractor must remove and replace any Unsuitable Material which has been identified.

5 Installation of pipes and box culverts

5.1 Damage during installation

- a) The Contractor must:
- i) verify that the load capacity of the pipes / box culverts (and associated structures) will not be exceeded during installation;
 - ii) ensure that pipes / box culverts are not damaged during transportation, handling, placement, backfilling, and subsequent construction activities; and
 - iii) if necessary, place sufficient protective material (in accordance with the manufacturer's instructions and design requirements) over the pipes / box culverts to prevent damage during construction activities.
- b) Any damage to reinforced concrete pipes will be considered a Non-Conformance and the associated Hold Point set out in PC-QA1 "Quality Management Requirements" or PC-QA2 "Quality Management Requirements for Major Projects" (as applicable) will apply.
- c) The Non-Conformance Report for Non-Conformances required in accordance with section 5.1b) must classify the damage in accordance with Austroads Technical Specification ATS-2210 Supply of Steel Reinforced Precast Concrete Pipes and be subject to assessment in accordance with Table RD-DK-C1 5-1.
- d) Fibre reinforced pipes must be rejected if fractures and cracks wider than 0.1 mm and deeper than 0.3 mm are present.

Table RD-DK-C1 5-1 Acceptability of Defects

Defect type	Pipe wall	Joint surface
1	May be acceptable	Not applicable
2	May be acceptable after completion of approved repair	Not applicable
3	Reject	Not applicable
4	May be acceptable after completion of approved repair	May be acceptable after completion of approved repair
5	May be acceptable after completion of approved repair	May be acceptable after completion of approved repair
6	Reject	Reject
7	Reject	Reject

5.2 Dimensions

- a) Where the Principal has provided an issued for construction design the length shown on drawings is:
- i) where pipes / box culverts terminate at headwalls, the length measured along the centreline of the pipes / box culverts units; and
 - ii) at other locations, the plan length measured from centre to centre of the drainage structure (unless otherwise shown).
- b) Nominal design gradients are calculated using the lengths specified in section 5.2a). Gradients quoted in drainage schedules on the Design Drawings are for guidance only and gradients

necessary to achieve quoted invert levels may vary from the quoted gradients, depending on the overall dimensions of drainage structures.

5.3 Bedding

- a) Bedding must be Sa-C Type C Sand, spread to a minimum compacted depth in accordance with the following:
 - i) 150 mm for pipes diameter 1500 mm or greater;
 - ii) 125 mm where verification testing is to be undertaken; and
 - iii) 100 mm otherwise.
- b) The Contractor must arrange for trials to be conducted to verify a method of achieving the specified compaction.
- c) The results of the trial and details of the proposed methodology must be provided to the Principal, which will constitute a **Hold Point**. The proposed method to achieve the specified compaction must not be used until the Hold Point has been released.
- d) For pipes, the bedding sand must be rammed under both sides of the haunches of the pipe to a height of one third the diameter of the pipe.
- e) For large box culverts, the foundation area must be prepared in accordance with the requirements shown on the drawings.
- f) Bedding for circular pipes and rectangular box culverts placed in fill must be in accordance with AS/NZS 3725 Design for installation of buried concrete pipes and extend 300 mm on each side of the pipe or rectangular box culvert.

5.4 Placement of concrete pipes

Concrete pipes must be placed and jointed in accordance with the manufacturer's instructions. Pipes must be placed with the female end upstream and with lifting holes (if any) uppermost. Lifting holes in pipes must be filled with plugs supplied by the pipe manufacturer for that purpose.

5.5 Placement of small box culverts

- a) Small box culverts must be placed so that the joints between base slabs are located half way between the joints on the crowns.
- b) In relation to small box culverts, mortar or pipe sealant must be used to seal the joint between the crown units and bases.
- c) In relation to small box culverts, a bituminised tape (Densopol 60HT or equivalent) must be used in accordance with the manufacturer's instructions to seal the joints of abutting crown units. Taping must be done immediately prior to backfilling to minimise the risk of separation of the tape from the concrete surfaces.
- d) In relation to small box culverts, lifting hooks must be cut off with a cutting disc, with both steel and concrete being ground away at least 5 mm below the surrounding concrete surface. The surface must then be finished flush with an epoxy grout (Bauer Concast 737 S/L epoxy grout or equivalent) to give a minimum cover of 5 mm over the remnant lifting hook.

5.6 Placement of large box culverts

- a) In relation to large box culverts and unless specified otherwise, crown units must not be placed on the cast-in-place slab for a period of 48 hours after placement of the base slab concrete.
- b) In relation to large box culverts, no superimposed loads other than the culvert crown units must be permitted on the base slab. If the Contractor intends loading the base slab with vehicular or other traffic, full calculations demonstrating that the concrete has sufficient capacity to support such loads must be provided as part of the Construction Documentation.

- c) In relation to large box culverts, immediately prior to positioning crown units onto the base slab, a 15 mm layer of cement mortar (1 part cement: 3 parts sand) must be placed into the recesses in the top of the base slab onto which the crown units are to be placed. Excess mortar must be removed to a minimum of 20 mm below the level of the base slab.
- d) In relation to large box culverts, following completion of the installation of the crown units and prior to commencement of backfilling, a stiff cement mortar (1 part cement: 3 parts sand) must be placed into the remaining spaces of the recess as shown on the drawings.
- e) In relation to large box culverts, lifting hooks must be cut off with a cutting disc, with both steel and concrete being ground away at least 5 mm below the surrounding concrete surface. The surface must then be finished flush with epoxy putty (Bauer Concast 737 S/L epoxy grout or approved equivalent) to give a minimum cover of 5 mm over the remnant lifting hook.

5.7 Junctions

- a) Where a junction is shown on the drawings it must be constructed as a bandaged joint in accordance with section 5.9.
- b) Backfill must not be placed against junctions until at least 24 hours after installation of the junction.
- c) The construction of the joint must provide an unobstructed waterway of the specified dimensions in each of the culverts after completion of the joint.

5.8 Cutting pipes / box culverts

- a) Cutting of pipes / box culverts to provide appropriate lengths at joints and drainage structures must be done in such a manner that it does not affect the structural capacity of the pipes / box culverts.
- b) Reinforcement exposed during cutting of pipes / box culverts must be painted with a thick highbuild epoxy (Megapoxy P1 or approved equivalent) of sufficient thickness to achieve protection equivalent to or better than the concrete cover and must be applied in accordance with the manufacturer's instructions.
- c) All Works and Temporary Works must be undertaken in accordance with the Contract Documents, including health and safety in relation to silica dust, cutting and PC-WHS1 "Work Health and Safety".

5.9 Extension of existing pipes / box culverts

- a) Where existing pipes / box culverts are to be extended, any existing headwalls or drainage structures must be demolished and disposed of by the Contractor.
- b) Bandaged joints must be constructed and the joint strengthened with a concrete fillet (bandage) around the pipes / box culverts forming the joint and extending at least 300 mm from the junction along the surface of each pipe / box culvert. The fillet must be a minimum of 100 mm thick and must be reinforced with SL62 mesh in accordance with AS/NZS 4671 Steel for the reinforcement of concrete, completely encircling both pipes forming the joint, lapped 300 mm and extending the full length of the fillet.
- c) Backfill must not be placed against fillet joints until at least 24 hours after installation of the fillet joints.
- d) The construction of the joint must provide an unobstructed waterway of the specified diameter in each of the pipes / box culverts after completion of the joint.

6 Backfill of trenches and reinstatement of existing pavements

- a) Backfill of trenches must comply with RD-EW-C2 "Trench Excavation and Backfill". Pipes / box culverts placed in fill must be protected from damage by construction machinery.

- b) Reinstatement of any existing pavements which are to be retained must comply with RD-PV-C6 "Reinstatement of Existing Pavements".

7 Excavation at inlets and outlets

- a) The Contractor must excavate as necessary to match the pipe / box culvert invert to the adjoining drainage channels or natural surface.
- b) Unless shown otherwise on the Design Drawings, the excavation must be uniformly graded at a maximum grade of 2% or to the boundary of the road reserve, whichever extends the least. The excavation must be the full width of the pipe / box culvert apron, with batters not steeper than 6 horizontal to 1 vertical.

8 Cast-in-place and precast concrete drainage structures

8.1 General

- a) If the Principal has provided the Design Documentation for the drainage structures, it will be based on cast-in-place structures and the use of precast drainage structures must be at the Contractor's risk. The information regarding location of existing culverts and services may not be sufficiently accurate for the use of precast structures. Where normal class concrete is specified on the drawings, the concrete must comply with ST-SC-S1 "Normal Class Concrete".
- b) Junction boxes must have inspection pit covers as detailed on the Design Drawings. Regardless of any note on the drawings to the contrary, junction boxes must be provided with inspection pit covers complying with AS 3996 Access covers and grates, Class D or AS 4198 Precast concrete access and maintenance chambers for sewerage applications, Class H as appropriate.
- c) Inspection pit covers must be installed flush with the final surface.
- d) Grated junction boxes and field gullies must include covers and frames. Grates and frames must be fabricated to the dimensions shown on Department Standard Drawing S-4065, sheet 1. Welds must be GP in accordance with AS/NZS 1554.1 Structural steel welding, Part 1: Welding of steel structures.
- e) Side entry pit covers for single or multiple openings must be minimum dimension 900 mm x 450 mm.
- f) Exposed steel work other than cast iron must be hot-dip galvanized in accordance with AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.

8.2 Foundation preparation for drainage structures

- a) Where detailed on the Design Drawings, foundation preparation concrete must be placed below cast-in-place structures.
- b) Bedding must be in accordance with section 5.3.
- c) Excavation below the specified levels must be filled with either Sa-C Type C Sand and compacted to the same standard as the bedding or with Grade 10 concrete where foundation preparation concrete is to be placed under the structure.

8.3 Formwork

- a) Both internal and external surfaces of walls must be formed. If the Contractor can demonstrate as part of the Construction Documentation that the ground is stable and will stand vertically without any distress or contamination of the concrete, the concrete may be cast against the ground, provided that:
 - i) the wall thickness is increased by at least 50 mm over that detailed; and
 - ii) the cover to reinforcement adjacent to the ground is increased by at least 50 mm.

- b) External formwork must be used for the top portion of junction boxes and gullies contained within the road pavement in all cases. Formwork must be used for all exposed faces of headwalls and drainage structures.

8.4 Precast drainage structures

Where a precast drainage structure is used, the external joint with the pipes / box culverts must be strengthened with a concrete fillet encircling the culvert at the joint. The fillet must be a minimum of 100 mm thick 10 MPa concrete (or rapid mix equivalent). The inside joint must be rendered flush with the inside wall of the structure with mortar (1 part cement and 3 parts sand) or equivalent.

9 Minor accesses and junctions

Pipes / box culverts used under any minor accesses and junctions for side drains must be placed in the centre of the side drain with the same grade as the side drain. The pipes / box culverts must allow unimpeded flow of water in the side drain.

10 Subsoil drainage

- a) This section 10 only applies where the construction of subsoil drainage is specified on the Design Drawings or in the Contract Documents.
- b) Subsoil drainage must be installed, and the trench backfilled in accordance with the manufacturer's instructions. Following placement of the subsoil drain and prior to backfilling, a **Hold Point** must apply. Backfilling must not occur until the Hold Point has been released.
- c) Flushout points must be provided where shown on the Design Drawings. Flushout points must consist of 100 mm diameter UPVC pipe connected to the subsoil drain and rising vertically to approximately 100 mm below the finished surface level and fitted with a threaded cap. A removable concrete cover (Ri Industries Flanged I.O cover and frame Type 1 - ϕ 150 mm or equivalent) must be provided.

11 Existing drainage connections

- a) Existing stormwater connections from private properties and council stormwater systems must be maintained at all times.
- b) Any works involving modification or connection to existing private, council or Drainage Authority stormwater infrastructure must be undertaken in consultation with the relevant owner of the stormwater infrastructure, the Principal and in accordance with all relevant Approvals.

12 Sedimentation

- a) Soil and any other material entering the pipes / box culverts or drainage structures must be removed so that the pipe / box culvert provides an unobstructed waterway of the specified dimensions at all times up to the completion of all of the work on the Site.
- b) Any sedimentation prevention measures (such as sediment traps, silt fences and straw bales) must be fully functional at the completion of all of the work on the Site.

13 Test procedures

The Contractor must carry out testing in accordance with the requirements of this Master Specification Part, including the Reference Documents and the test procedures listed in Table RD-DK-C1 13-1. Results of the testing must be provided as part of the Quality Management Records.

Table RD-DK-C1 13-1 Test procedures

Test	Test procedure
Sampling of soil, aggregates and rocks	Department Test Procedure TP226 Sampling of Soil, Aggregates and Rocks
Preparation of samples	AS 1289.1
Site selection by stratified random technique	AS 1289.1.4.2
Field density:	Nuclear method AS 1289.5.8.1
Moisture content:	Oven drying method AS 1289.2.1.1
	Microwave method AS 1289.2.1.4
Maximum dry density:	Modified compaction AS 1289.5.2.1
	Rapid method Department Test Procedure TP164 ⁽¹⁾ Determination of the Dry Density/Moisture Content Relation of a Soil - 3 Point Method
Dry density ratio	Department Test Procedure TP320 Compaction Control Test - Dry Density Ratio, Moisture Variation and Moisture Ratio

Table notes:

(1) This test may only be used for control testing, not for verification testing.

14 Hold Points

Table RD-DK-C1 14-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table RD-DK-C1 14-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
4.5a)	Inspection after excavation	Construction quality	24 hours notification
5.3c)	Results of trials to verify a method of achieving the specified compaction	Documentation	5 Business Days review
10b)	After placing subsoil drain and prior to backfilling	Construction quality	24 hours notification

15 Measurement

Where the Contract Documents require measurement for the purpose of payment, the measurement of pipes / box culverts must be based on the length of installed culvert and the measurement of kerb and gutter must include the gutter across the openings of gullies (which may include deflector vanes).

16 Verification requirements and records

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table RD-DK-C1 16-1 have been complied with.

Table RD-DK-C1 16-1 Verification requirements and records

Section reference	Subject	Property	Test Procedure	Test frequency	Acceptance limits
5.6	Placement of large culverts: dimensions, level and position	Placement tolerances	As specified in PC-SI1 "Site Surveys"	As specified in PC-SI1 "Site Surveys"	Within ± 20 mm of specified horizontal position and within ± 10 mm of specified vertical position, with the proviso that the invert of the structure must not impede the gravity flow of water into or from the structure
5.3	Culvert bedding	Compaction	Department Test Procedure TP320 Compaction Control Test - Dry Density Ratio, Moisture Variation and Moisture Ratio	The Contractor must develop a method specification in accordance with section 5.3b)	Not less than 90%
6	Backfill	Compaction	Department Test Procedure TP320 Compaction Control Test - Dry Density Ratio, Moisture Variation and Moisture Ratio	As specified in RD-EW-C2 "Trench Excavation and Backfill"	As specified in RD-EW-C2 "Trench Excavation and Backfill"
8	Drainage structures: concrete requirements	Concrete requirements, refer to ST-SC-S1 to S7 and ST-SC-C1 to C7	As specified in ST-SC-S1 to S7 and ST-SC-C1 to C7	As specified in ST-SC-S1 to S7 and ST-SC-C1 to C7	As specified in ST-SC-S1 to S7 and ST-SC-C1 to C7
8	Placement of drainage structures: dimensions, level and position	Variation in cross-sectional dimensions	As specified in PC-SI1 "Site Surveys"	As specified in RD-EW-C1 "Earthworks"	Within ± 6 mm of specified dimension
		Misplacement from specified position	As specified in PC-SI1 "Site Surveys"	As specified in PC-SI1 "Site Surveys"	Within ± 20 mm of specified position
		Permissible surface irregularities	As specified in PC-SI1 "Site Surveys"	As specified in PC-SI1 "Site Surveys"	Less than 10 mm
		Variation of levels of invert from specified level	Surveyors level	As specified in PC-SI1 "Site Surveys"	Within ± 10 mm of specified position, with the proviso that the invert of the structure must not impede the gravity flow of water into or from the structure
10	Subsoil drainage: level and position	Misplacement from horizontal position	Tape measure	Every 10 m	Within ± 100 mm of specified position
		Variation from specified level	Surveyors level	Every 10 m	Within ± 30 mm of specified level; with the proviso that gravity flow of water to the drainage outlet must be provided