CAPRICORN MUNICIPAL

DEVELOPMENT GUIDELINES

FLOODWAYS

D14

**DESIGN GUIDELINE**

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**Keeping the Capricorn Municipal Development Guidelines up-to-date**

The Capricorn Municipal Development Guidelines are living documents which reflect progress of municipal works in the Capricorn Region. To maintain a high level of currency that reflects the current municipal environment, all guidelines are periodically reviewed with new editions published and the possibility of some editions to be removed. Between the publishing of these editions, amendments may be issued. It is important that readers assure themselves they are using current guideline, which should include any amendments which may have been published since the guideline was printed. A guideline will be deemed current at the date of development approval for construction works.

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| GENERAL |  |
| SCOPE |  |
| * 1. The work to be executed under this Specification consists of:  1. bed level floodway design; 2. pipe culvert floodway design; 3. box culvert floodway design; 4. Department of Agriculture, Fisheries and Forestry Development Application. |  |
| * 1. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in Annexure D14A. | Quality |
| * 1. The following order of priority for interpretation of documents will apply: (Please note that reference to a Guideline or Standard, is reference to the latest version of the relevant document, unless specifically a version number is specifically stated)   CMDG Design Specification D14 – Floodways  Queensland Urban Drainage Manual (QUDM)  Manual of Uniform Traffic Control Devices (MUTCD)  AUSTROADS | Order of Priority |

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| REFERENCE DOCUMENTS |  |
| * 1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. | ***Documents Standards Test Methods*** |
| **(a) CMDG Specifications**  D1 – Geometric Road Design  D2 – Pavement Design  D5 – Stormwater Drainage Design |  |
| **(b) QLD State Authorities**  Department of Transport and Main Roads   * Road Drainage Design Manual (RDDM ) Chapter 9: culvert design and Chapter 10: floodway design * Manual of Uniform Traffic Control Devices (MUTCD) Part 1: General Introduction and Sign Illustrations * Manual of Uniform Traffic Control Devices (MUTCD) Part 2: Traffic Control Devices for General Use * Bridge Scour Manual * Design Criteria for Bridges and Other Structures (DCB&S) * Insitu Stabilised Pavements using Cement or Cementitious Blends (MRTS07B)   Department of Energy and Water Supply   * Queensland Urban Drainage Manual (QUDM), Third Edition 2013.   Department of Agriculture Fisheries and Forestry   * Guide for the determination of waterway using the spatial data layer *Queensland waterways for waterway barrier works* * Development assessment provisions * Code for self-assessable development - Minor waterway barrier works (Code WWBW01) Part 3: culvert crossings and Part 4: bed level crossings   **c) Other**  AUSTROADS   * Austroads Guide to Road Design (AGRD) Part 3: Geometric Design |  |

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| DEFINITIONS |  |
| * 1. A waterway is—  1. a river; or 2. a creek; or 3. a stream; or 4. a watercourse or inlet of the sea; or 5. as marked on the data layer Queensland Waterway Barrier Works   Regardless of whether they are tidal, freshwater, dry, static or flowing (ephemeral or perennial) waters. | Waterway |
| * 1. For flowing waterways, the low flow channel is the base flow level. For static/dry waterways, the low flow channel is to the height of flow from an AEP 63.2% (1 year ARI). | Low Flow Channel |
| * 1. The main channel of a given waterway is the active component of the flow channel. The extent of the main channel can also be referred to as ‘bankfull level’. The furthest extent of the main channel can be characterised by a distinct change in the appearance of the bank at a certain level, including; * Undercutting; * Changes in vegetation density; * Sudden changes in bank slope; * Boundary levels for water marks; * Mosses or lichens; * Changes in sediment particle size; or * The height of a point bar on the inside of a meander bend. | Main Channel |
| * 1. Culvert means the support structure for a crossing over a waterway, for example, box, pipe, slab, open or arch culvert. | Culvert |
| * 1. Bed level means the lowest point of the natural stream bed (pre-construction), within the footprint of the proposed crossing. | Bed Level |
| * 1. The average or expected value of the period between exceedances of a given rainfall total accumulated over a given duration. It is implicit in this definition that the periods between exceedances are generally random. | ARI |
| * 1. The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. | AEP |
| * 1. A topographically defined area drained by a stream where all outflow is directed to a single point. | Catchment |
| * 1. The limits from where surface runoff will make its way, either by natural or man-made paths, to this point. | Catchment area of any Point |
| * 1. The network of planned and unplanned drainage routes providing safe, well-defined overland flow paths for rare and extreme storm runoff events. It includes roads, natural channels, streams, culverts, community retention/detention basins and other facilities. | Major System |
| * 1. The gutter and pipe network capable of carrying and controlling flows from frequent runoff events. It includes kerb and channels, inlet structures, open drains and underground pipes and on-site detention facilities. | Minor System |
| * 1. Waterway zone—   DAFF has defined five distinct waterway zones.  **Green**  These are waterways with the lowest risk of impact. Any culvert structure used to cross these types of waterways can be self-assessable developments.  **Amber**  These are waterways with moderate risk of impact. Bed level crossings, culvert crossings and temporary works are all self-assessable developments. However, any low impact dams or weirs that are proposed in these waterways must go through the state development approval process prior to installation.  **Red**  These are waterways with high risk of impact. The same as amber waterways, red waterways also require bed level crossings, culvert crossings and temporary works are all self-assessable developments. However, any low impact dams or weirs that are proposed in these waterways must go through the state development approval process prior to installation.  **Purple**  These are waterways with major risk of impact. Bed level crossings and temporary works are self-assessable developments similar to amber and red waterways. However, any low impact dams or weirs and culvert crossings that are proposed in these waterways must go through the state development approval process prior to installation.  **Grey**  Similar to purple waterways, these are waterways with major risk of impact. However, only temporary works are self-assessable developments while any other developments that are proposed in these waterways must go through the state development approval process prior to installation.  **Table D14.03.01- Summary of approvals required for waterway barriers**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Waterway Zoning Colour** | **Risk of Impact** | **Development Type** | | | | | **Bed-Level Crossing** | **Culvert Crossing** | **Low Impact Dam/Weir** | **Temporary Works** | | Green | Low | Self-assessable | Self-assessable | Self-assessable | Self-assessable | | Amber | Moderate | Self-assessable | Self-assessable | Development Approval | Self-assessable | | Red | High | Self-assessable | Self-assessable | Development Approval | Self-assessable | | Purple | Major | Self-assessable | Development Approval | Development Approval | Self-assessable | | Grey | Major | Development Approval | Development Approval | Development Approval | Self-assessable | | Waterway Zone |
| DESIGN CALCULATIONS |  |
| * 1. Floodway's shall be designed to convey a storm event consistent to that of the adjoining road. | Design Storm Event |
| * 1. The catchment area shall be determined in accordance with the requirement of the Specification for STORMWATER DRAINAGE D5. | Catchment Area |
| * 1. Pipe sizing shall be calculated in accordance with the requirement of the Specification for STORMWATER DRAINAGE D5. | Pipe Sizing |
| * 1. Vertical curves and changes in grade shall be designed in accordance with the requirements of the Specification for GEOMETRIC ROAD DESIGN D1 and AGRD Part 3. | Vertical Curves |

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| BED LEVEL CROSSINGS |  |
| EXCAVATION |  |
| * 1. Excavation shall be undertaken in accordance with the requirements of the Specification for EARTHWORKS C213 | General |
| STANDARD |  |
| * 1. Bed level crossings must be perpendicular (within 10° of the water flow) and no greater than 15m in width. Bed level crossing must be installed as per CMDG standard drawing. | General |
| MATERIAL |  |
| * 1. Where bed level crossing is to be constructed from stabilised gravel: * Gravel must be Type 2.3 or similar approved product * To achieve a modified pavement UCS must be between 0.8 and 2. To achieve a rigid pavement UCS must be greater than 2 * Depth of gravel to be minimum 200mm compacted thickness where subgrade material is adequate. If subgrade material is inadequate, this material must be removed and replaced with suitable material * Design and construction must be in accordance with MRTS07B | Stabilised Gravel |
| * 1. Where the bed level crossing is to be constructed from rocks: * Rocks must be clean with minimal fine material * Rocks must be equivalent of larger size than the natural bed material at the site and at least 50mm diameter * The surface shall be left rough and not over compacted (e.g. track-rolled finish or rougher) | Rock Crossing |
| * 1. Rocks used for scour protection are to be clean with minimal fine material and minimum 100mm diameter. Mean rock size is to be   Where:  d50 = mean diameter of the rock (m)  y = depth of flow (m)  Se = Slope of bed (m/m)  = angle between the bed and horizontal | Rock Scour Protection |
| * 1. Concrete shall be minimum 32MPa and shall be in accordance with AS3600. Reinforcement to have minimum 50mm cover and shall be in accordance with AS3600. Reinforced concrete design to be approved by a Registered Professional Engineer of Queensland (RPEQ). | Concrete & Reinforcement |
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| FLOODWAY FURNITURE |  |
| * 1. Guide posts shall be installed as per AS1742.2 with a minimum four (4) guide posts to be installed, one on each corner of the floodway as per CMDG standard drawing. | Guide Posts |
| * 1. Flood depth markers to be installed at the lowest point of the floodway such that it can be read from both ends of the floodway. | Flood Depth Markers |
| * 1. Advanced Warning signage to be in accordance with MUTCD Part 1 and Part 2. | Advanced Warning Signage |
| CONFIGURATIONS |  |
| **Option 1** |  |
| * 1. The Lowest point of the crossing must be installed at the level of the lowest point of the natural stream bed (pre-construction), within the footprint of the proposed crossing. | General |
| * 1. There must be a height difference of at least 100mm from the lowest point of the crossing to the edges of the low flow channel. The crossing must not be built up above the natural level of the channel. Possible configurations of this option are illustrated in Figure D14.09.01. The stream bed must be dug down to accommodate minimum material thicknesses. | Vertical Alignment |
| **Figure D14.09.01: Bed Level Crossing Configuration Option 1 - Minimum height difference across the crossing** |
| * 1. Extent of bed level crossing to extend 10m beyond the top of bank on either end of the floodway. To be confirmed onsite. | Horizontal Alignment |
| * 1. Scour protection is to be used when option 1 type bed level crossing is constructed of concrete. Rocks to be not over compacted and left proud and uneven (e.g. track-rolled finish or rougher)     **Figure D14.09.02: Scour Protection** | Scour Protection |
| * 1. Gabion rock protection to be in accordance with DTMR’s Scour Manual, DCB&S and DTMR SD 2241. | Gabion Rock Scour Protection |
| * 1. Grouted rock protection to be in accordance with DTMR’s Scour Manual, DCB&S. | Grouted Rock Scour Protection |
| * 1. Minimum thickness of free rock protection is to be 300mm or the limit shown in Table D14.09.01, whichever is greater.   **Table D14.09.01- Minimum thickness of free rock scour protection**   |  |  |  | | --- | --- | --- | | **Min Thickness** | **Size distribution (d50/d90)** | **Description** | | 1.4 d50 | 1.0 | Highly uniform rock size | | 1.6 d50 | 0.8 | Typical upper limit of quarry rock | | 1.8 d50 | 0.67 | Recommended lower limit of distribution | | 2.1 d50 | 0.5 | Typical lower limit of quarry rock |   Where d50 is the mean rock size determined in clause D14.07.03. | Free Rock Scour Protection |
| **Option 2** |  |
| * 1. The pavement surface of the bed level crossing can be built up to a maximum of 300mm above the lowest point of the natural stream bed (pre-construction), within the footprint of the proposed crossing. | Vertical Alignment |
| * 1. Extent of bed level crossing to extend 10m beyond the top of bank on either end of the floodway. To be confirmed onsite. | Horizontal Alignment |
| * 1. Directly upstream and downstream of the crossing, adjacent to each bank and at the low flow section of the crossing, a rock chute at a slope no greater than 1 in 30 (3.3%) must be incorporated into the design. The minimum width of the bank rock chutes are 3m and the minimum width of the low flow channel rock chute is 100% of the low flow channel   Length of rock chutes are to be as defined in Figure D14.09.02.  Thickness of rock chutes are to be as defined in Table D14.09.01.  For concrete crossings, the surface of the crossing must be broom finished for the width of the rock chutes.    **Figure D14.09.03: Bed Level Crossing Configuration Option 2 - Purple, Red and Amber Waterways** | Rock Chutes for Purple, Red or Amber waterways |
| * 1. Directly upstream and downstream of the crossing, at the low flow section of the crossing, a rock chute at a slope no greater than 1 in 30 (3.3%) must be incorporated into the design. The minimum width of the low flow channel rock chute is 100% of the low flow channel   Length of rock chutes are to be as defined in Figure D14.09.02.  Thickness of rock chutes are to be as defined in Table D14.09.01.  For concrete crossings, the surface of the crossing must be broom finished for the width of the rock chutes.    **Figure D14.09.04: Bed Level Crossing Configuration Option 2 - Green Waterways** | Rock Chutes for Green waterways |

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| CULVERT CROSSINGS |  |
| EXCAVATION |  |
| * 1. Excavation shall be undertaken in accordance with the requirements of the Specification for EARTHWORKS C213 | General |
| STANDARD |  |
| * 1. All culvert crossings must be installed as per CMDG standard drawings. | General |
| * 1. The culvert or group of culverts must span a minimum of 100% of the low flow channel. | Span |
| * 1. The culverts must be installed at a gradient no steeper than the natural waterway. | Gradient |
| * 1. Scour protection to be provided upstream and downstream of the floodway for the length determined using Figure D14.11.01.     **Figure D14.11.01: Length of Scour Protection and Rock Chutes for Culverts** | Scour protection |
| BOX CULVERTS |  |
| * 1. For cast insitu wingwalls, headwalls and aprons to be in accordance with DTMR SD 1303. Precast headwalls can be used in lieu of cast insitu concrete. | Wingwalls, Headwalls & Aprons |
| * 1. Roughening elements such as baffles must be installed on the bank side walls of the outermost culverts to a minimum of 95% of the full height of the vertical extent of the culvert sidewalls with a gap of no greater than 30mm at the bottom. Roughening elements must also be installed on the upstream wingwalls on both banks to the height of the upstream obvert or the full height of the wingwall. | Roughening Elements for Purple and Red Waterways |
| * 1. Baffles must have maximum 150mm horizontal protrusion into the flow and maximum be no thicker than 10mm. Baffles must be spaced at 2 x horizontal protrusion of baffle within 1.2m of the culvert inlet and 4 x the horizontal protrusion for the rest of the culvert length. Baffle details are shown in Figure D14.12.01.     **Figure D14.12.01: Baffle Details** | Baffle Specifications |
| **Configuration Option 1 (Purple and Red Zones)** |  |
| * 1. The width of the culvert or group of culverts must span a minimum of 75% of the main channel width. | Span |
| * 1. All culverts must be set at a minimum of 300mm below the bed level unless installed on bedrock where the natural bed surface is maintained through the culvert. | Setting |
| * 1. The obvert of the culvert must be a minimum of 600mm above the commence to flow water level (or bed level on dry waterways). Minimum box culvert height is 900mm to allow for culvert to be set 300mm below bed level. | Obvert Level |
| * 1. If the culvert is designed with a flood immunity of less than AEP 2%, the depth of cover over the culvert(s) (including the pavement) is no greater than 750mm. | Culvert Cover |
| **Configuration Option 2 (Purple and Red Zones)** |  |
| * 1. The width of the culvert or group of culverts must span a minimum of 75% of the main channel width. | Span |
| * 1. At least 1 culvert in the crossing is to be set at a minimum of 300mm below bed level, unless installed on bedrock where the natural bed surface is maintained, with minimum width of 1200mm and must be aligned with the low flow channel of the waterway.   All other culverts in the crossing must be at (or below) bed level and roughened throughout the culvert floor to approximately simulate natural bed conditions. | Setting |
| * 1. The obvert of the culvert must be a minimum of 600mm above the commence to flow water level (or bed level on dry waterways). The obvert of the culvert below bed level must be no lower than the obvert of the highest culvert sell in the crossing. | Obvert Level |
| * 1. If the culvert is designed with a flood immunity of less than AEP 2%, the depth of cover over the culvert(s) (including the pavement) is no greater than 750mm. | Culvert Cover |
| **Configuration Option 3 (Purple and Red Zones)** |  |
| * 1. The width of the culvert or group of culverts must span a minimum of 3.6m or 100% of the main channel width, whichever is greater. The crossing must incorporate at least one culvert with a minimum width of 1200mm | Span |
| * 1. All culverts must be set at a minimum of 300mm below the bed level unless installed on bedrock where the natural bed surface is maintained through the culvert. | Setting |
| * 1. The obvert of the culverts must be a minimum of 300mm above the commence of flow water level (or bed level on dry waterways) | Obvert Level |
| * 1. The depth of cover over the culvert(s) (including pavement) is no greater than 300mm | Culvert Cover |
| * 1. The maximum deck height of the crossing is 1.2m at the lowest point of the natural stream bed | Deck Height |
| * 1. Adjacent to each bank a rock chute with slope no greater than 1 in 20 (5%) must be incorporated into the design.   The width of each rock chute is 3m of the combined cell width and  Thickness of rock chutes are to be as defined in Table D14.09.02.  As a minimum the toe of the rock chute is to extend to the level of the obvert of the culverts | Rock Chutes |
| **Amber Zones** |  |
| * 1. Culverts must span a minimum width of 2.4m or 100% of the main channel width which is greater. | Span |
| * 1. All culverts must be installed at or below bed level. Where the culvert is installed less than 300mm below bed level, the culvert floor must be roughened throughout to approximately simulate natural bed conditions. | Setting |
| **Green Zones** |  |
| * 1. Culverts must span a minimum width of 1.2m or 100% of the main channel width whichever is greater. | Span |
| * 1. All culverts must be installed at or below bed level. | Setting |
| PIPE CULVERTS |  |
| * 1. Pipe culverts are to only be used on Green or Amber classified waterways and to be installed as be CMDG standard drawings. | General |
| * 1. Cast insitu wingwalls, headwalls and aprons for pipe diameter 750-2400mm to be in accordance with DTMR SD 1304. Precast wingwalls, headwalls and aprons can be used in lieu of cast insitu concrete. | Wingwalls, Headwalls & Aprons |
| **Amber Zones** |  |
| * 1. Pipes must span a minimum of 2.4m or 100% of the main channel width whichever is greater. | Span |
| * 1. All pipes must be roughened through the bottom of the culvert and must be installed no higher than bed level. | Setting |
| **Green Zones** |  |
| * 1. Culverts must span a minimum width of 1.2m or 100% of the main channel width whichever is greater. | Span |
| * 1. All culverts must be installed no higher than bed level. | Setting |
| BACKFILLING |  |
| * 1. Backfilling shall be carried out in accordance with the requirements of the relevant culvert structure's Specifications. | Detail |

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| SELF ASSESSMENT |  |
| Pre-works |  |
| * 1. Following completion of the design, DAFF pre-works advice sheet must be completed. This advice sheet is located in section 8 of Part 3 and Part 4 of the DAFF code WWBW01.   Information required to be included in this advice sheet is;   * Date work to commence * Estimated construction duration * Details of the person or organisation undertaking the works * Location of the works in decimal degrees and site photographs (A, B and C minimum) as shown in figure D14.16.01 * Works details including the purpose of work and the type and size of the proposed structure * If there will be marine plant disturbance * Signed declaration | Application |
| * 1. The advice sheet is to be sent to:   Northern Fisheries Facility - Cairns  Department of Agriculture, Fisheries and Forestry  Att: Manager (Planning and Assessment)  PO Box 5396  Cairns QLD 4870  Or emailed to: idasnfc@daff.qld.gov.au | Submission |
| Post-works |  |
| * 1. Following completion of the waterway barrier works (i.e. the placing and backfill of culverts, not necessarily including the road or surfacing on top of the culverts); the DAFF post-works advice sheet must be completed. This advice sheet is located in section 8 of Part 3 and Part 4 of the DAFF code for self-assessable development, WWBW01.   Information required to be included in this advice sheet is;   * Date of completion * Post-work site photographs (A, B, C, D and E) as shown in figure D14.16.01 | Notification |
| * 1. The advice sheet accompanied by a copy of the pre-works advice sheet is to be sent to:   Northern Fisheries Facility - Cairns  Department of Agriculture, Fisheries and Forestry  Att: Manager (Planning and Assessment)  PO Box 5396  Cairns QLD 4870  Or emailed to: idasnfc@daff.qld.gov.au | Submission |
| **Figure D14.16.01: The location and direction of pre and post works photos at a site of proposed waterway crossing works** |  |
| DEVELOPMENT APPLICATION PROCESS |  |
| Process for Grey Zones and culvert floodways in Purple Zones |  |
| * 1. If works are being completed in a grey waterway or culvert works are being undertaken in a purple waterway, a development approval will be required to be submitted through the Department of Infrastructure, Local Government and Planning.   The construction and rising of a waterway barrier is classed as operational works under the *Sustainable Planning Act 2009*, thereby requiring development approval. Included in the development approval process is an assessment under the *Fisheries Act 1994*. An aquatic ecology report will be required to be included in the Development Application. | Requirement |
| * 1. To lodge a development application, the Integrated Development Assessment (IDAS) process is followed. IDAS forms 1 and 27 must be completed to lodge the application. These forms can be found at <http://www.dilgp.qld.gov.au/resources-ilgp/forms-templates-checklists/spa-idas-forms.html>. The Operational Work Checklist (checklist number 1) should also be completed to ensure further forms aren't required as a part of the development application. | Forms |
| * 1. Consideration should be given to the timeframes required for a Development Application. This process can take between 2 and 6 months. | Timeframes |
| * 1. Application fees associated with this application are as stated in the LGIP | Fees |

# ANNEXURE D14A

## QUALITY CONTROL TESTING

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| **Activity** | **Key Quality Verification Requirements** | **Maximum**  **Lot Size** | **Minimum**  **Test Frequency** | **Test**  **Method** | |
| **MANDATORY TESTING** | | | | | |
| Material supporting concrete structures | Bearing Pressures  PASS & ASS | 1 contract/size  1 contract/size | 1 per type/size  1 per type/size | AS1289  AS 4969 | |
| Concrete | Refer Specification for Minor Concrete Works |  |  |  | |
| Gravel | | UCS | 1 contract/size | 1 per type/size | AS |
| **AUDIT TESTING – IF ORDERED BY COUNCIL** | | | | | |
| Supply of Precast Units | | Precast Quality -  Suppliers documentary evidence and certification | 1 batch | 1 per type/size/  class per batch |  |
| Siting and Excavation | | Geometry | 1 drainage  line/structure | 1 per drainage  line/structure | Survey |
| Foundation | | Compaction | 1 drainage  line/structure | 1 per 20 lin m \* | AS 1289.5.4.1 |
| Material surrounding Steel Structures | | Material Quality  - pH/Electrical Resistivity | 1 drainage  line/structure | 1 per material type | AS 1289.4.3.1  AS 1289.4.4.1 |
| Bedding | | Material Quality |  |  |  |
|  | | - Particle Size Distribution | 1 contract | 1 per 200m3 \* | AS 1141.11 |
|  | | Compaction/Moisture Content | 1 drainage  line/structure | 1 per layer, per 20 lin m | AS 1289.5.7.1,  AS 1289.5.4.1 |
| Concrete Bedding or Lining | | Geometry |  | 1 Cross Section per 25m | Survey and 3m Straight Edge |
| Installation of Precast Units | | Geometry | 1 drainage  line/structure | 1 per drainage line/structure | Survey |
| Selected Backfill | | Material Quality |  |  |  |
|  | | - Maximum Particle Size | 1 contract | 1 per 100m3 \* |  |
|  | | - Plasticity Index | 1 contract | 1 per 100m3 \* | AS 1289.3.3.1 |
|  | | Compaction/Moisture Content | 1 drainage line/structure | 1 per 2 layers per 50m2 | AS 1289.5.7.1,  AS 1289.5.4.1 |
| Rock Fill for Gabions/  Wire Mattresses | | Material Quality: |  |  |  |
|  | | - Wet Strength | 1 contract | 1 per contract | AS 1141.22 |
|  | | -Wet/Dry Strength Variation | 1 contract | 1 per contract | AS 1141.22 |

\* Note: or part thereof, per lot