<table>
<thead>
<tr>
<th>Publication Number:</th>
<th>MITS 16B Edition 1 Revision 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Effect:</td>
<td>July 2019</td>
</tr>
<tr>
<td>Supersedes:</td>
<td></td>
</tr>
<tr>
<td>Endorsed By:</td>
<td>Karl Cloos</td>
</tr>
<tr>
<td>Approved By:</td>
<td>Ken Marshall</td>
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**Document Information**

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Key Information</th>
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<tbody>
<tr>
<td>MITS 16B Ponds</td>
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**Next review date**

**Key words**

| AUS-SPEC Base Document | 1351 Stormwater Drainage (construction) |

**Revision Register**

<table>
<thead>
<tr>
<th>Edition/ Revision Number</th>
<th>Clause Number</th>
<th>Description of Revision</th>
<th>Authorised By</th>
<th>Date</th>
</tr>
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<tr>
<td>1/0</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
# CONTENTS

## 1 PONDS

1.1 **General** .......................................................................................................................................................................................................................................................... 5

1.1.1 Responsibilities.................................................................................................................................................................................................................................. 5

1.1.2 Cross references.............................................................................................................................................................................................................. 5

1.1.3 Referenced documents .................................................................................................................................................................................................. 7

1.1.4 Interpretation......................................................................................................................................................................................................................... 8

1.1.5 Submissions....................................................................................................................................................................................................................... 8

1.1.6 Hold points and witness points ................................................................................................................................................................................... 10

1.2 **Preconstruction planning** ......................................................................................................................................................................................... 12

1.2.1 Protection to WSUD .................................................................................................................................................................................................... 12

1.3 **Materials** ................................................................................................................................................................................................................. 12

1.3.1 General...................................................................................................................................................................................................................... 12

1.3.2 Liner materials........................................................................................................................................................................................................ 12

1.3.3 Edge protection materials ....................................................................................................................................................................................... 14

1.3.4 Filtration layer ..................................................................................................................................................................................................... 15

1.4 **Execution** .......................................................................................................................................................................................................... 16

1.4.1 General.................................................................................................................................................................................................................. 16

1.4.2 Pond slopes ......................................................................................................................................................................................................... 18

1.4.3 Embankment survey markers .................................................................................................................................................................................. 18

## 2 MAINTENANCE

2.1 **Commencement** .................................................................................................................................................................................................. 19

2.2 **Works during maintenance period** ................................................................................................................................................................. 19

2.3 **Completion** ........................................................................................................................................................................................................ 20

## 3 MEASUREMENT AND PAYMENT

3.1 **Measurement** ..................................................................................................................................................................................................... 21

3.2 **Pay items** ........................................................................................................................................................................................................ 22
LIST OF TABLES

Table 16B-1  Hold point table ............................................................................................................. 10
Table 16B-2  Witness point table ...................................................................................................... 11
Table 16B-3  Clay liner properties table .......................................................................................... 13
Table 16B-4  Geotextile liner properties table ................................................................................. 14
Table 16B-5  Gravel properties ........................................................................................................ 14
Table 16B-6  Filter layer properties table ........................................................................................ 15
Table 16B-7  Minimum thickness of pond layers .............................................................................. 17
Table 16B-8  Minimum compaction of pond layers ......................................................................... 17
Table 16B-9  Maximum slopes of pond embankments .................................................................... 18
Table 16B-10 Pay items table ........................................................................................................... 22
1 PONDS

1.1 General

General: This Specification comprises the supply and construction of Water Quality Control Ponds.

Requirement: Construct Water Quality Control Ponds in accordance with TCCS requirements

Exclusions: This Specification does not include other WSUD measures such as bioretention measures, wetlands, gross pollutant traps etc. Preliminaries, Traffic Management, Earthworks, Drainage Structures, Incidental Works, Landscaping, Concrete Works and Signage required to construct wetlands shall be included under the respective MITS 00 Preliminaries, MITS 01 Traffic Management, MITS 02 Earthworks, MITS 03 Underground services, MITS 08 Incidental works, MITS 09 Landscape, MITS 10 Concrete works and MITS 14 Road signs.

1.1.1 Responsibilities

1.1.1.1 Objectives

Requirement: Provide pond systems, as documented and as follows:

> Free of pollutants
> Stormwater diverted off line until construction works including for upstream areas are complete to the satisfaction of the Authorised Person or as agreed with TCCS.
> Constructed in accordance with the detailed design plans
> In accordance with the construction tolerances specified.

1.1.2 Cross references

General: The following documents are related to this Specification:

1.1.2.1 Legislation

Environmental Protection Act
Lakes Act
Public Roads Act
Road Transport (General) Act
Road Transport (Safety and Traffic Management) Act
Road Transport (Mass, Dimensions and Loading) Act
Road Transport (Safety and Traffic Management) Regulation
Scaffolding and Lifts Act
Scaffolding and Lifts Regulation
Territory Plan and related Codes
Water Resources Act
Waste Minimisation Act
Work Health and Safety Act
1.1.2.2 Specifications
Requirement: Conform to the following:

MITS 00 Preliminaries
MITS 01 Traffic Management
MITS 02 Earthworks
MITS 03 Underground services
MITS 06 Concrete kerbs, footpaths and minor works
MITS 09C Planting
MITS 10 Concrete works
MITS 14 Road Signage
MITS 16A Bioretention Systems
MITS 16C Wetlands
MITS 16D Gross Pollutant Traps

1.1.2.3 Design Standards
General: The following Design Standards are related to this Specification:

MIS 17 Ponds
Attachment B Design acceptance requirements
Canberra Central Design Manual

1.1.2.4 TCCS Reference Documents
General: The following TCCS reference documents are related to this Specification:

Reference document 4 Protection of public landscape assets
Reference document 7 Operational acceptance submissions
Reference document 8 Works as executed quality records
Reference document 9 Final acceptance submissions
Reference document 10 Landscape consolidation
Reference document 11 Drafting Standard for Civil and Landscape works
1.1.3  Referenced documents

1.1.3.1  Standards
General: The following documents are incorporated into this Specification by reference:

**Australian standards**

- AS 1141  Methods for sampling and testing aggregates
- AS 1141.11.1  Particle size distribution - Sieving method
- AS 1141.22  Wet/dry strength variation
- AS 1289  Methods of testing soils for engineering purposes.
- AS 1289 2.1.1  Moisture Content Tests
- AS 1289 3.1.1  Plastic Limit Tests
- AS 1289 3.1.2  Atterberg Limit Tests
- AS 1289 3.2.1  Liquid Limit Tests
- AS 1289 3.3.1  Plasticity Index Tests
- AS 1289 3.6.1  Particle Size Distribution Tests
- AS 1289 3.8.1  Emerson Class Number
- AS 1289.5.2.1  Maximum Modified Dry Density Test
- AS 1289.5.4.1  Optimum Moisture Content
- AS 1289.5.5.1  Soil compaction and density tests - Determination of the minimum and maximum dry density of a cohesionless material - Standard method
- AS 1289 5.7.1  Optimum Moisture Content
- AS 1289 6.7.3  Permeability (remoulded) on undisturbed tube samples collected from the completed pad liner
- AS 2758.5  Filter Material Test
- AS 3706.2  Geotextile Grab Tensile Strength
- AS 3706.3  Geotextile Trapezoidal Tear Strength
- AS 3706.7  Geotextile EOS – Pore Size
- AS 3706.9  Geotextile Flow Rate
- AS 4133.4.1  Rock Point Load Strength
- AS/NZS 5667.1 and 6  Sampling of Water

**Standards**

- IPWEA (NSW)  Specification for the supply of recycled materials for pavements, earthworks and drainage (Greenspec)
- USEPA  Calcium Carbonate content
- Austroads 90  Geotextile G Rating

**Austroads**

- AGPT  Austroads guide to pavement technology
1.1.4 Interpretation

1.1.4.1 Abbreviations
General: For the purposes of this Specification the following abbreviations apply:

D: External diameter of the pipe.
DN: Nominal Diameter of pipe.
PAP: Principal Authorised Person (For use with GC-21 contracts)
WSUD: Water Sensitive Urban Design.
ITP: Inspection and Test Plan.
NATA: National Association of Testing Authorities.
RMS: NSW Roads and Maritime Services.
TCCS: Transport Canberra and City Services, ACT Government and its successors.

1.1.4.2 Definitions
General: For the purposes of this Specification the definitions given below apply:

Authorised person: PAP/Superintendent/Client of the works.

Inadequate foundation material: Material beneath or adjacent to the proposed drainage structures with insufficient strength to support the structure and loads on the structure, or material with characteristics that would adversely affect the performance or construction of the drainage structure.

Select fill: Backfill material with known properties and grading placed and compacted in layers.

Water Sensitive Urban Design (WSUD): The approach to urban planning and design that aims to integrate the management of the urban water cycle into the urban development process.

1.1.5 Submissions

1.1.5.1 General
Conform to Hold points and witness points

Drawings: Prepare drawings or other documentation to record extent and constitution of final works in accordance with Requirements for Works as Executed quality records, TCCS.

1.1.5.2 Certification
Supply of Materials: All materials proposed for supply to the site shall be delivered with certification from the manufacturer confirming the material is compliant with this specification.
1.1.5.3 Execution details
Survey: Submit set-out survey for temporary and permanent drainage systems.

Set-out of stormwater drainage system (Temporary and Permanent): Submit details of any proposed changes to the location, length, design levels, strength, and conditions of installation or cover to suit construction procedures.

Temporary drainage during construction: Submit details of procedures/devices to maintain effective drainage of the works area and/or upstream diversions.

Soil type: Give notice if the soil type on site is not consistent with the soil type used for design.

1.1.5.4 Reports
Maintenance Report: A maintenance report shall be provided to the Authorised Person in accordance with this specification to achieve maintenance period completion.

1.1.5.5 Samples
General: Submit the following:

> Components:
  - Pond Materials
  - Water

> Samples:
  - Pond Materials: Submit a minimum 5kg sample of each different type and/or source of material with conforming test results for approval by the Authorised Person prior to ordering. Samples are to be indicative of the material to be supplied for each different use.

1.1.5.6 Tests
Requirement: A NATA registered laboratory and a geotechnical engineer or an agronomist experienced and qualified in sandy loam soil testing must be used to carry out all testing for and verification of the pond materials.

Sample all stockpiles in accordance with AS1141. Sample and test from supplier stockpiles at the minimum rate of 1 test/100m³ of materials and a minimum of 1 test shall be provided per project and material. Test results up to 3 months old on the same stockpile will be accepted.

Provide the Authorised Person with copies of all test results, together with certification by the Testing Authority that all the stockpiled materials are in accordance with the Project Samples and the tolerances nominated in this Specification.

Carry out sampling and testing of the pond materials to confirm compliance with the material requirements tabulated within the Filter layer properties table.

The amount of organic material to be added to the filter material shall be that required to achieve the required water holding capacity.

Hydraulic conductivity and water holding capacity tests are to simulate the material in the installed condition, i.e. with the amendments incorporated and the materials compacted to the densities determined to meet Specification requirements.

Testing frequencies are also tabulated within MITS 00B Quality construction.
1.1.6 Hold points and witness points

1.1.6.1 Notice

General: Give notice so that the documented inspection and submissions may be made to the Hold point table and the Witness point table.

Table 16B-1 Hold point table

<table>
<thead>
<tr>
<th>Item</th>
<th>Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>16B.1</strong></td>
<td>Liner, Embankment, Edge Gravel, Filtration Materials - General</td>
<td>Provide documentation of conformity of liner, embankment, edge gravel and filtration materials and installation process</td>
<td>14 days before proceeding to provide liner materials</td>
<td>Authorised Person</td>
</tr>
<tr>
<td><strong>Execution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>16B.2</strong></td>
<td>Protection of Pond System from Pollutant Ingress and Upstream Drainage Established</td>
<td>The Contractor shall notify the Authorised Person that protection measures to prevent pollutants entering pond works (including upstream diversions) are constructed in accordance with the specification and ready for inspection and approval.</td>
<td>3 days prior to commencement of excavation for pond.</td>
<td>Authorised Person</td>
</tr>
<tr>
<td><strong>16B.3</strong></td>
<td>Establishment - Set out</td>
<td>Submit the proposed set-out for approval by the Authorised Person.</td>
<td>7 days before planned execution.</td>
<td>Authorised Person</td>
</tr>
<tr>
<td><strong>16B.4</strong></td>
<td>Installation of Liner Material</td>
<td>Approval of completed liner layer and drainage infrastructure.</td>
<td>1 working day prior to construction of filter layer and/or edge gravels.</td>
<td>Authorised Person</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>16B.5</strong></td>
<td>Maintenance of pond – Commencement</td>
<td>Submit request to commence maintenance period with proposed maintenance schedule in accordance with Clause 3.1 of this specification.</td>
<td>5 working days prior to proposed commencement of maintenance period upon operational acceptance by TCCS or as detailed in the contract.</td>
<td>Authorised Person</td>
</tr>
<tr>
<td>Item</td>
<td>Clause title</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td>Release by</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>-------------</td>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>16B.6</td>
<td>Maintenance of pond – Decreased life/Damage to system functionality from upstream catchment outside contractor scope</td>
<td>The contractor shall provide a summary of the extent of damage occurred to WSUD and include a report on specific sources of pollution for further investigation by the Authorised Person. The Authorised person shall then determine and provide the contractor with a summary of activities required (if any) to rectify the damage to WSUD.</td>
<td>5 working days after damage has been identified to newly constructed WSUD measures.</td>
<td>Authorised Person</td>
</tr>
<tr>
<td>16B.7</td>
<td>Maintenance of pond systems – Undertaking of maintenance works</td>
<td>The contractor shall provide all relevant approved TTM/Environmental documentation and proposed materials/methodologies for use in the rectification of WSUD infrastructure.</td>
<td>5 working days prior to commencing maintenance works on WSUD system</td>
<td>Authorised Person</td>
</tr>
<tr>
<td>16B.8</td>
<td>Maintenance of pond - Completion</td>
<td>Submit request to complete maintenance period with submission of maintenance records completed in accordance with Clause 3.3 of this specification. Notify that the pond is ready for inspection.</td>
<td>5 working days prior to proposed completion of maintenance period.</td>
<td>Authorised Person</td>
</tr>
</tbody>
</table>

**Table 16B-2 Witness point table**

<table>
<thead>
<tr>
<th>Item</th>
<th>Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Execution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16B.1</td>
<td>Temporary drainage during construction</td>
<td>Locate materials and equipment clear of water courses and provide temporary drainage to protect area of works.</td>
<td>5 working days prior to positioning</td>
</tr>
<tr>
<td>16B.2</td>
<td>Establishment - Set out</td>
<td>Submit the proposed set-out for approval by the Authorised Person.</td>
<td>5 working days before planned execution</td>
</tr>
<tr>
<td>16B.3</td>
<td>Installation of edge protection gravels</td>
<td>Approval of completed liner works prior to commencement of edge protection gravels.</td>
<td>1 working day prior to installation of drainage layer materials</td>
</tr>
<tr>
<td>16B.4</td>
<td>Backfilling with Filtration Layer</td>
<td>Approval of completed liner and gravel edge protection layers prior to installation of filtration layer materials.</td>
<td>1 working day prior to installation of overlay landscaping work</td>
</tr>
<tr>
<td>Item</td>
<td>Clause title</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>-------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>16B.5</td>
<td>Placing of embankment survey markers</td>
<td>Witness survey markers have been placed and locations recorded by survey.</td>
<td>Within 5 days of embankment construction completion.</td>
</tr>
</tbody>
</table>

1.2 Preconstruction planning

1.2.1 Protection to WSUD

Embankments vegetated areas, edge protection and liner material: Do not allow construction unnecessary traffic access to areas of pond systems. Provide fences if required to protect pond components. Refer MITS 01 Traffic Management for protection of ponds (Sensitive Areas) from traffic.

Temporary Protection: Install silt fences, filter rolls or other approved sediment and erosion protection measures to protect the pond system during all construction works in accordance with MITS 00C Control of erosion and sedimentation.

1.3 Materials

1.3.1 General

1.3.1.1 Materials and components

Stormwater Pipes and culvert materials: To MITS 03B Pipe drainage

Precast Stormwater Structures materials: To MITS 03C Precast box culverts

Other Drainage Structures: To MITS 03D Drainage structures

Recycled Material: To MITS 03H Road openings and restorations

Spillway: To MITS 08 Incidental works and/or MITS 10 Concrete works

1.3.2 Liner materials

1.3.2.1 Impermeable Liner Materials

Clay Liner Properties: Clay Liner material properties must comply with the Clay liner properties table.

Organic Materials Prohibited: The clay lining material shall be free of topsoil, tree roots and organic matter.

Manufactured Products: Geosynthetic Clay and HDPE liners shall not be utilised without prior written approval from TCCS.

Variance: If proposed clay liner material fall outside the specification in the Clay liner properties table, a geotechnical engineer may review the test results and provide a report recommending the material as suitable for use for review and approval by the Authorised Person and Design Engineer.
<table>
<thead>
<tr>
<th>Property</th>
<th>Specification to be met</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size Distribution (PSD)</td>
<td>As below</td>
<td>AS 1289 3.6.1</td>
</tr>
<tr>
<td>Particles passing 53-mm sieve</td>
<td>&gt;100%</td>
<td>AS 1289 3.6.1</td>
</tr>
<tr>
<td>Particles passing 19-mm sieve</td>
<td>&gt;90%</td>
<td>AS 1289 3.6.1</td>
</tr>
<tr>
<td>Particles passing 2.36-mm sieve</td>
<td>&gt;70%</td>
<td>AS 1289 3.6.1</td>
</tr>
<tr>
<td>Particles passing 0.075-mm sieve</td>
<td>&gt;30%</td>
<td>AS 1289 3.6.1</td>
</tr>
<tr>
<td>Maximum particle size</td>
<td>40 mm</td>
<td>AS 1289 3.6.1</td>
</tr>
<tr>
<td>Atterberg Limits</td>
<td>As below</td>
<td>AS 1289 3.1.2, 3.2.1, 3.3.1, 3.4.1</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>≥15% and above Casagrande A line</td>
<td>AS 1289 3.3.1</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>35 - 60%</td>
<td>AS 1289 3.1.2</td>
</tr>
<tr>
<td>Permeability (remoulded)</td>
<td>≤ 1 x 10^-9 m/sec</td>
<td>AS 1289 6.7.3</td>
</tr>
<tr>
<td>Permeability on undisturbed tube samples</td>
<td>≤ 1 x 10^-9 m/sec</td>
<td>AS 1289 6.7.3</td>
</tr>
<tr>
<td>Permeability on undisturbed tube samples</td>
<td>(300-mm thick clay pad liner)</td>
<td>AS 1289 6.7.3</td>
</tr>
<tr>
<td>Emerson Class Number</td>
<td>&gt; 4</td>
<td>AS 1289 3.8.1</td>
</tr>
<tr>
<td>Calcium Carbonate content</td>
<td>&lt; 15%</td>
<td>USEPA</td>
</tr>
</tbody>
</table>
1.3.2.2 Geotextile Liner Materials

Requirement: The geotextile liner properties shall be a UV stabilised non-woven geotextile provided in accordance with the Geotextile liner properties table below.

**Table 16B-4 Geotextile liner properties table**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification to be met</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>&gt; 900 N</td>
<td>AS 3706.2</td>
</tr>
<tr>
<td>Trapezoidal Tear Strength</td>
<td>&gt; 350 N</td>
<td>AS 3706.3</td>
</tr>
<tr>
<td>G Rating</td>
<td>&gt; 2000</td>
<td>Austroads 90</td>
</tr>
<tr>
<td>EOS – Pore Size</td>
<td>≤ 120 μm</td>
<td>AS 3706.7</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>&gt; 50 l/m2/s</td>
<td>AS 3706.9</td>
</tr>
</tbody>
</table>

1.3.3 Edge protection materials

Requirement: Edge protection materials shall comply with the following requirements.

1.3.3.1 Gravel Materials

Requirement: The gravel material properties shall be a UV stabilised non-woven geotextile provided in accordance with the Gravel properties table below.

**Table 16B-5 Gravel properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification to be met</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particles Passing 100mm sieve</td>
<td>95%</td>
<td>AS 1289.3.6.1</td>
</tr>
<tr>
<td>Particles Passing 53mm sieve</td>
<td>5%</td>
<td>AS 1289.3.6.1</td>
</tr>
<tr>
<td>Point Load Strength</td>
<td>Min 1.0Mpa</td>
<td>AS 4133.4.1</td>
</tr>
<tr>
<td>Wet Strength</td>
<td>Min 100 kN</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td>Wet/Dry Strength Variation</td>
<td>Max 45</td>
<td>AS 1141.22</td>
</tr>
</tbody>
</table>
1.3.4 **Filtration layer**

Standards applicable: *AS 2758.5, AS 1141* and *AGPT04J*.

Requirement: Filtration properties shall be provided in accordance with the **Filter layer properties table** below.

**Table 16B-6 Filter layer properties table**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification to be met</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
<td>A loam/sand, a washed well-graded sand or a sand/gravel mix</td>
</tr>
<tr>
<td><strong>Hydraulic conductivity</strong></td>
<td>100 – 300 mm/hr. Determine using ASTM F1815-11 method</td>
</tr>
<tr>
<td><strong>Clay &amp; silt content</strong></td>
<td>&lt; 3% (w/w)</td>
</tr>
<tr>
<td><strong>Grading of particles</strong></td>
<td>Smooth grading – all particle size classes should be represented across sieve sizes from the 0.05mm to the 3.4mm sieve (as per ASTM F1632-03(2010))</td>
</tr>
<tr>
<td><strong>Nutrient content</strong></td>
<td>Total Nitrogen (TN) &lt; 1000 mg/kg Available phosphate (Colwell) &lt; 80 mg/kg</td>
</tr>
<tr>
<td><strong>Organic matter content</strong></td>
<td>≤ 5% to support vegetation</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>5.5 – 7.5 – as specified for ‘natural soils and soil blends’ in AS4419 – 2003 (pH 1:5 in water)</td>
</tr>
<tr>
<td><strong>Electrical conductivity</strong></td>
<td>&lt; 1.2 dS/m – as specified for ‘natural soils and soil blends’ in AS4419 – 2003</td>
</tr>
<tr>
<td><strong>Horticultural suitability</strong></td>
<td>Visual assessment and report on test results by horticulturalist – media must be capable of supporting healthy vegetation. Note that additional nutrients are delivered with incoming stormwater</td>
</tr>
</tbody>
</table>

**Particle size distribution**

<table>
<thead>
<tr>
<th>Particle size distribution</th>
<th>(% w/w)</th>
<th>Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay &amp; silt</td>
<td>&lt; 3%</td>
<td>(&lt; 0.05 mm)</td>
</tr>
<tr>
<td>Very fine sand</td>
<td>5-30%</td>
<td>(0.05-0.15mm)</td>
</tr>
<tr>
<td>Fine sand</td>
<td>10-30%</td>
<td>(0.15-0.25 mm)</td>
</tr>
<tr>
<td>Medium sand</td>
<td>40-60%</td>
<td>(0.25-0.5 mm)</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>&lt; 25%</td>
<td>(0.5-1.0 mm)</td>
</tr>
<tr>
<td>Very coarse sand</td>
<td>0-10%</td>
<td>(1.0-2.0mm)</td>
</tr>
<tr>
<td>Fine gravel</td>
<td>&lt; 3%</td>
<td>(2.0-3.4 mm)</td>
</tr>
</tbody>
</table>
1.4 Execution

1.4.1 General

1.4.1.1 General

General: All works shall be constructed in accordance with the construction drawings.

Survey control: Provide for the following:

- Mapping and pegging the drainage system.
- Locating components.

Survey data: Provide data for the set-out of gradients, culverts and drains and construction to tolerances.

Stormwater Pipes and culverts: To *MITS 03B Pipe drainage*

Precast Stormwater Structures: To *MITS 03C Precast box culverts*

Other Drainage Structures: To *MITS 03D Drainage structures*

Recycled Material: To *MITS 03H Road openings and restorations*

1.4.1.2 Earthworks for Construction of Batters

Earthworks Specification: All earthworks required to construct batters to finish surface levels shall be undertaken in accordance with *MITS 02B Bulk Earthworks*.

1.4.1.3 Subgrade Preparation

Requirement: To provide a sound and stable base for liner construction.

Stripping: Topsoil and organic material should be removed.

Subgrade Compaction: The subgrade should be ripped and compacted to achieve 90% of the Maximum Modified Dry Density (*AS 1289.5.2.1*) to a minimum depth of 150 mm.

Subgrade finish: The subgrade must be smooth, unyielding and free of stones prior to liner placement.

Proof Rolling/Inspection: The prepared subgrade must be proof-rolled to *AS3798* in the presence of the Authorised Person or Principal’s geotechnical engineer to determine the presence of zones (such as uncontrolled fill, voids and weak or compressible materials that are susceptible to collapse).

1.4.1.4 Clay Liner Placement

Layer Thickness: The compacted clay liner must be constructed in maximum 100mm thick layers.

Layer Bonding: An effective bond shall be created between successive layers. Prior to placement of each layer the surface of the previous layer shall be scarified to 25mm depth at maximum 300mm spacing and moisture conditioned as necessary to achieve a moisture content % (*AS1289.2.1.1 method 2.1.1*) between the plastic limit % (*AS1289.3.2.1*) and the liquid limit % (*AS1289.3.1.1*), to bond the layers and prevent laminations at the layer interface. The final surface should be smooth and evenly graded.

Tolerance: A constriction tolerance of +50mm and -0mm applies to the clay liner thickness.

Verification: The finished liner thickness must be surveyed to confirm it meets the design specifications and be tested in-situ to ensure that it meets the specified permeability criteria (*AS1289 6.7.3*).
Maintenance: Clay lining should be maintained and watered regularly to avoid desiccation during and following construction. Also if water is encountered while preparing earthworks, the site should be dewatered and dried to an appropriate level before being lined with clay.

Compaction: Minimum compaction of Clay liners shall be in accordance with the Minimum thickness of pond layers table.

1.4.1.5 Minimum Thickness of Pond Layers

The Minimum thickness of pond layers table below describes the minimum thickness required and associated construction tolerance for each layer of the pond system.

<table>
<thead>
<tr>
<th>Table 16B-7 Minimum thickness of pond layers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Surrounding Topsoil</td>
</tr>
<tr>
<td>Filter Material (Macrophyte Zone)</td>
</tr>
<tr>
<td>Edge Protection Rock</td>
</tr>
<tr>
<td>Clay Liner</td>
</tr>
</tbody>
</table>

1.4.1.6 Compaction of Pond Layers

Compaction of pond layers shall be undertaken in maximum 100mm thick layers in accordance with the Minimum compaction of pond layers table.

<table>
<thead>
<tr>
<th>Table 16B-8 Minimum compaction of pond layers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Surrounding Topsoil</td>
</tr>
<tr>
<td>Filter Material (Macrophyte Zone)</td>
</tr>
<tr>
<td>Clay Liner</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
1.4.2  Pond slopes

1.4.2.1  Batter Slopes
The maximum grade for pond batter slopes is detailed within Table 2-9 below. All shoreline slopes are to be constructed to allow free drainage surfaces surrounding the pond.

Finish surface levels of ponds shall be constructed to provide an even ponding depth over the submerged area with a maximum depth variation of ± 50mm.

Table 16B-9  Maximum slopes of pond embankments

<table>
<thead>
<tr>
<th>Location of Slope</th>
<th>Grade Tolerance (%)</th>
<th>Maximum Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrounding Topsoil and general embankments</td>
<td>± 2%</td>
<td>1(V) : 6(H)(^1)</td>
</tr>
<tr>
<td>Macrophyte Zone</td>
<td>± 1%</td>
<td>1(V) : 15(H)</td>
</tr>
<tr>
<td>Edge Protection Rock</td>
<td>± 2%</td>
<td>1(V) : 8(H)(^2)</td>
</tr>
<tr>
<td>Clay Liner</td>
<td>± 2%</td>
<td>1(V) : 6(H)</td>
</tr>
<tr>
<td>Dam/Spillway Embankments</td>
<td>± 2%</td>
<td>1(V) : 6(H)(^1)</td>
</tr>
<tr>
<td>Access Ramps</td>
<td>± 1%</td>
<td>1(V) : 6(H)</td>
</tr>
</tbody>
</table>

1. 1(H) in 4(V) slopes will not be accepted without specific prior approval from TCCS.
2. up to 1m below the normal operating level.

1.4.2.2  Earthworks for Construction of Batters
All earthworks required to construct banks to finish surface levels shall be undertaken in accordance with *MITS 02 Earthworks*.

1.4.3  Embankment survey markers
All survey markers shall be established in accordance with the design documentation within 5 days of completion of the embankment construction. The locations of each mark shall be recorded prior to and following filling of the pond to the final water level.
2 MAINTENANCE

2.1 Commencement

In order to achieve maintenance period commencement, the following documentation shall be submitted to the Authorised Person:

- Maintenance Schedule: In tabular format detailing proposed dates for maintenance, description of maintenance to be undertaken in alignment with the Design Operation and Maintenance Plan. The schedule is to include room for signoff by the contractor that the maintenance was undertaken.

2.2 Works during maintenance period

Maintenance of the pond and associated pond system shall be undertaken in accordance with the following:

- Inspection: Inspect pond systems every fortnight between October to March and once a month between April to September. Items that are to be checked include but are not limited to the following:
  - Litter;
  - Water turbidity;
  - Drainage effectiveness of embankments/shallows;
  - Apparent algae blooms;
  - Scouring and/or cracking/shifting of embankments;
  - Sediment within SQID system;
  - Oils or other contaminants apparent on water surface.

- Litter: Remove litter and dead plant material from Embankments and Macrophytes.

- Herbicide: Do not use herbicides within 3m of ponds.

- After rainfall of over 10mm, within 2 days:
  - Remove surplus silt build up at inlets.
  - Replace washed away soils/gravels and mulches at embankments and assess/rectify impact on surrounding water/soil quality.
  - Remove litter.

A description of works including a photo of each pond area before and after each scheduled maintenance must be provided to the Authorised Person within 3 days of the works occurring.
2.3 Completion

2.3.1.1 Submissions
Work as Executed Records: To MITS 00B Quality Requirements.

2.3.1.2 Report
A complete report shall be provided to the Authorised Person upon completion of the maintenance period. The maintenance report shall include the following documentation.

- All photos of before and after maintenance works undertaken. Including description of location and works undertaken.
- Signoff against the maintenance schedule by the contractor for each set of works undertaken,

2.3.1.3 Removal of silt build up from WSUD system
The contractor shall verify that any potential silt build-up in the base of the pond system is not affecting the capacity of the pond through a minimum of 8 depth readings at locations specified by the Authorised Person. If silt build-up is suspected to have affected the pond system capacity, the Authorised Person may request resurvey of the final surface level or bathymetry of the system to determine the final capacity at the Contractors cost.

If the pond volume is determined by the Authorised Person to be sufficient, the cost for additional survey will be payable by the Principal.

If the pond volume is deemed insufficient and not meeting the design quantity/intent, the contractor shall propose rectification measures in writing within 2 weeks for review by the Authorised Person. The Authorised Person shall review and make amendments to the proposed rectification measures as required and instruct the Contractor in writing to rectify silt build up as required within 1 week.

The contractor shall undertake all rectification measures as noted within the Authorised Persons formal instruction. Commencing within 2 weeks of the instruction and achieving completion based on a suitable timeline agreed with the Authorised Person.

All works completed shall be verified by the Contractor and presented to the Authorised Person for approval in a written report with all verification documentation and conformance survey included.
3 MEASUREMENT AND PAYMENT

3.1 Measurement

3.1.1.1 General
Payments made to the Bill of Quantities: To MITS 00A General requirements, this Specification, the drawings and Pay items.

3.1.1.2 Methodology
The following methodology will be applied for measurement and payment:

- Allow for all work, materials, testing and quality assurance requirements in each Pay Item.
- Earthworks associated with the construction of swales, batters, bulk cutting or filling: To MITS 02 Earthworks.
- Inlet/Overflow pits and drainage structures: To MITS 03C Precast box culverts and MITS 03D Drainage structures.
- Spillway construction: To MITS 02B Bulk Earthworks, MITS 08 Incidental Works and MITS 10 Concrete Works.
- Planting of Macrophytes, shrubs, grassing and mulch: To MITS 09 Landscape.
- Floodway and Warning signage: To MITS 14 Road Signs.
- Formalised Edge protection such as retaining walls, boulders, fences: To MITS 08 Incidental Works.
- Subsoil drains: To MITS 03J Subsoil and foundation drainage.
- Excavation and replacement of Unsuitable Material: MITS 02B Bulk Earthworks.
- Barrier fences for drainage structures: To MITS 08A Fences and Barriers.
- Removal of existing drainage structures: To MITS 03A Trenching for underground services.
- Hardstand pavement, driveways, kerbing: To MITS 06A Concrete kerbs and open drains and MITS 06B Concrete paths, driveways medians.
- No Additional payment will be made for excavation in rock, overbreak of trench due to ground conditions or over excavation of trenches.
### 3.2 Pay items

<table>
<thead>
<tr>
<th>Item No</th>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule of rates scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>16B.1</td>
<td>Clay Liner Material for Ponds</td>
<td>m³</td>
<td>All activities associated with the construction of clay liner including detailed excavation in all types of material encountered including rock, supply, placement and compaction of the clay liner material in accordance with this specification inclusive of dewatering and watering as required.</td>
</tr>
<tr>
<td>16B.2</td>
<td>Filtration Layer for Ponds</td>
<td>m³</td>
<td>All activities associated with the construction of filtration layer including detailed excavation in all types of material encountered including rock, supply, placement and compaction of the filtration Layer materials in accordance with this specification.</td>
</tr>
<tr>
<td>16B.3</td>
<td>HDPE/Geotextile Liner Materials for Ponds</td>
<td>m² of liner material installed, not including overlaps required at joints</td>
<td>All activities associated with the construction of a HDPE/Geotextile liner including the supply and installation of the nominated liner material to manufacturer specification except where amended by this specification. A separate pay item shall be included in the Contract for each type of liner material. For example; 16B.3.1 Geotextile 16B.3.2 HDPE</td>
</tr>
<tr>
<td>16B.4</td>
<td>Rock Edge Protection Material</td>
<td>m²</td>
<td>All activities associated with the construction of rock edge protection material including detailed excavation in all types of material encountered including rock, supply, placement and compaction of the material in accordance with this specification.</td>
</tr>
<tr>
<td>16B.5</td>
<td>Maintenance Period</td>
<td>Weeks of maintenance undertaken following maintenance commencement as directed by the Authorised Person.</td>
<td>This pay item shall include all works associated with maintenance of pond systems in accordance with the specification.</td>
</tr>
</tbody>
</table>