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ABBOT POINT GROWTH GATEWAY PROJECT

Preliminary Stormwater Management Plan for the Dredged Material Containment Ponds

Submitted to:
Project Manager
Department of State Development

REPORT

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Golder Associates

Terminology

Term	Definition
AHD (Australian Height Datum)	The Australian Height Datum (AHD) is the reference level for defining reduced levels adopted by the National Mapping Council of Australia. The level of 0.0 m AHD is approximately mean sea level.
AEP (Annual Exceedance Probability)	The Annual Exceedance Probability is the likelihood of occurrence of an event (rainfall amount, flood or storm tide inundation) of a given size or larger in any one year, usually expressed as a percentage. For example, if an event has an AEP of 1%, it means that there is a 1% risk (i.e. probability of 0.01 or a likelihood of 1 in 100) of this event occurring in any one year. A 1% AEP event should not be interpreted as only occurring once in 100 years.
ARI (Average Recurrence Interval)	The Average Recurrence Interval (ARI) is a statistical estimate of the average period in years between the occurrences of an event of a given size. For example, the 10 year ARI event will occur on average once every 10 years: this is equivalent to a 10 year ARI having a 10% probability (AEP) of occurring in any given year.
1 in 100 Flood	An event that has an AEP of 1%. The chance of this event occurring is 1 chance in 100 in any given year, thus the probability is 0.01 (1%).
Freeboard	A factor of safety usually expressed as a height above the adopted Defined Flood Level. A freeboard may compensate for factors such as wave action and historical and modelling uncertainties
Storm tide	Also known as storm surge, the large waves that occur when an additional surge is applied on top of the astronomical tide caused by meteorological (storm) conditions.

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1.0 INTRODUCTION

This stormwater management plan addresses the dredged material containment pond (DMCP) facility for the temporary storage of dredged material associated with Terminal 0 (T0) berth pocket and apron dredging at Abbot Point, as part of the Abbot Point Growth Gateway project. This report documents the stormwater management plan, highlighting both the management of internal and external stormwater.

The proposed capital dredging for T0 at Abbot Point is expected to remove approximately 1,100,000 m^3 of in-situ material. Onshore storage of dredged material will require the construction of ponds to contain the bulked material and to treat the tailwater to a standard where it can be discharged back to the ocean. The final layout and design of the DMCP (including discharge points) is currently in progress. The footprint of the DMCP site is shown along with the pre-development catchments in Figure 001 (Appendix B).

The DMCP has four key phases to its design life:

- Construction: Ground preparation and scraper operation to cut in-situ material to use as fill for earth embankments, such that the overall facility meets the objectives of containing the dredge solids and managing the associated water from the dredging operations. This phase is expected to require approximately 3 to 6 months in duration.
- Operation: A Cutter Suction Dredge (SCD) will pump solids and water in a slurry from the proposed berth pocket and apron to a deposition point in the DMCP. After settling, the decanted tailwater will be pumped from the pond to an offshore discharge point. This phase is expected to require between 8 and 13 weeks in duration.
- Post-dredging: After dredging, the DMCP supernatant water will be pumped to the offshore discharge point. Following this, for a period of between 1 to 6 months, the dredged material and rainfall stormwater in the DMCP will be under management and monitoring.
- Final landform: The DMCP will be reconfigured to manage the solids and embankment such that the stormwater is directed approximately as per pre-DMCP landform hydrology.

It is intended that the placed dredged material will be available for beneficial reuse purposes as part of the future port developments. This may either be by using ground improvement techniques to allow construction over the reclaimed areas or by excavation and reuse of the material on other sites.

2.0 STORMWATER MANAGEMENT PHILOSOPHY

The design is based on addressing the DMCP for the temporary storage of dredged material associated with Terminal 0 (T0) dredging only.

For the DMCP four key design life phases, the water management philosophy is as follows:

- Construction: Focus on erosion and sediment control during construction, through management of disturbed area and use of controlled stormwater release points aligned with natural topography.
- Operation: Focus on erosion and sediment control of the outer embankment wall and management of stormwater from the small catchments to controlled stormwater release points aligned with natural topography, as shown in Figure 002 (Appendix B). Minimise the possibility of dredged material supernatant water and stormwater collected within the DMCP footprint from overtopping the embankment.
- Post-dredging: Stormwater management from the small catchments comprised of the outer embankment wall, and monitoring the stormwater collected within the DMCP footprint.
- Final landform: The embankment height is lowered at 4-6 locations to reduce the volume of stormwater that can be retained within DMCP footprint. Stormwater collected within the DMCP footprint is directed through the embankment at pre-determined locations designed to replicate the pre-DMCP catchment

hydrology as shown in Figure 003 (Appendix B), Sediment control is provided through shallow water retention prior of stormwater release.

The stormwater management includes two components, the management of external and internal stormwater.

3.0 EXTERNAL STORMWATER MANAGEMENT

The external stormwater management philosophy addresses rainfall and associated stormwater runoff from the outer DMCP embankment. The approach has adopted the following guiding principles:

- Preserve as much as possible the existing hydrology associated with pre-development catchments, as shown in Figure 001 (Appendix B)
- Limit impacts to the DMCP embankment from erosive flow velocities associated with intercepting and diverting local drainage catchments around the DMCP embankment.
- Limit the erosion impact of ponding of water against the DMCP embankment from local catchment drainage, regional flood levels, storm surge, and mean sea level rise.
- At completion of dredging, return the DMCP area landform to mimic pre-development catchment areas.

3.1 Drainage management design criteria

The external stormwater management concept has the following design criteria:

- Meet ANZECC guidelines for stormwater quality discharge.
- 10 year design life for the DMCP.
- Channel hydraulic design for a 1:10 AEP flood capacity (in line with industry practice associated with the life of the facility).
- Trapezoidal or triangular swale cross-section with armouring to suit design velocities.
- Minimise the channel widths to increase capacity of the DMCP.
- Minimum drain gradients of 0.05% to gain positive flow conditions.
- Minimise the use of excavated drains by utilising the natural topographical gradients and the embankment as much as possible to achieve positive drainage.
- Embankment design to consider the 1:100 AEP tropical cyclone-induced extreme water level, and surge plus tide including climate change (2100 Climate Change Scenario)
- Embankment design to consider the 1:100 AEP storm surge.
- Embankment design to consider the 1:50 AEP regional flood water level.

3.2 Documentation and data

The following information has been used in this assessment and has been relied upon.

1) Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council*, 2000.

2) Australia Government Bureau of Meteorology, Rainfall Intensity Frequency Duration information http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml (Accessed November 2014).

3) Queensland Government, Department of Energy and Water Supply, Queensland Urban Drainage Manual Third Edition 2013 – Provisional, Rational Method calculation of peak stormwater drainage, http://www.dews.qld.gov.au/water-supply-regulations/urban-drainage (Accessed November 2014).

4) International Erosion Control Association (IECA), "Best Practice Erosion and Sediment Control", International Erosion Control Association, NSW Australia, 2008

5) Connell Hatch Geotechnical Investigation Report Abbot Point Bulk Coal Terminal X80/X110 *Expansion Ports Corporation of Queensland Volume 1; Report 2009 H6000-80-GEO-GT06-002/01 Rev 1* , Soils Information.

6) Australian Government Department of Sustainability, Environment, Water, Population and Communities, Referral of Proposed Action: Abbot Point Port and Wetland Strategy, October 2014.

7) Environment Australia (EA) (2001), A Directory of Important Wetlands in Australia, Third Edition, Environment Australia, Canberra.

8) BMT WBM (2014) Coastal inputs – Abbot Point approvals project risk analysis of dredge material containment, L.B21155.002, 18 November 2014.

9) AECOM (2008) Bowen Abbot Point Flood Modelling Study, Assessment of Flooding Constraints, 60026519, 14 March 2008.

10) GHD (2010) Hancock Prospecting Pty Ltd, Alpha Coal Project (Rail) Abbot Point Surface Water Model, September 2010.

11) GVK layouts of adjoining lease (T2T3-SK-G-0003.dwg) received May 2015.

12) Queensland Department of Environment and Heritage Protection (DEHP), Coastal Hazard Areas Map, Storm Tide Inundation Area, Centred on Lot on Plan: 34SP253263.

13) Queensland Department of Environment and Heritage Protection (DEHP), Coastal Hazard Areas Map, Erosion Prone Area, Centred on Lot on Plan: 34SP253263.

14) Queensland Government Department of State Development, Infrastructure and Planning, 2014. *SPP Interactive Mapping System*, available at http://www.dsdip.qld.gov.au/about-planning/spp-mapping-online-system.html accessed November 2014.

3.3 Background information

The following assumptions have been made with respect to site data and assessment methodology:

- This assessment is based upon the site boundaries, provided topographical information, and current infrastructure layouts.
- This assessment has made no provision for future infrastructure that may be built adjacent to the site boundaries of which may influence the local or regional hydrology.
- This assessment relies upon the flood levels specified in the AECOM (2008) and GHD (2011) studies and the storm surge and tidal levels specified in WBM BMT (2014).
- The information provided in this assessment is of a design level for the stormwater management, provided for the purposes of informing the design of the Abbot Point Growth Gateway DMCP Project.
- Specific and detailed drainage design information is not included at this stage.

3.4 Site Description

The site is bordered by the existing Abbot Point coal terminal (T1) sediment control ponds to the north, the T1 western drain to the east and the proposed T3 terminal to the west. As shown in Figure 001 (Appendix B) the site adjoins a complex continuous wetland aggregation of subtidal and intertidal marine and estuarine wetlands to the south.

The wetland is listed in the Directory of Important Wetlands in Australia (EA, 2001). The Directory (EA, 2001) describes the wetland as being comprised of ‘fresh to brackish seasonally variable water quality with a central water body, Lake Caley, being brackish’.

The majority of the site is generally level to gently undulating, there is a gentle slope from the south-western embankment extending north. Elevations range from approximately RL 5.50 m (all levels to AHD) to RL 2.65 m along the outside of the northern embankment.

3.5 Regional hydrology

3.5.1 Design flood

The GHD (2011) report provides an assessment of the potential impacts upon the water levels of the Caley Valley wetland for the Alpha Coal Project (Rail). It particularly focuses on the potential impacts of the projects at Abbot Point. The assessment showed that the Caley Valley Wetland would have a peak flood water elevations of RL 2.11 – 2.22 m under existing conditions for the 1:50 AEP event.

3.5.2 Climate change and storm surge impacts

Design water levels for “existing” and climate change” scenarios are provided in (BMT WBM, 2014) for the following AEP cases.

- 1% AEP – corresponding to 1:100 year ARI (or 1% probability of exceedance in any given year)
- 0.2% AEP – corresponding to 1:500 year ARI (or 0.2% probability of exceedance in any given year)
- 0.1% AEP – corresponding to 1:1000 year ARI (or 0.1% probability of exceedance in any given year)

Table 1 provides a summary of the “surge plus tide” levels expected during a tropical event at Abbot Point (BMT WBM, 2014).

Table 1: Tropical Cyclone-Induced Extreme Water level - Existing Scenario

AEP	Likelihood to occur in 100 year period	Surge + tide level (RL m AHD)
1% (1:100)	Likely	2.07
0.2% (1:500)	Possible	2.33
0.1% (1:1000)	Unlikely	2.44

Table 2 provides a summary of the “surge plus tide including climate change” levels expected during a tropical event at Abbot Point projected for the 2100 Climate Change Scenario (BMT WBM, 2014).

Table 2: Tropical Cyclone-Induced Extreme Water level - 2100 Climate Change Scenario

AEP	Likelihood to occur in 100 year period	Surge + tide level + climate change level (RL m AHD)
1% (1:100)	Likely	2.84
0.2% (1:500)	Possible	3.21
0.1% (1:1000)	Unlikely	3.39

The toe of the DMCP embankment is above the 0.1% AEP (1:1000) climate change scenario combined surge, tide and climate change level of RL 3.39m AHD, with the exception of a small length of the DMCP embankment (i.e. along the northern embankment with a low of RL 2.65 m AHD) which is above the 0.1% (1:1000) existing scenario extreme water level of RL 2.44 m AHD.

External embankment flood protection is not proposed as the embankment is located on elevations above the design criteria extreme water levels.

3.6 Local hydrology

3.6.1 Design rainfall

Rainfall data for the 1, 2, 5, 10, 20, 50 and 100 year ARI storm events have been collected for use in catchment hydrology assessment for drainage design. Site specific Intensity Frequency Duration (IFD) data has been sourced from the Australian Bureau of Meteorology (BOM)[1].

3.6.2 Existing Hydrology – Pre-Construction Phase

The local drainage catchments which overlap the DMCP footprint were delineated using GIS topographic interpretation and by visual assessment. The catchment areas are shown on Figure 001 (Appendix B) and provided in Table 3.

3.6.3 Proposed Hydrology – Construction and Operation Phase

The relative change in catchment areas during the transitionary construction phase, where the hydrology is modified from pre-construction to operation phase, is provided in Table 3. The largest change in catchment area is observed in catchment 7, with a decrease in catchment area of approximately 41%.

Table 3: Catchment areas and relative changes that occur during the construction phase

Catchment No.	Catchment Area Pre-Construction Phase (ha)	Catchment Area Operation Phase (ha)	Change in Catchment Area (%)
1	371.5	346.7	-6.7
2	70.8	65.4	-7.7
3	7.9	7.9	0.0
4	105.9	88.5	-16.4
5	102.5	102.3	-0.2
6	50.0	44.1	-11.9
7	59.9	35.3	-41.1
8	19.3	18.7	-3.1

Reductions in the natural catchment areas results in a decreased amount of runoff reporting to the wetland, downstream of the DMCP.

3.6.4 Proposed Hydrology – Post-Dredging and Final Landform Phase

Catchment areas are partially restored during the post-dredging/final landform phase, shown in Figure 003 (Appendix B), with the relative change in catchment areas from the pre-construction phase provided in Table 4. The largest change in catchment area is observed in catchment 7, with an increase in catchment area of approximately 15%.

Table 4: Catchment areas and relative changes during the post-dredging phase

Catchment No.	Catchment Area Pre-Construction Phase (ha)	Catchment Area Post-Dredging Phase (ha)	Change in Catchment Area (%)
1	371.5	372.5	0.3
2	70.8	65.4	-7.7
3	7.9	7.9	0.0
4	105.9	107.8	1.8

[1] Australia Government Bureau of Meteorology, http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml (Accessed November 2014)

Catchment No.	Catchment Area Pre-Construction Phase (ha)	Catchment Area Post-Dredging Phase (ha)	Change in Catchment Area (%)
5	102.5	102.3	-0.2
6	50.0	44.1	-11.9
7	59.9	69.1	15.4
8	19.3	18.7	-3.1

3.7 Seepage

Lateral seepage that may exit the downstream side of the embankment is not expected to be significant due to the lining of the internal embankments. Seepage that may occur will be captured by the stormwater drainage system.

3.8 External Drainage

The external stormwater drainage concept has been developed based on the stormwater management philosophy and design criteria.

As shown in Figures 001 and 002 (Appendix B), the DMCP is located along upstream catchment boundaries; and drainage catchments are predominantly the footprint of the outer embankment, road and drainage channel. Runoff is conveyed around the DMCP and released at five discharge locations.

3.8.1 Stormwater catchment area delineation

The DMCP is situated along upstream boundaries in all identified catchments, excluding Catchment 3, with runoff over the existing land flowing away from the DMCP. Therefore, the only areas which are captured by the stormwater drainage network include: Catchment 3 and the area associated with the outer embankment, road and drainage channels.

Once the DMCP has been constructed, external stormwater runoff from the contributing areas will be diverted around the DMCP to the down gradient catchments by utilising the natural topographical gradients, thereby minimising the use of excavated drains. Runoff will be discharged via five constructed outlets to the natural/existing drainage network, as shown in Figure 002 (Appendix B).

There will be no constructed drainage along two lengths of the outer embankment, identified as B and G in Figure 002 (Appendix B). Sheet flow from these areas is expected to be sufficient based on existing topography, allowing runoff to freely flow from the outer embankment to the natural/existing drainage network.

A summary of the drainage outlets are provided in Table 5

Table 5: Summary of Stormwater Drainage Outlets (External Stormwater Management)

Drainage Outlet	Type of Outlet	Drainage Length (km)	Contributing Catchment	Receiving Drainage
A	Constructed	0.83	None	Natural Environment
B	Sheet Flow	0.81	None	Western Drain (existing)
C	Constructed	1.16	3	Western Drain (existing)
D	Constructed	0.84	None	Natural Environment
E	Constructed	0.67	None	Natural Environment
F	Constructed	0.56	None	Natural Environment
G	Sheet Flow	0.33	None	Natural Environment

3.8.2 Calculation of peak flow

Peak flow for each local drainage catchment has been calculated using the rational method as described in the *Queensland Urban Drainage Manual Third Edition 2013 – Provisional*. As recommended by the guideline for a “type C” catchment condition (small, non-piped catchments of less than 500 ha with no formal creek) the time of concentration has been calculated using Friend’s Equation for overland flow and Manning’s Equation for Channel flow. Surface soils information was obtained from the *Connell Hatch Geotechnical Investigation Report* identified in the reference documentation and data above. Vegetation cover of each catchment drainage area has been identified from site imagery. Peak flow calculations using the Rational Method are for the 1:10 AEP event.

3.8.3 Drainage Sizing

The stormwater drainage takes into account the constraints of the topography, local hydrology, regional flood levels, storm surge and predicted sea level rise. The catchment diversion swales and drainage will minimise the use of excavated drains by utilising the natural topographical gradients and the embankment to achieve positive drainage.

Swales are used for external drainage around the DMCP, excluding the western embankment. The swale geometry allows for occasional vehicular access. A trapezoidal drainage channel is used for the western embankment. The swales and drainage channel are designed to convey a 1:10 AEP storm event.

A summary of the drainage sizes are provided in Table 6.

Table 6: Summary of drainage sizes (External Stormwater Management)

Parameter	Drainage Section (Refer to Appendix B Figure 001)									
	A1	**A2**	**C1**	**C2**	**D1**	**D2**	**E1**	**E2**	**F1**	**F2**
Type	Swale	Swale	Trapezoidal Drain	Trapezoidal Drain	Swale	Swale	Swale	Swale	Swale	Swale
Lining	Vegetated	Vegetated	Vegetated	Vegetated	Vegetated	Vegetated	Vegetated	Vegetated	Vegetated	Vegetated
Flow (m^3/s)	0.23	0.34	1.08	0.56	0.30	0.24	0.31	0.16	0.24	0.16
Average Velocity (m/s)	0.29	0.42	0.46	0.48	0.61	0.28	0.47	0.47	0.28	0.47
Depth (m)	0.38	0.38	0.85	0.40	0.27	0.47	0.27	0.27	0.47	0.27
Base Width (m)	0.00	0.00	2.25	2.75	0.00	0.00	0.00	0.00	0.00	0.00
Right Side Slope (xH:1V)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Left Side Slope (xH:1V)	8.50	8.50	2.00	2.00	13.00	6.50	13.00	13.00	6.50	13.00
Total Width (m)	4.00	4.00	4.50	4.00	4.00	4.00	4.00	4.00	4.00	4.00

4.0 EROSION AND SEDIMENT CONTROL

There are several types of erosion processes which are capable of dislodging and transporting soil particles from one location to another. The processes relevant to site are outlined below:

- Sheet - This is an often-imperceptible form of erosion where rainfall runoff flows as a sheet over the soil surface. This runoff will remove soil and transport already dislodged soil particles away, often into streams. Even though one cannot always see sheet erosion, it is responsible for a large volume of soil loss from bare ground.
- Rill - When rainfall runoff forms small channels, called rills, the water gathers more energy and becomes more erosive. Rills are often difficult to treat once they have formed.
- Gully - Untreated rills may expand, or several small rills may join and grow into a large gully. Gullies are caused by poor drainage design from roads, driveways, or building sites, by downcutting in stream drainages.
- Channel - channel erosion generally results from inadequate channel design due to experienced velocities and shear stresses exceeding that of permissible values for the respective channel lining system. Erosion of channel banks can also occur due to unstable bank slopes.
- Shoreline - Shoreline erosion is caused by wave energy and tidal currents. This type of erosion can occur on the internal batters of large water reservoirs.

The consequences of erosion are numerous but primarily relate to water quality issues in which flora and fauna, both terrestrial and aquatic, are negatively impacted. Sediment transported from disturbed areas has the potential to accumulate in downstream tributaries, estuaries and ultimately the ocean, where there may be impacts to environmental and/or social values.

There are several techniques that can be used to minimise erosion and sedimentation. Typically more than one technique will be required to effectively reduce erosion and sedimentation.

The erosion protection to be incorporated into the stormwater management plan is discussed in the attached Erosion and Sediment Control Plan (Appendix B).

5.0 INTERNAL STORMWATER MANAGEMENT

The internal stormwater management philosophy (Section 5.0) addresses rainfall received within the DMCP footprint which is managed by the Dredging Contractor along with sea water pumped into the DMCP during the dredging process. The internal stormwater management approach applies to the Operation and Post-dredging phases only, and comprises of the following principles:

- Minimise the possibility of overtopping of the DMCP due to the design dredged material, dredged material supernatant water, and design wind event during dredging
- Provide freeboard capacity within the DMCP to contain the design dredged material, dredged material supernatant water, and design storm event during dredging
- Post-dredging, provide means to limit the volume of stormwater that will be retained within the DMCP to allow drying and conditioning of solids for possible re-use.

5.1 Stormwater operating parameters

The design basis for determining the required freeboard and maximum water level the dredging contractor can operate with during dredging (the ‘Maximum Operating Level’) considers:

- The short duration of dredging operations
- Operating procedures that provide active management of accumulated water in the DMCP

- Limiting the impact to receiving environment and maintaining DMCP integrity through minimising the risk of overtopping
- Relevant guidelines and engineering best practice.

The adopted stormwater operating parameters, allowing for the above considerations, is provided in Table 7.

Table 7: Operating parameters

Phase	Initial Water Level	Storm Event Allowance (m)	Wind Set-Up and Wave Run-up Allowance (m)
Operation	Maximum Operating Level	10 year ARI 72 hour rainfall managed by pump capacity	2 year ARI wind event
Post-Dredging	Top of dredged material	Spillway design flow and 20 year ARI 3 month seasonal rainfall	10 year ARI wind event
Landform	Top of landformed dredged material	10 year 4 hour storm	N/A

Note: (a) ARI = Average Recurrence Interval

5.2 Wind set-up and wave height

Freeboard values were calculated for the proposed Primary and Secondary DMCP areas. This freeboard includes wave set-up and wave run-up corresponding to the 10 year ARI wind event. The methodology presented in the *Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams* (U.S. Department of the Interior Bureau of Reclamation, 1981) was adopted to estimate the wind set-up and wave run-up. The wind freeboard calculation uses wind data from the Australian Standard for Region C (*AS1170.2:2011)*. The wind reduction factor was determined from the World Meteorological Organization's *Guidelines for Converting between Various Wind Averaging Periods in Tropical Cyclone Conditions* (2008).

5.3 Storm Event Management

The dredging contractor will be required to actively manage operating water levels within the DMCP to ensure the return water quality meets approval conditions and to minimise the possibility of overtopping during storm events.

Based on early discussions with potential Dredge Contractors, it can be estimated that the return water pump capacity will be in the order of 6000 to 9 000 m^3/hr pending dredge size. This relates to a pumping capacity of between 144 and 216 ML per day, assuming the pump is operating 24 hours per day as expected.

Therefore the return water pumping system would be expected to drain the design 10 year ARI, 72 hour storm event within 32 to 48 hours (assuming dredging has ceased during the storm event) or within 48 to 72 hours if dredging was to continue.

6.0 SPILLWAY

The inclusion of a spillway in any water impounding structure is good engineering practice, as it ensures that should water levels for whatever reasons exceed design levels, then there will be no uncontrolled failure of the embankments, but rather the event would exit the structure in a controlled location and manner to maintain the integrity of the structure.

The consequence category assessment of the DMCP was carried out in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*[2].

[2] Department of Environment and Heritage Protection, Nov 2013 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures EM635 Version 4 Queensland

This assessment, based on the knowledge Golder currently has of the site and the DMCP, has indicated the following with regards to design details:

- The initial assessment of ‘low’ for the ‘failure to contain – seepage’ scenario indicates that no specific performance requirements for containment systems such as liners are mandated.
- The initial assessment of ‘low’ for the ‘failure to contain – overtopping’ scenario indicates that no specific performance requirements for containment of stormwater are mandated. A stormwater management plan for the operational facility incorporating water quality guidelines and associated storage requirements for potential discharge would still need to be compiled and adhered to.
- The initial assessment of ‘significant’ for the ‘dambreak’ scenario indicates that specific design criteria for spillway and embankment crest levels are required, as shown in Table 8.

Table 8: ‘Dambreak’ Performance Objectives

Design Parameter	Criteria
Spillway	1:100 annual exceedance probability (AEP)
Flood level for embankment crest levels	Spillway design flood peak level + wave run-up allowance for 1:10 AEP wind

Thus, while the spillway is not expected to be activated, it provides a risk mitigation measure to provide a location and method for controlled outflow that does not erode the embankment or lead to embankment failure. The DMCP spillway is located at the southern end of the embankment

The spillway has been designed to incorporate a fuseplug. The spillway will be constructed with a broad crested sill that will be in action during a design flood. Events smaller than the design flood will be contained within the DMCP by the fuseplug, which is constructed on top of the spillway of material that will release when subjected to the flow and velocities associated with the design flood. On release, the discharge flow will be controlled to minimise additional erosion and mitigate against a full collapse of the embankment.

The spillway width was determined using a 1D XP-RAFTS hydrologic and hydraulic model. The sizing assessment is based on the flood routing method for estimation of peak outflow. This method uses temporal pattern hyetographs from Australian Rainfall & Runoff (1987)[3] and scaling with rainfall Intensity Frequency Duration (IFD) data for the site. It allows for attenuation of storm inflows over the DMCP storage area prior to release through the spillway.

7.0 CLOSURE

We trust this assessment meets your expectations. Please do not hesitate to contact the undersigned if you have any questions or comments.

[3] Engineers Australia, 1998, *Australian Rainfall and Runoff*, Volume 1 – Book 5, Barton, ACT

Report Signature Page

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APPENDIX A

Drainage Figures

LEGEND

- CATCHMENT OUTLET
- CATCHMENT BOUNDARY
- INFERRED DRAINAGE PATHWAYS
- Cx CATCHMENT NUMBER
- CONTAINMENT POND OUTLINE

DEPARTMENT OF STATE DEVELOPMENT

Golder Associates

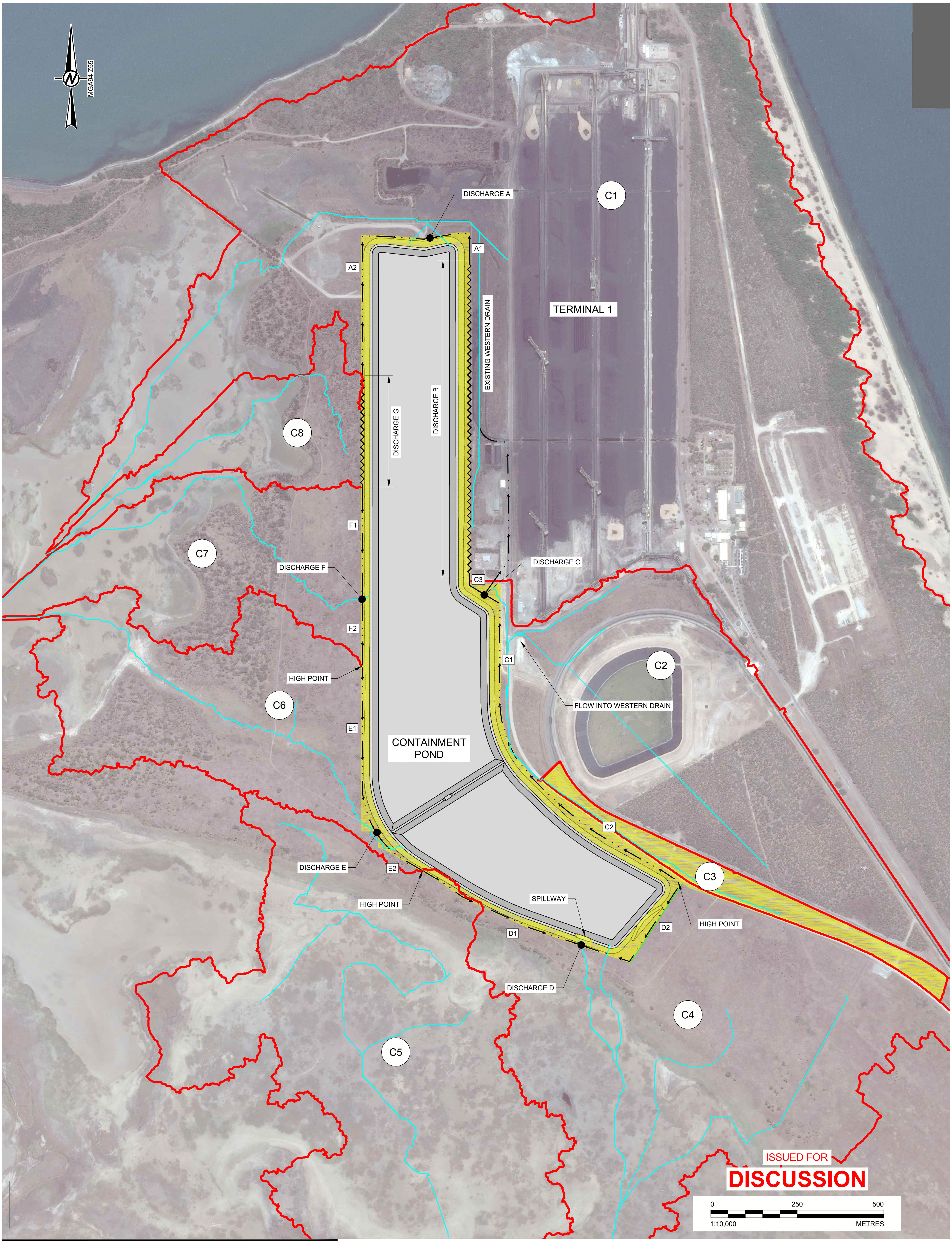
	2015-07-01
	EJC
	MP
	RDM
	AMB

ABBOT POINT GROWTH GATEWAY PROJECT
CONCEPTUAL DRAINAGE OUTLETS

EXISTING CONDITIONS

	DOC No.		FIGURE
1525905	019	B	F001

25 mm



LEGEND

	DRAINAGE CATCHMENT		CATCHMENT BOUNDARY
		Cx	CATCHMENT NUMBER
E1	DRAINAGE PATH		
	SHEET FLOW		INFERRED DRAINAGE PATHWAYS
	DRAINAGE OUTLET		

DEPARTMENT OF STATE DEVELOPMENT

Golder Associates

2015-07-01
EJC
MP
RDM
AMB

ABBOT POINT GROWTH GATEWAY PROJECT
CONCEPTUAL DRAINAGE OUTLETS

CONSTRUCTION AND OPERATION PHASES

1525905 | DOC No. 019 | B | FIGURE F002

LEGEND

MAINTAINED WALL

CONSTRUCTED WALL

Cx CATCHMENT NUMBER

CATCHMENT BOUNDARY

INFERRED DRAINAGE PATHWAYS

DEPARTMENT OF STATE DEVELOPMENT

Golder Associates

2015-07-01

EJC

MP

RDM

AMB

ABBOT POINT GROWTH GATEWAY PROJECT
CONCEPTUAL DRAINAGE OUTLETS

POST DREDGING PHASE

1525905

DOC No. 019

B

FIGURE F003

APPENDIX B

Erosion and Sediment Control Plan

REPORT

24 July 2015

ABBOT POINT GROWTH GATEWAY PROJECT

Erosion and Sediment Control Plan for the Dredged Material Containment Ponds

Submitted to:
Project Manager
Department of State Development

Report Number. 1525905-048-Rev1

Distribution:

1 PDF electronic copy

Golder Associates

Table of Contents

1.0 INTRODUCTION

This Erosion and Sediment Control Plan (ESCP) addresses the dredged material containment ponds (DMCP) facility for the temporary storage of dredged material associated with Terminal 0 (T0) berth pocket and apron dredging at Abbot Point, as part of the Abbot Point Growth Gateway Project.

The DMCP has four key phases to its design life:

- Construction: Ground preparation and scraper operation to cut in-situ material to use as fill for earth embankments, such that the overall facility meets the objectives of containing the dredge solids and managing the associated water from the dredging operations. This phase is expected to require approximately 3 to 6 months in duration.
- Operation: A Cutter Suction Dredge (SCD) will pump solids and water in a slurry from the proposed berth pocket and apron to a deposition point in the DMCP. After settling, the decanted tailwater will be pumped from the pond to an offshore discharge point. This phase is expected to require between 8 and 13 weeks in duration.
- Post-dredging: After dredging, the DMCP supernatant water will be pumped to the offshore discharge point. Following this, for a period of between 1 to 6 months, the dredged material and rainfall stormwater in the DMCP will be under management and monitoring.
- Final landform: The DMCP will be reconfigured to manage the solids and embankment such that the stormwater is directed approximately as per pre-DMCP landform hydrology.

It is intended that the placed dredged material will be available for beneficial reuse purposes as part of the future port developments. This may either be by using ground improvement techniques to allow construction over the reclaimed areas or by excavation and reuse of the material on other sites.

This report documents the supporting documentation and ESCP for the construction, operation and post dredging phases of the DMCP. The ESCP is to achieve compliance with the *IECA Best Practice Erosion and Sediment Control Guideline* (the Guideline), IECA 2008[1], and *The Environmental Protection Act 1994*.

2.0 PRINCIPLES OF EROSION AND SEDIMENT CONTROL

Soil disturbing activities associated with construction such as clearing, grubbing and earthworks increase the soils exposure to wind, rain and concentrated sheet flow. The sediment generated in these processes has the potential to be introduced to receiving water environments.

Appropriate management of such activities minimises or prevents soil erosion and therefore sediment losses. An understanding of the following basic principles will enable good management for soil conservation.

- Integrate erosion and sediment control issues into site and construction planning.
- Develop effective and flexible ESCPs based on anticipated soil, weather, and construction conditions.
- Control water movement through the site.
- Minimise soil erosion.
- Promptly stabilise disturbed areas.
- Maximise sediment retention on the site.
- Maintain ESC measures in proper working order at all times.
- Monitor the site and adjust ESC practices to maintain the required performance standard.

[1] IECA 2008, Best Practice Erosion and Sediment Control *Guidelines*

3.0 SITE DESCRIPTION

The site is bordered by the existing Abbot Point coal terminal (T1) sediment control ponds to the north, the T1 western drain to the east and the proposed T3 terminal to the west. As shown in Figure 001 (Appendix B) the site adjoins a complex continuous wetland aggregation of subtidal and intertidal marine and estuarine wetlands to the south.

The wetland is listed in the Directory of Important Wetlands in Australia (EA, 2001). The Directory (EA, 2001) describes the wetland as being comprised of 'fresh to brackish seasonally variable water quality with a central water body, Lake Caley, being brackish'.

The majority of the site is generally level to gently undulating, there is a gentle slope from the south-western embankment extending north. Elevations range from approximately RL 5.50 m (all levels to AHD) to RL 2.65 m along the outside of the northern embankment.

4.0 DESIGN CRITERIA AND PARAMETERS

The following information and parameters have been used to design the concept ESC measures associated with this ESCP:

- Design rainfall obtained from the Bureau of Meteorology.
- Selection of erosion and sediment control techniques based on the Guideline recommendations.
- Sizing of sediment control structures have been undertaken using the fact sheets and standard drawings provided by IECA with the Guideline.
- A drainage design completed for a 1:10 AEP rainfall event.
- Construction schedule has been assumed based on information presently available.

5.0 REVIEW OF SITE SOILS

5.1 Soil assessment

A review of the geotechnical studies previously completed for the site was conducted. In particular, the following soil properties were analysed as indicated in the Guideline:

- Emerson class number
- Soil classification
- Electrical conductivity (EC) and pH
- Particle size distribution
- Dispersion index

A geotechnical investigation of areas adjacent to the DMCP site has been conducted by WorleyParsons (2015). Only three samples were sent to laboratory analysis for this investigation to inform the EIS and construction management practices. The sampling was conducted on the same geological unit as the DMCP. pH readings ranged between 6 and 7, and electrical conductivity between 0.00 – 0.07 dS/m. These results are non-problematic. Emerson tests conducted by WorleyParsons suggest that subsoils are likely to be stable although the grey and yellow sandy clays should not be exposed subaerially.

A geotechnical investigation of the soils from the borrow sites have been conducted by Golder (2015). The borrow site is located west of the DMCP. This investigation has yielded site soils with Emerson Class Numbers ranging from 2 to 6. Class 1 or 2 results are indication that soils may be dispersive. Soils are considered dispersive if the combined percentage of clay (< 0.002 mm) plus half the percentage of silt (0.002 mm – 0.02 mm) expressed as a decimal fraction, and then multiplied by the dispersion index is greater than 10%. The particle size distribution testing completed on these samples yielded that many of the samples contained over 10% clay, and is considered dispersive.

In order to satisfy soil sampling requirements for the ESCP according to the Guidelines, further geotechnical investigations will be required. Soil assessments from the DMCP area (WorleyParsons 2015) so far indicate that soils are not dispersive. According to the Guideline Section 3.5.2, 2 boreholes per hectare of site disturbance will be required for soil sampling. However, there are indications from Golder (2015) investigation of the site that some areas may contain dispersive soil, in which case 5 holes per 2ha will be required for areas of site disturbance.

5.2 Potential areas of mass movement

Mass movement of soil is not evident on the site. The site is generally level to gently undulating. However there is the potential for erosion without suitable treatment of the transition zones between stormwater drainage infrastructure and natural surfaces and drainage channels.

5.3 Soil loss estimation

Soil loss estimation was undertaken using the revised universal soil loss equation (RUSLE). This soil loss estimation is used to estimate the relative average soil loss from a site based on the proposed works and help to determine the sediment control standard required.

Annual soil loss anticipated based on RUSLE is expected to be 102 t/ha/yr off the outer embankments. The sediment control standard recommended by IECA based on soil loss estimation is Type 2 for the embankment area. However, with the use of bonded fibre matrix as a cover on the embankments, soil loss estimation is reduced to 0 t/ha/yr and Type 2 sediment controls are not a requirement.

Areas other than the embankment is relatively level, and based on RUSLE, 66 t/ha/yr is expected from these areas. Type 3 sediment control is considered sufficient in these flat areas.

Table 1, 2 and 3 presents the parameters used for the soil loss assessments.

Table 1: Soil Loss Calculations – Outer embankments with no cover

A = R x K x LS x C x P		
Assumption	**Value**	**Comment**
A = annual soil loss (t/ha/yr)	101.66 t/ha/yr	-
R = rainfall erosivity factor	4600	Bowen
K = soil erodability factor	0.017	Sandy clay
LS = topographic factor (length vs slope)	1.0	2 m slope length, 33% slope
C = cover management factor	1.00	No cover
P = erosion control practice factor	1.3	Compacted and smooth

Table 2: Soil Loss Calculations – Outer embankments with bonded fibre matrix

A = R x K x LS x C x P		
Assumption	**Value**	**Comment**
A = annual soil loss (t/ha/yr)	101.66 t/ha/yr	-
R = rainfall erosivity factor	4600	Bowen
K = soil erodability factor	0.017	Sandy clay
LS = topographic factor (length vs slope)	1.0	2 m slope length, 33% slope
C = cover management factor	0.0	Bonded fibre matrix
P = erosion control practice factor	1.3	Compacted and smooth

Table 3: Soil Loss Calculations – Borrow areas

A = R x K x LS x C x P

Assumption	Value	Comment
A = annual soil loss (t/ha/yr)	66 t/ha/yr	-
R = rainfall erosivity factor	4600	Bowen
K = soil erodability factor	0.044	Clayey sand
LS = topographic factor (length vs slope)	0.41	200 m slope length, 1 - 2% slope
C = cover management factor	1.00	No cover
P = erosion control practice factor	0.8	loose soil to 300 mm

6.0 EROSION AND SEDIMENT CONTROL STRATEGY

Two ESCPs have been developed. One labelled Conceptual Erosion and Sediment Control Plan – Construction (F004 Appendix B) which applies at during construction and period of revegetation. The other ESCP applies for the operational phase for the DMCP, labelled Conceptual Erosion and Sediment Control Plan – Operational (F005 Appendix B). Each of the required erosion and sediment control features are described here and the feature locations are indicated on the ESCPs.

The Guideline recommends the integration of three control measures; drainage, erosion, and sediment control measures.

The drainage design standard is based on the selection of appropriate average recurrence interval (ARI) of the design storm. In Queensland, temporary drainage works with design life less than 12 months are to be designed to a 1 in 2 year design storm. Flow diversion features were chosen based on the slope and type of flow (sheet flow or concentrated flow) through a disturbed area or stockpile. Velocity control structures were chosen based on the maximum allowable flow velocity for the channel surface material. Permanent drainage design has also been completed for stormwater management purposes and has been included in the operational ESCP.

The erosion control standard recommended by IECA is based on monthly rainfall erosivity. Staging of construction during dry months in Bowen, April to October, when erosivity is rated low to very low would be in line with best practice requirements for land clearing and rehabilitation requirements. Erosivity is greatest during high rainfall periods, such that November and December have an erosivity rating of ‘medium’ and ‘high’ respectively. The Guideline stipulates that the selection of control features depends on the identification of areas at risk, and the length of time at risk of erosion and applying the most suitable control for that purpose.

The sediment control standard recommended by IECA is based on soil loss estimation. Based on the soil loss rate, Type 3 sediment controls are required. A description of each sediment control standard is summarised in Table 4.

Table 4: Classification of sediment control standards

Sediment Control Standard	Description
Type 1	■ Under typical flow conditions (discharge and suspended sediment concentration), is capable of capturing and holding at least 90% of material larger than 0.045 mm in equivalent diameter. ■ Sufficient sediment retention capacity (volume) to capture and hold one month’s sediment runoff from the catchment in question under average annual conditions. ■ Is capable of sustaining its hydraulic and structural integrity under normal site conditions. A sediment trapping system that has even a minor risk of experiencing performance-affecting damage within a given work site due to such things as vandalism, and foot or construction traffic, cannot be classified as a Type 1 sediment trap.

Sediment Control Standard	Description
Type 2	■ Under typical flow conditions (discharge and suspended sediment concentration), is capable of capturing and holding at least 90% of material larger than 0.14 mm in equivalent diameter. ■ Sufficient sediment retention capacity (volume) to capture and hold one month's sediment runoff from the catchment in question under average annual conditions ■ Has an acceptable capability to sustain its hydraulic and structural integrity under normal site conditions. A sediment trapping system that is highly likely to experience performance-affecting damage within a given work site due to such things as vandalism, and foot or construction traffic , cannot be classified as a Type 2 sediment trap
Type 3	■ Under typical flow conditions (discharge and suspended sediment concentration), is capable of capturing and holding 90% of material greater than 0.42 mm in equivalent diameter. ■ Sufficient sediment retention capacity (volume) to capture and hold one month's sediment runoff from the catchment in question under average annual conditions ■ Has an acceptable capability to sustain its hydraulic and structural integrity under normal site conditions. A sediment trapping system that is highly likely to experience performance-affecting damage within a given work site due to such things as vandalism, and foot or construction traffic , cannot be classified as a Type 3 sediment trap

6.1 ESC Measures - During Construction

6.1.1 Entry and Exit

Entry and exit points during construction will require a rock pad as an ESC measure. As the soils contain clay, the rock pad is the most suitable. A rock pad consists of a length of rocks located at an entry/exit which aims to strip dirt and mud attached to vehicle tyres.

Rock pad specifications are presented in Appendix C.

6.1.2 Embankment

The use of bonded fibre matrix or an equivalent product on the embankment surface is recommended to minimise soil loss during establishment of vegetation on the embankment. The implementation of bonded fibre matrix as a cover will largely reduce the level of sediment control required in the drainage lines.

Bonded fibre matrix specifications are presented in Appendix C.

6.1.3 Stockpiles

There will be stockpiles of fill materials and topsoil on the construction site, south of the DMCP. Sediment fencing should be installed on the down-slope perimeter of the stockpiles to prevent sediment entering drainage lines. Sediment fences are classified as a Type 3 sediment trap. The fence fabric adopted should be composite non-woven fabric to capture fine sediment particles.

The maximum height of stockpiled fill materials is to be limited to 2 m to minimise erosion risk.

Sediment fence design specifications are presented in Appendix C.

6.1.4 Stormwater Drains

The maximum velocity of flow in the table drains during the design event has been calculated under the assumption of unvegetated embankments and stormwater drains.

The maximum allowable velocity for bare earth is between 0.50 m/s and 0.70 m/s. The velocities in the drainage lines are within allowable values except for D1, where velocity reaches 0.91 m/s. Check dams constructed from sandbags or coir rolls are recommended to be installed in the drainage lines for velocity reduction and as a minor sediment control.

The maximum allowable velocity for grassed table drains is between 1.40 m/s to 1.80 m/s assuming 50% to 70% grass cover and up to 2% channel gradient. The flow expected in the swales and trapezoidal stormwater drains during the design event are all well within the allowable velocity during construction of the DMCP. Within the grass swales, the highest velocity expected is $0.47m^3/s$ and within the trapezoidal drains, the highest expected velocity is $0.48\ m^3/s$. Once grass is established within the channels, check dams will no longer be required.

Check dam details are presented in Appendix C.

6.1.5 Drainage Discharge Points

Permanent outlet structures for erosion and sediment control during construction and for continued operational use is required. This structure will disperse flow to minimise erosion at the base of the discharge points as well as remove sediment during construction works. As these outlet structures are to be permanent, detailed design will be required and completed at a later date.

The discharge points B and G are recommended to have woven sediment fences located down slope to capture sediment. At these points, discharge is in sheet flow and further controls should not be required. The sediment fences should be implemented until vegetation cover on the embankments are established.

Outlet structure and sediment fence design specifications are presented in Appendix C.

6.2 Inspection, Monitoring and Maintenance

Inspections of the ESC devices will be required weekly to ensure they are performing as intended. Accumulated sediment is to be removed during the inspection. Sediment must be disposed of in a manner that will not cause an erosion or pollution hazard.

In addition, the ESC devices should be inspected if significant rainfall is forecast or has occurred. Minor rainfall events (less than 20 mm over 24 hours) should not necessitate additional inspections. If more than 20 mm of rain is forecast, or has occurred over a 24 hour period, ESC devices should be inspected to ensure adequate performance and to initiate repair work if required.

Specific maintenance requirements for each ESC device are presented in Appendix C.

7.0 LIMITATIONS

Your attention is drawn to the document - “Limitations”, which is included in Appendix A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

8.0 CLOSURE

We trust that this conceptual ESCP meets your requirements. Please don’t hesitate to contact the undersigned if you have any questions or comments regarding this plan.

Report Signature Page

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APPENDIX A

Study Limitations

LIMITATIONS

This Document has been provided by Golder Associates Pty Ltd ("Golder") subject to the following limitations:

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APPENDIX B

Erosion Sediment Control Plans

Path: \\golder.gds\gap\Brisbane\Geomatics\DSDIP\ABBOT_POINT\99_PROJECTS\1525905_ABBOT_POINT_GGP\02_PRODUCTION\DWG\FIGURES\ | File Name: 1525905-019-F-004.dwg

NOTE(S)

1. NOTE ESCP SYMBOLS SHOWN INDICATE THE APPROXIMATE LOCATION AND TYPE OF ESC DEVICE. ESCP SYMBOLS ARE NOT TO SCALE. REFER TO APPENDIX C FOR DETAILED SPECIFICATIONS OF SPECIFIC ESC FEATURES.

LEGEND

- DRAINAGE CATCHMENT
- E1 DRAINAGE PATH
- SHEET FLOW
- DRAINAGE OUTLET
- OUTLET STRUCTURE
- SEDIMENT FENCE
- CATCHMENT BOUNDARY
- Cx CATCHMENT NUMBER
- INFERRED DRAINAGE PATHWAYS
- BFM BONDED FIBRE MATRIX
- CHECK DAM SEDIMENT TRAP

0 250 500
1:10,000 METRES

CLIENT
DEPARTMENT OF STATE DEVELOPMENT

PROJECT
ABBOT POINT GROWTH GATEWAY PROJECT
DREDGED MATERIAL CONTAINMENT PONDS

CONSULTANT

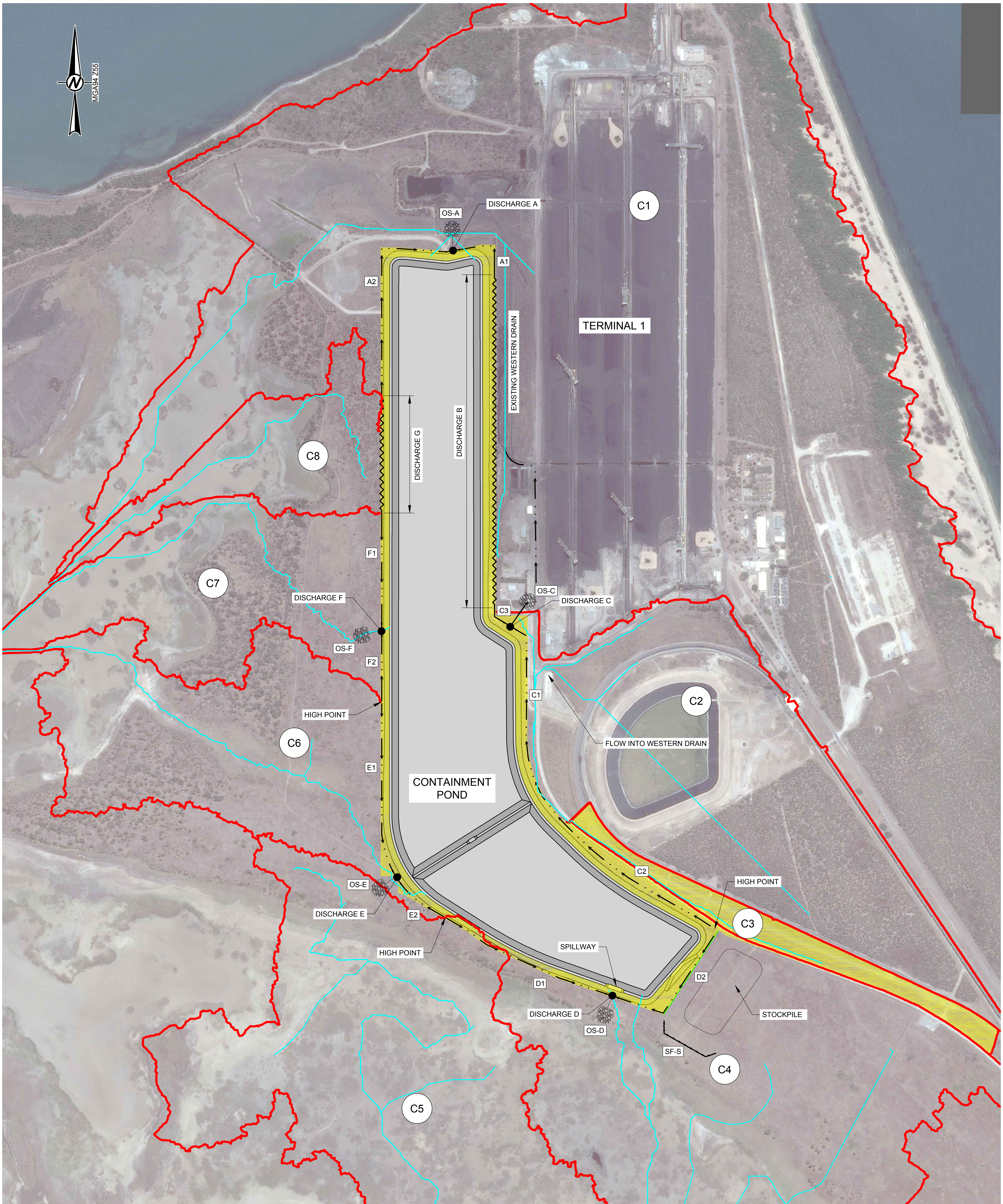
Golder Associates

YYYY-MM-DD	2015-07-13
DESIGNED	DCR
PREPARED	MPB
REVIEWED	AMB
APPROVED	RDM

TITLE
CONCEPTUAL EROSION AND SEDIMENT CONTROL PLAN - CONSTRUCTION PHASE

PROJECT NO.	DOC No.	REV.	FIGURE
1525905	19	A	F004

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
0 25 mm



NOTE(S)

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LEGEND

DRAINAGE CATCHMENT

CATCHMENT BOUNDARY

Cx CATCHMENT NUMBER

E1 DRAINAGE PATH

SHEET FLOW

INFERRED DRAINAGE PATHWAYS

DRAINAGE OUTLET

OUTLET STRUCTURE

0 250 500

1:10,000 METRES

CLIENT

DEPARTMENT OF STATE DEVELOPMENT

PROJECT

ABBOT POINT GROWTH GATEWAY PROJECT
DREDGED MATERIAL CONTAINMENT PONDS

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-07-13
DESIGNED	DCR
PREPARED	MPB
REVIEWED	AMB
APPROVED	RDM

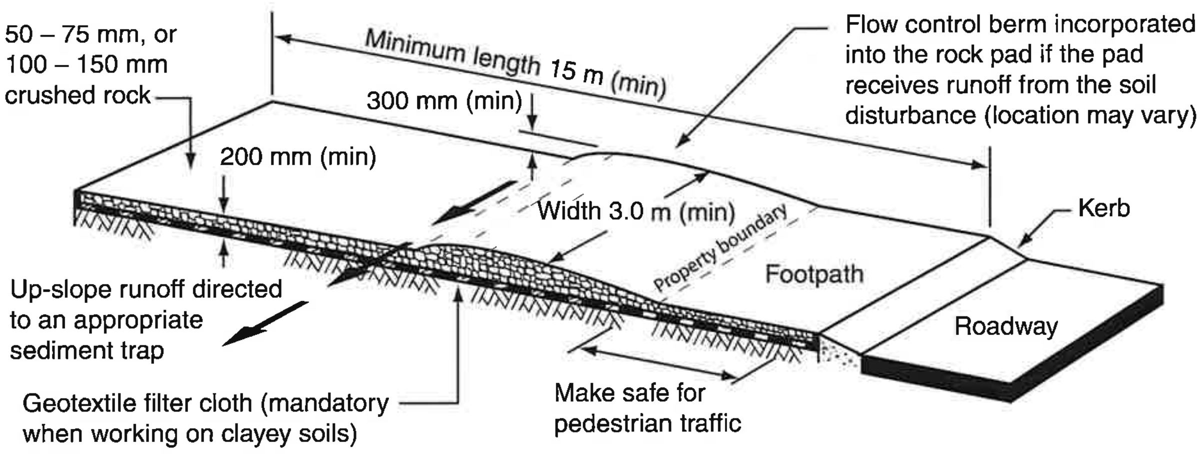
TITLE

CONCEPTUAL EROSION AND SEDIMENT CONTROL PLAN - OPERATIONAL PHASE

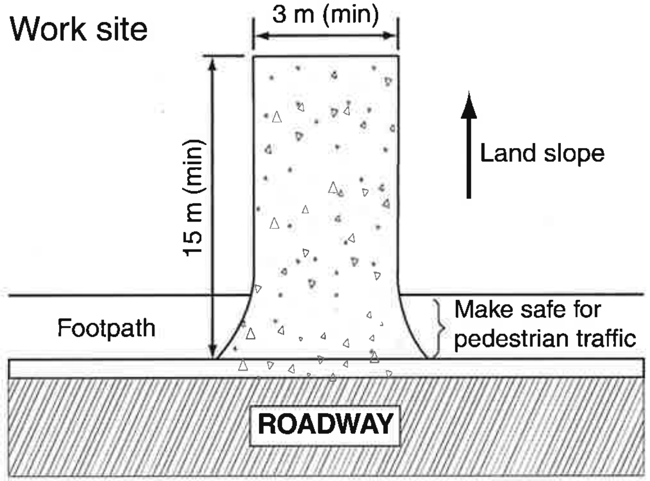
PROJECT NO.	DOC No.	REV.	FIGURE
1525905	019	A	F005

APPENDIX C

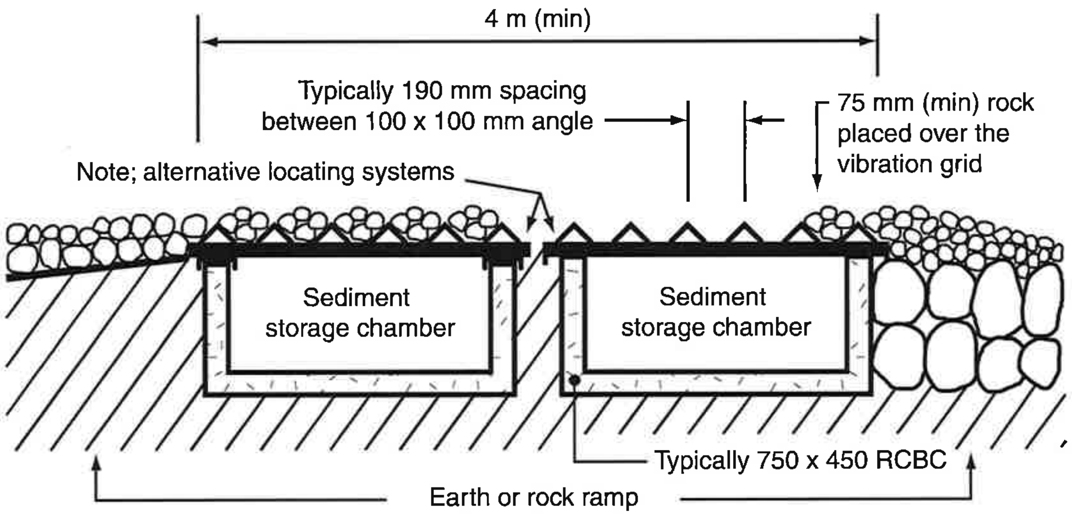
Typical Drawings of ESCP Features



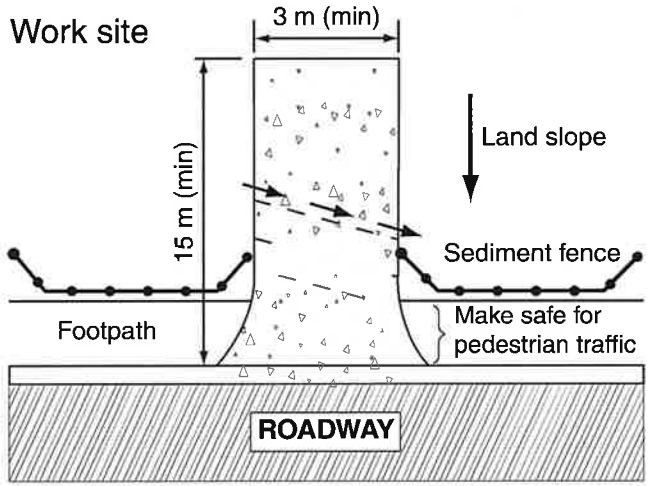
(a) Rock entry/exit pad for construction sites
(refer to Standard Drawing Exit-03 for building sites)



(b) Rock pad sloping away from road



(c) Alternative low maintenance arrangement
(still under development)



(d) Rock pad sloping towards the road

Drawn: GMW	Date: Apr-10	Construction Exit - Rock Pad (construction sites only)	Exit-01

MATERIALS

ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, NOMINAL DIAMETER OF 50 TO 75mm (SMALL DISTURBANCES) OR 100 TO 150mm (LARGE DISTURBANCES). ALL REASONABLE MEASURES MUST BE TAKEN TO OBTAIN ROCK OF NEAR UNIFORM SIZE.

FOOTPATH STABILISING AGGREGATE: 25 TO 50mm GRAVEL OR AGGREGATE.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH ('BIDIM' A24 OR EQUIVALENT).

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND DIMENSIONAL DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, DIMENSIONS, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION OF THE ROCK PAD, REMOVING STUMPS, ROOTS AND OTHER VEGETATION TO PROVIDE A FIRM FOUNDATION SO THAT THE ROCK IS NOT PRESSED INTO SOFT GROUND. CLEAR SUFFICIENT WIDTH TO ALLOW PASSAGE OF LARGE VEHICLES, BUT CLEAR ONLY THAT NECESSARY FOR THE EXIT. DO NOT CLEAR ADJACENT AREAS UNTIL THE REQUIRED EROSION AND SEDIMENT CONTROL DEVICES ARE IN PLACE.

3. IF THE EXPOSED SOIL IS SOFT, PLASTIC OR CLAYEY, PLACE A SUB-BASE OF CRUSHED ROCK OR A LAYER OF HEAVY-DUTY FILTER CLOTH TO PROVIDE A FIRM FOUNDATION.

4. PLACE THE ROCK PAD FORMING A MINIMUM 200mm THICK LAYER OF CLEAN, OPEN-VOID ROCK.

5. IF THE ASSOCIATED CONSTRUCTION SITE IS UP-SLOPE OF THE ROCK PAD, THUS CAUSING STORMWATER RUNOFF TO FLOW TOWARDS THE ROCK PAD, THEN FORM A MINIMUM 300mm HIGH FLOW CONTROL BERM ACROSS THE ROCK PAD TO DIVERT SUCH RUNOFF TO A SUITABLE SEDIMENT TRAP.

6. THE LENGTH OF THE ROCK PAD SHOULD BE AT LEAST 15m WHERE PRACTICABLE, AND AS WIDE AS THE FULL WIDTH OF THE ENTRY OR EXIT AND AT LEAST 3m. THE ROCK PAD SHOULD COMMENCE AT THE EDGE OF THE OFF-SITE SEALED ROAD OR PAVEMENT.

7. FLARE THE END OF THE ROCK PAD WHERE IT MEETS THE PAVEMENT SO THAT THE WHEELS OF TURNING VEHICLES DO NOT TRAVEL OVER UNPROTECTED SOIL.

8. IF THE FOOTPATH IS OPEN TO PEDESTRIAN MOVEMENT, THEN COVER THE COARSE ROCK WITH FINE AGGREGATE OR GRAVEL, OR OTHERWISE TAKE WHATEVER MEASURES ARE NEEDED TO MAKE THE AREA SAFE.

MAINTENANCE

1. INSPECT ALL SITE ENTRY AND EXIT POINTS PRIOR TO FORECAST RAIN, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER RUNOFF-PRODUCING RAINFALL, OR OTHERWISE AT FORTNIGHTLY INTERVALS.

2. IF SAND, SOIL, SEDIMENT OR MUD IS TRACKED OR WASHED ONTO THE ADJACENT SEALED ROADWAY, THEN SUCH MATERIAL MUST BE PHYSICALLY REMOVED, FIRST USING A SQUARE-EDGED SHOVEL, AND THEN A STIFF-BRISTLED BROOM, AND THEN BY A MECHANICAL VACUUM UNIT, IF AVAILABLE.

3. IF NECESSARY FOR SAFETY REASONS, THE ROADWAY SHALL ONLY BE WASHED CLEAN AFTER ALL REASONABLE EFFORTS HAVE BEEN TAKEN TO SHOVEL AND SWEEP THE MATERIAL FROM THE ROADWAY.

4. WHEN THE VOIDS BETWEEN THE ROCK BECOMES FILLED WITH MATERIAL AND THE EFFECTIVENESS OF THE ROCK PAD IS REDUCED TO A POINT WHERE SEDIMENT IS BEING TRACKED OFF THE SITE, A NEW 100mm LAYER OF ROCK MUST BE ADDED AND/OR THE ROCK PAD MUST BE EXTENDED.

5. ENSURE ANY ASSOCIATED DRAINAGE CONTROL MEASURES (e.g. FLOW CONTROL BERM) ARE MAINTAINED IN ACCORDANCE WITH THEIR DESIRED OPERATIONAL CONDITIONS.

6. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

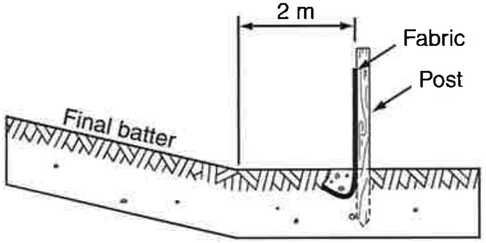
REMOVAL

1. THE ROCK PAD SHOULD BE REMOVED ONLY AFTER IT IS NO LONGER NEEDED AS A SEDIMENT TRAP.

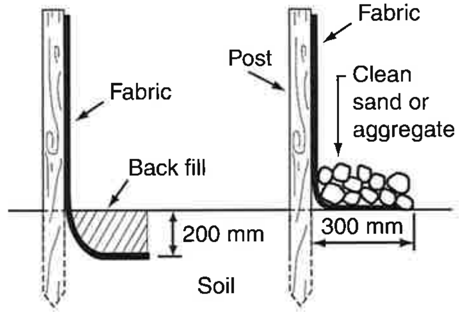
2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. RE-GRADE AND STABILISE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

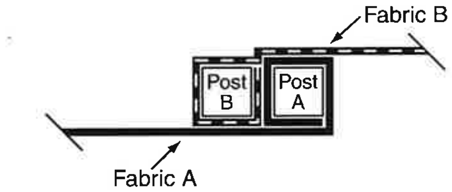
Drawn:	Date:		
GMW	Apr-10	Construction Exit - Rock Pad (construction sites only)	Exit-02



(a) Location of fence relative to base of slope

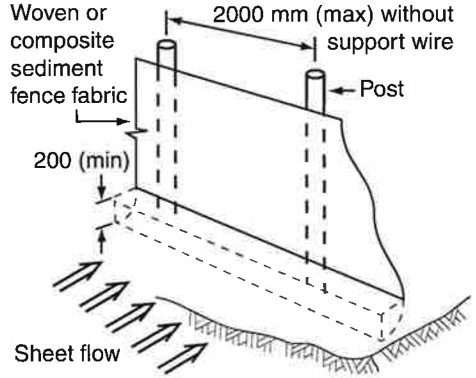


(b) Anchoring base of fabric

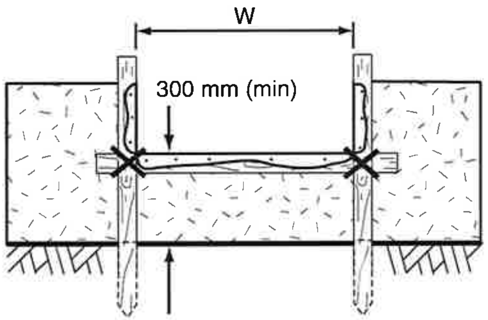


Fabric to fold around each stake one full turn.
Stake B to be drive tightly against Stake A.
The tops of both stakes to be secured with wire.

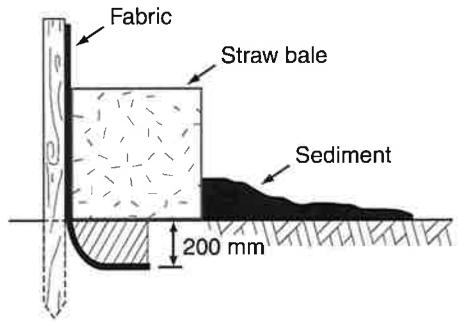
(c) Joining fabric - Method 1



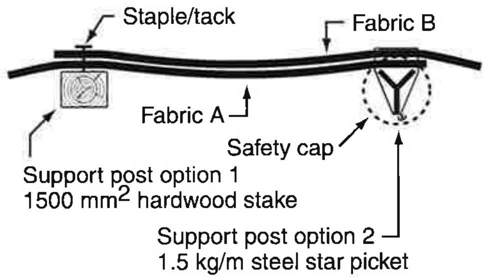
(d) Installation without backing support



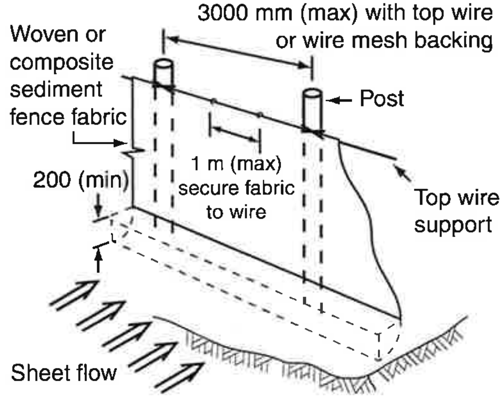
(e) Spill-through weir



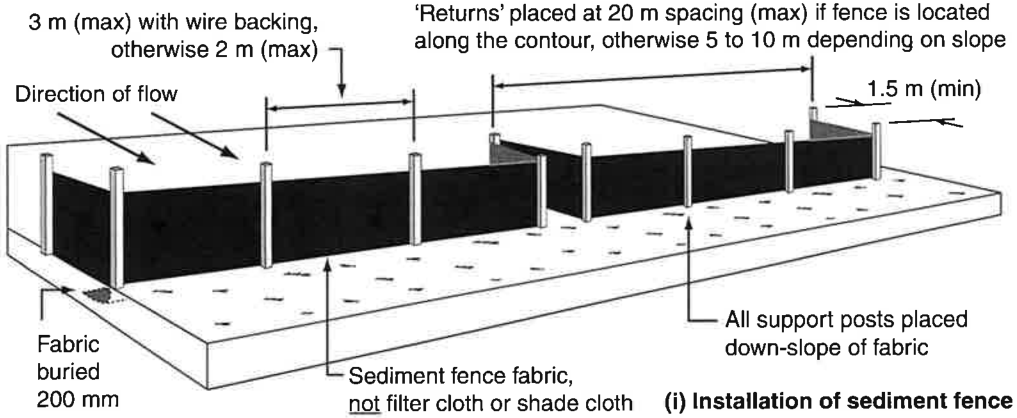
(f) Placement of up-slope straw bale



(g) Joining fabric - Method 2



(h) Installation with top wire support



(i) Installation of sediment fence

Notes:

1. Sediment fence to be installed along a line of constant ground elevation wherever practical.
2. Both end of the sediment fence to extend up the slope at least 1m.
3. Support post to be spaced a maximum 2m unless the fence is supported by a top wire or wire mesh backing, in which case 3m maximum spacing.
4. Fence 'returns' shall be installed at maximum 20m spacing if fence is installed along the contour, otherwise 5 to 10m maximum spacing.
5. Minimum 4 staples or tie wires per stake.

Drawn:	Date:		
GMW	Dec-09	Sediment Fence	SF-01

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140GSM. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm^2 (MIN) HARDWOOD, 2500mm^2 (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. TO THE MAXIMUM DEGREE PRACTICAL, AND WHERE THE PLANS ALLOW, ENSURE THE FENCE IS LOCATED:
(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;
(ii) ALONG A LINE OF CONSTANT ELEVATION WHEREVER PRACTICAL;
(iii) AT LEAST 2m FROM THE TOE OF ANY FILLING OPERATIONS THAT MAY RESULT IN SHIFTING SOIL/FILL DAMAGING THE FENCE.

3. INSTALL RETURNS WITHIN THE FENCE AT MAXIMUM 20m INTERVALS IF THE FENCE IS INSTALLED ALONG THE CONTOUR, OR 5 TO 10m MAXIMUM SPACING (DEPENDING ON SLOPE) IF THE FENCE IS INSTALLED AT AN ANGLE TO THE CONTOUR. THE 'RETURNS' SHALL CONSIST OF EITHER:
(i) V-SHAPED SECTION EXTENDING AT LEAST 1.5m UP THE SLOPE; OR
(ii) SANDBAG OR ROCK/AGGREGATE CHECK DAM A MINIMUM 1/3 AND MAXIMUM 1/2 FENCE HEIGHT, AND EXTENDING AT LEAST 1.5m UP THE SLOPE.

4. ENSURE THE EXTREME ENDS OF THE FENCE ARE TURNED UP THE SLOPE AT LEAST 1.5m, OR AS NECESSARY, TO MINIMISE WATER BYPASSING AROUND THE FENCE.

5. ENSURE THE SEDIMENT FENCE IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE FENCE, AND THE UNDESIRABLE DISCHARGE OF WATER AROUND THE ENDS OF THE FENCE.

6. IF THE SEDIMENT FENCE IS TO BE INSTALLED ALONG THE EDGE OF EXISTING TREES, ENSURE CARE IS TAKEN TO PROTECT THE TREES AND THEIR ROOT SYSTEMS DURING INSTALLATION OF THE FENCE. DO NOT ATTACH THE FABRIC TO THE TREES.

7. UNLESS DIRECTED BY THE SITE SUPERVISOR OR THE APPROVED PLANS, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE PROPOSED FENCE LINE, PLACING THE EXCAVATED MATERIAL ON THE UP-SLOPE SIDE OF THE TRENCH.

8. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 3m IF SUPPORTED BY A TOP SUPPORT WIRE OR WEIR MESH BACKING, OTHERWISE NO GREATER THAN 2m.

9. IF SPECIFIED, SECURELY ATTACH THE SUPPORT WIRE OR MESH TO THE UP-SLOPE SIDE OF THE STAKES WITH THE MESH EXTENDING AT LEAST 200mm INTO THE EXCAVATED TRENCH. ENSURE THE MESH AND FABRIC IS ATTACHED TO THE UP-SLOPE SIDE OF THE STAKES EVEN WHEN DIRECTING A FENCE AROUND A CORNER OR SHARP CHANGE OF DIRECTION.

10. WHEREVER POSSIBLE, CONSTRUCT THE SEDIMENT FENCE FROM A CONTINUOUS ROLL OF FABRIC. TO JOIN FABRIC EITHER:
(i) ATTACH EACH END TO TWO OVERLAPPING STAKES WITH THE FABRIC FOLDING AROUND THE ASSOCIATED STAKE ONE TURN, AND WITH THE TWO STAKES TIED TOGETHER WITH WIRE; OR
(ii) OVERLAP THE FABRIC TO THE NEXT ADJACENT SUPPORT POST.

11. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS USING 25 X 12.5mm STAPLES, OR TIE WIRE AT MAXIMUM 150mm SPACING.

12. SECURELY ATTACH THE FABRIC TO THE SUPPORT WIRE/MESH (IF ANY) AT A MAXIMUM SPACING OF 1m.

13. ENSURE THE COMPLETED SEDIMENT FENCE IS AT LEAST 450mm, BUT NOT MORE THAN 700mm HIGH. IF A SPILL-THOUGH WEIR IS INSTALLED, ENSURE THE CREST OF THE WEIR IS AT LEAST 300mm ABOVE GROUND LEVEL.

14. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

ADDITIONAL REQUIREMENTS FOR THE INSTALLATION OF A SPILL-THROUGH WEIR

1. LOCATE THE SPILL-THROUGH WEIR SUCH THAT THE WEIR CREST WILL BE LOWER THAN THE GROUND LEVEL AT EACH END OF THE FENCE.

2. ENSURE THE CREST OF THE SPILL-THROUGH WEIR IS AT LEAST 300mm THE GROUND ELEVATION.

3. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE SUPPORT POSTS/ STAKES EACH SIDE OF THE WEIR. CUT THE FABRIC DOWN THE SIDE OF EACH POST AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

4. INSTALL A SUITABLE SPLASH PAD AND/OR CHUTE IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION AND APPROPRIATELY DISCHARGE THE CONCENTRATED FLOW PASSING OVER THE WEIR.

MAINTENANCE

1. INSPECT THE SEDIMENT FENCE AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. IF THE FENCE IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 1/3 THE HEIGHT OF THE FENCE.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS 6-MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT FENCE ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE FENCE MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Sediment Fence	SF-02

MATERIAL

MULCH: TYPICALLY 100% WOOD FIBRE, 100% BAGASSE, OR 75% CANE FIBRE AND 25% RECYCLED PAPER. THE REMAINDER MUST CONSIST OF SUITABLE MULCHING MATERIAL SUCH AS RECYCLED PAPER.

TACKIFIER: NON RE-WETTING, CROSS-LINKED, GUAR PRODUCT COMBINED WITH EITHER A COPOLYMER PVA BINDER (TROPICAL ENVIRONMENTS) OR POLYACRYLAMIDES (PAMs), UNLESS USED SPECIFICALLY FOR WEED CONTROL.

APPLICATION

THE FOLLOWING SPECIFICATION APPLIES TO GRASS SEEDING, NOT THE APPLICATION OF NATIVE TREE OR SHRUB SEED. THE ADOPTED SPECIFICATION MUST BE APPROPRIATE FOR LOCAL CONDITIONS.

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. ENSURE ALL NECESSARY SOIL TESTING (e.g. SOIL pH, NUTRIENT LEVELS) AND ANALYSIS HAS BEEN COMPLETED, AND REQUIRED SOIL ADJUSTMENTS PERFORMED PRIOR TO APPLICATION.

3. ENSURE THE SURFACE IS FREE OF DEEP TRACK MARKS OF OTHER FEATURES THAT MAY RESULT IN ONGOING FLOW CONCENTRATION DOWN THE SLOPE. WHERE NECESSARY, ESTABLISH UP-SLOPE DRAINAGE CONTROLS TO LIMIT RUN-ON WATER THAT MAY DISTURB THE MATRIX.

4. CONTOUR SCARIFY THE SOIL SURFACE AND FILL AREAS PRIOR TO APPLICATION OF THE MATRIX.

5. IF THE SOIL IS DRY, WATER THE TREATMENT AREA BEFORE APPLICATION TO INCREASE PENETRATION OF THE ADHESIVE AND FERTILISER ADDITIVES.

6. MACHINE APPLICATIONS MUST COMPRISE A MINIMUM OF TWO PASSES IN OPPOSITE DIRECTIONS UNLESS OTHERWISE SPECIFIED. ENSURE COMPLETE COVERAGE OF THE SPECIFIED TREATMENT AREA OCCURS.

7. DURING APPLICATION, ALL REASONABLE EFFORTS MUST BE TAKEN TO AVOID SPRAY ONTO ROADS, PATHWAYS, DRAINAGE CHANNELS NOT INTENDED FOR APPLICATION, AND EXISTING VEGETATION.

8. CONTINUE TO WATER AFTER ALLOWING 24 HOURS DRYING TIME. WATER AS REQUIRED TO MAINTAIN SUITABLE GERMINATION AND PLANT GROWTH. THE MATRIX SHOULD BE KEPT MOIST UNTIL SUCCESSFULLY SEED GERMINATION OCCURS.

MAINTENANCE

1. INSPECT THE APPLICATION FORTNIGHTLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CHECK FOR RILL EROSION, OR DISLODGMENT OF THE FIBRE MATRIX.

3. REPLACE ANY DISPLACED FIBRE MATRIX TO MAINTAIN THE REQUIRED COVERAGE.

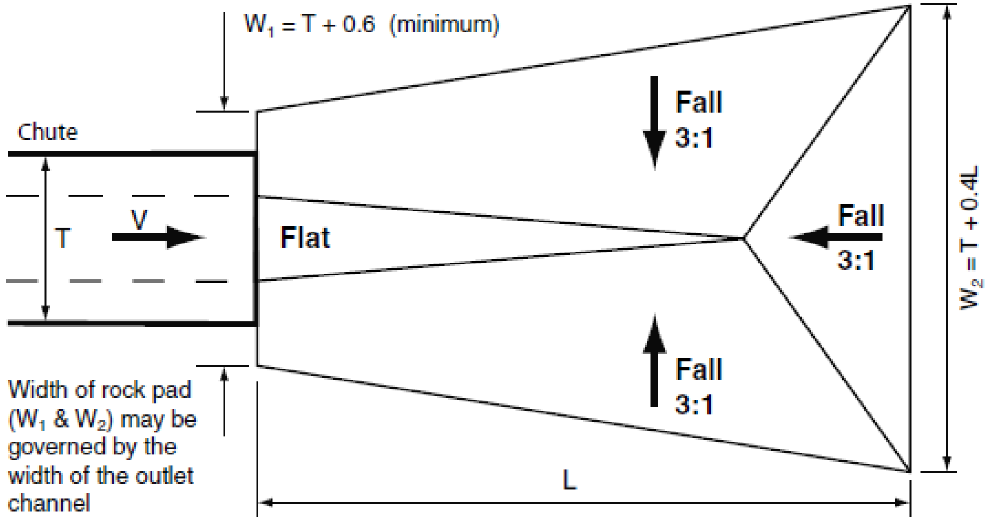
4. IF STORMWATER RUNOFF DISPLACES MORE THAN 10% OF THE FIBRE MATRIX, THEN INVESTIGATE THE NEED FOR ADDITIONAL DRAINAGE CONTROLS TO PREVENT FURTHER DISPLACEMENT.

5. CONTINUE INSPECTIONS UNTIL VEGETATION IS SUITABLY ESTABLISHED OR EROSION CONTROL IS NO LONGER REQUIRED.

6. IF THE FIBRE MATRIX IS NOT EFFECTIVE IN CONTAINING THE SOIL EROSION IT SHOULD BE REPLACED, OR AN ALTERNATIVE EROSION CONTROL PROCEDURE ADOPTED.

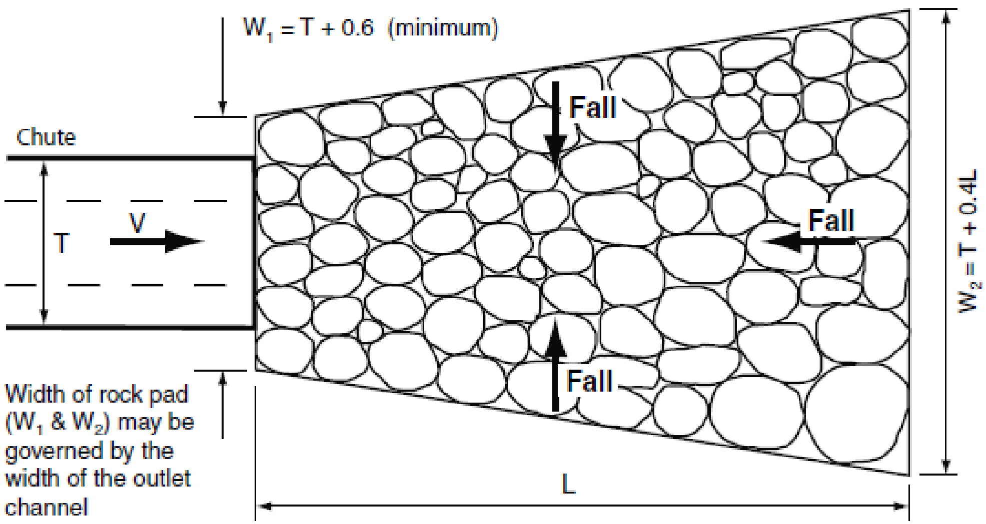
Drawn: GMW	Date: Dec-09	Bonded Fibre Matix	BFM-01

Recessed rock pad dimensions					
	OS-A	OS-C	OS-D	OS-E	OS-F
Mean rock size, d50 (mm)	110	200	100	100	100
Recommended length, L (m)	1.6	3.0	1.4	1.4	1.4
W1 (m)	4.0	4.0	4.0	4.0	4.0
W2 (m)	4.7	5.2	4.6	4.6	4.6
Recommended recess depth, Z (m)	0.2	0.2	0.2	0.2	0.2

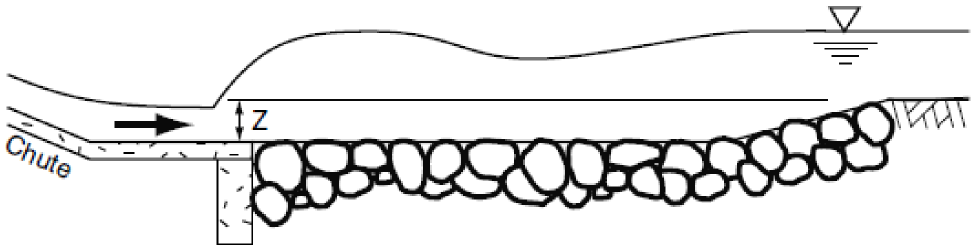


T = Maximum top width of flow at base of chute

(b) Typical form of a rock pad outlet structure for a drainage chute



(c) Typical layout of a rock pad outlet structure for a drainage chute



(d) Typical profile of a rock pad outlet structure for a drainage chute

Notes:

1. Drawings applicable to temporary drainage chutes and slope drains.
2. Rock pad outlet structures for slope drains usually are not required to be recessed below natural ground level as is the case for chute outlets (see Figure B).

Drawn: GMW	Date: Dec-09	Outlet Structures	OS-01

MATERIALS

ROCK: 150 TO 300mm EQUIVALENT DIAMETER, HARD, EROSION RESISTANT ROCK.

SANDBAGS: GEOTEXTILE BAGS (WOVEN SYNTHETIC, OR NON-WOVEN BIODEGRADABLE) FILLED WITH CLEAN COARSE SAND, CLEAN AGGREGATE, OR COMPOST.

INSTALLATION (ROCK CHECK DAM)

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT OF THE SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.

3. LOCATE EACH CHECK DAM SEDIMENT TRAP AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES.

4. IF THE CHECK DAMS ARE ALSO BEING USED TO CONTROL EROSION WITHIN THE DRAINAGE CHANNEL, THEN LOCATE EACH SUCCESSIVE CHECK DAM SUCH THAT THE CREST OF THE IMMEDIATE DOWNSTREAM DAM IS LEVEL WITH THE CHANNEL INVERT AT THE IMMEDIATE UPSTREAM CHECK DAM.

5. CONSTRUCT EACH CHECK DAM TO THE DIMENSIONS AND PROFILE SHOWN WITHIN THE APPROVED PLAN.

6. WHERE SPECIFIED, THE CHECK DAMS MUST BE CONSTRUCTED ON A SHEET OF GEOTEXTILE FABRIC USED AS A DOWNSTREAM SPLASH PAD.

7. EACH CHECK DAM MUST BE EXTENDED UP THE CHANNEL BANK (WHERE PRACTICABLE) TO AN ELEVATION AT LEAST 150mm ABOVE THE CREST LEVEL OF THE DAM.

INSTALLATION (COMPOST-FILLED SOCKS)

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT OF THE SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.

3. LOCATE EACH SOCK AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES.

4. PLACE EACH SOCK TO THE LINES AND PROFILE SHOWN IN THE APPROVED PLAN OR AS DIRECTED BY THE SITE SUPERVISOR.

5. ENSURE EACH SOCK EXTENDS UP THE CHANNEL BANKS (WHERE PRACTICAL) TO A LEVEL AT LEAST 100mm ABOVE THE CREST LEVEL OF THE CHECK DAM.

MAINTENANCE

1. INSPECT EACH CHECK DAM AND THE DRAINAGE CHANNEL AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CORRECT ALL DAMAGE IMMEDIATELY. IF SIGNIFICANT EROSION OCCURS BETWEEN ANY OF THE CHECK DAMS, THEN CHECK THE SPACING OF THE DAMS AND WHERE NECESSARY INSTALL INTERMEDIATE CHECK DAMS OR A SUITABLE CHANNEL LINER.

3. CHECK FOR DISPLACEMENT OF THE CHECK DAMS.

4. CHECK FOR SOIL SCOUR AROUND THE ENDS OF EACH CHECK DAM. IF SUCH EROSION IS OCCURRING, CONSIDER EXTENDING THE WIDTH OF THE CHECK DAM TO AVOID SUCH PROBLEMS.

5. IF SEVERE SOIL EROSION OCCURS EITHER UNDER OR AROUND THE CHECK DAMS, THEN SEEK EXPERT ADVICE ON AN ALTERNATIVE TREATMENT MEASURE.

6. DE-SILT SEDIMENT TRAP IF THE SEDIMENT LEVEL EXCEEDS 1/3 THE CREST HEIGHT.

7. DISPOSE OF COLLECTED SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN CONSTRUCTION WORK WITHIN THE DRAINAGE AREA ABOVE THE CHECK DAMS HAS BEEN COMPLETED AND DISTURBED AREAS SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE DAMS MUST BE REMOVED, UNLESS THE SEDIMENT TRAPS ARE TO REMAIN AS A PERMANENT FEATURE.

2. REMOVE COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REMOVE AND APPROPRIATELY DISPOSE OF ALL MATERIALS INCLUDING ANY GEOTEXTILE FABRIC.

4. STABILISE THE DISTURBED CHANNEL WITH A LINING OF FABRIC AND ROCK, OR ESTABLISH VEGETATION AS APPROPRIATE.

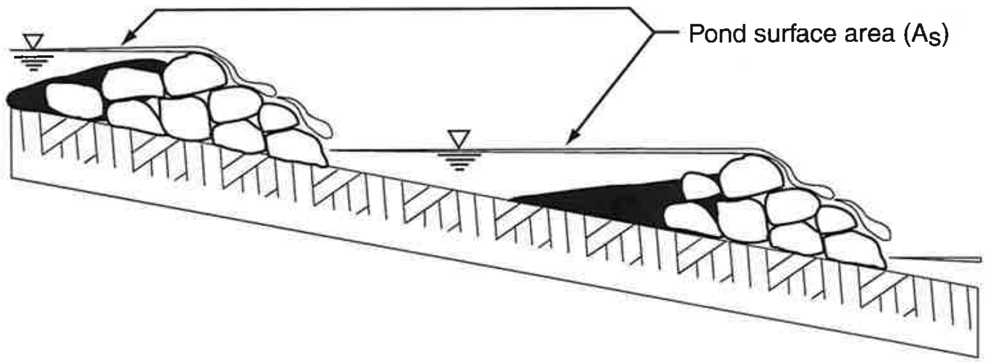


Figure 1 - Placement of check dam sediment traps

Drawn:	Date:		
GMW	Apr-10	Check Dam Sediment Trap	CDT-01

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