Transport Roads & Maritime Services

Technical Direction
Geotechnology

GTD 2016/001

Geotechnical design and construction requirements for sediment basins

Summary:	Audience:
This Technical Direction specifies the geotechnical design requirements for sediment basins on RMS projects.	• Designers • Project Managers • Contract Managers • Corridor Asset Owners

Background

Sediment basins are an integral feature for most construction projects within the Roads and Maritime network. Current requirements for the design and construction of sediment basins are often referred to in specification G38 (Soil and Water Management), and Managing Urban Stormwater: soils and construction (Landcom, 2004 and 2008). These documents mainly focus on environmental aspects of sediment basins without explicit geotechnical design and construction requirements.

Unsatisfactory performance of sediment basin have been identified on a number of Roads and Maritime projects and are mostly related to basins instability and leakage, which have impacted the integrity of the local environment and nearby assets, and resulted in disruption to road users.

Purpose and scope

This technical direction provides geotechnical design and construction requirements for sediment basins. These requirements aim at reducing the likelihood of failure and maintenance costs of sediment basins, as well as potential disruption of the road network.

This technical direction is to be used in conjunction with specifications G38 and R44.

Approvals:

Owner:	Principal Engineer, Pavements & Geotechnical	**Review Date:**	1 March 2017
Authorised by:	Chris Harrison, Chief Engineer	**Effective Date:**	27 January 2016

Geotechnical design and construction requirements

General

1. Design and construction of sediment basin must conform to specification G38 and 'Managing Urban Stormwater: soils and construction' Volumes 1 and 2 (Landcom, 2004 and 2008).

2. Safety in design, operation and maintenance must be considered and carried out in accordance with industry best practice.

3. Refer to specification G38 Annexure G38/E for the Design Average Recurrence Intervals for peak flow and Annexure G38/L for Minimum Frequency of Testing.

4. Sediment basins should be located:
    a) to maximise overall sediment trapping capabilities and runoff
    b) where expected overflow or seepage will not cause damage to nearby structures or assets;
    c) to enable access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the required capacity;
    d) above the 1 in 5 year ARI flood level, if located on or near a watercourse floodplain.

5. Width of embankment crest must be at least 2.5 m and the height of the basin embankment must be limited to 3 m, unless otherwise noted on the drawings.

6. The basin floor must be suitable to support maintenance machinery when access is required within the basin, typically overlain with hard material, such as rockfill or concrete.

7. Sediment basins must include features to accommodate overflow or bypass flows that exceed the design storm event.

8. The design must ensure the basin storage and stability performance particularly after prolonged periods of drought or basin emptiness.

9. Sediment basins must be designed, reviewed and certified by a suitably qualified geotechnical engineer that all the requirements in this technical direction are met.

10. Temporary basins with a design life less than 12 months are not to be used as permanent sediment basins and they must be decommissioned at the end construction. In exceptional cases they may be converted to long term operational basins. The road operator or asset owner must ensure that the sediment basin is in good working condition and that the design capacity is adequate for such a conversion. The asset owner must also ensure that the basin satisfies the minimum design requirements as per specification G38 and this technical direction (including geotechnical stability and seepage requirements) for permanent basin.

11. The asset owner must ensure that an adequate maintenance program for sediment basins is prepared and updated as needed.

12. A surveyor undertakes final measurements of the basin and verifies that the as-built is as the design capacity.

Geotechnical requirements

In addition to the general requirements above, the sediment basin must also design for the following:

1. Embankments must be formed from earth, rock, gabions or suitable crushed concrete depending on the preferred drainage system.
2. The minimum batter gradients for the basins must conform to 'Managing Urban Stormwater: soils and construction' Volume 1 (Landcom, 2004).
3. The design height of the embankment must allow for effects of potential settlements.
4. Scour protection measures must be installed in accordance with specification G38, Clause 3.
5. The spillway and inlet to the basin must be protected from erosion with rock or rock mattresses and underlain by impermeable membrane. Basin floor and spillway rock should be: hard, angular, durable, weather resistant and well graded rock (minimum dimension 100 mm) in accordance with specification R44. The protection should cover the length of the batter. Grass-lined spillway chutes are not to be used for sediment basins.
6. Unreinforced/reinforced embankment slope and gravity retaining walls for basin must be designed and constructed in accordance with AS 5100 and the geotechnical strength reduction factors for Load Cases A and B for strength and stability design must comply with Table 1 instead of Table 13.3.1(A) of AS5100.3.

Table 1 - Range of geotechnical strength reduction factors (φg) for sediment basin in design

Load Case	Range of values of φ_g			
	Bearing and passive capacity	**Restoring moment contributed by gravity force and non-passive pressure**	**Shear strength in sliding and slip surface analyses.**	**Pullout strength of soil reinforcement (excluding ground anchors)**
A[a]	0.35 - 0.50	0.50	0.65	0.5
B[b]	0.50 - 0.65	0.65	0.8	0.65

Notes:

a) Load Case A: Gravity load + nominal vertical live load (trafficable: 20 kPa, non-trafficable: 10 kPa) including the steady state condition. Construction surcharge to be considered separately where necessary.

a) Load Case B: Gravity load + the most critical transient load (i.e. only 1 transient load at anytime). Transient loads include, but are not limited to, earthquake load, traffic impact load, traffic breaking load, wind load and rapid drawdown load.

7. The effect of the steady state seepage of the basin must be accounted for in the long term overall stability case (Load Case A) with particular consideration on the impacts to existing nearby structures and pavements.
8. Linings using either clay or geomembrane must be provided in the following areas to prevent water in the basin from excessive leakage:
    a) floor of basin;

b) upstream face of embankment;

c) spillway.

9. The design, construction, material requirements and testing of the impermeable liners must conform to the requirements of Guideline EPA 509/14 - Wastewater lagoon construction.

10. The earthwork construction must conform to specification G38 for basin fill materials and Clause 5 of specificationR44 for fill compaction, testing and conformance.

Further advice

For further information, please contact Manager Geotechnical Engineering (Project Engineering), Pavements and Geotechnical Section, Engineering Services Branch.

References

AS 5100.3 (2004) *Bridge Design - Foundation and soil supporting structures*, Standards Australia, Sydney, NSW.

Environmental Protection Agency (2014) *Wastewater lagoon construction* Guide EPA 509/14, Environmental Protection Agency, SA.

Landcom (2004) *Managing urban stormwater: soils and construction* Volume 1, Ed. 4, Landcom, NSW.

Landcom (2008) *Managing urban stormwater: soils and construction* Volume 2, A to E, Landcom, NSW.

Roads and Maritime (2014) *Earthworks* Specification R44, Ed5, Rev. 0, Roads and Maritime Services, North Sydney, NSW.

Roads and Maritime (2015) *Soil and Water Management* Specification G38, Ed2, Rev. 2, Roads and Maritime Services, North Sydney, NSW.