DISPERSIVE SOILS *and their* MANAGEMENT

Guidelines for Landholders, Planners and Engineers

1.0 WHY MANAGEMENT OF DISPERSIVE SOILS IS IMPORTANT

In recent years, urban expansion has occurred in areas with dispersive soils. Disturbance of dispersive soils has resulted in tunnel erosion, damage to infrastructure, and environmental harm. Greater awareness of the difficulties posed by development on dispersive soils is required to prevent future damage. Tunnel erosion results in the formation of underground cavities that can collapse causing gully erosion and damage to infrastructure such as optical fibre cables, septic systems, roads, culverts and dwellings. Unlike other forms of erosion, tunnel erosion involves both chemical and physical processes associated with the dispersion of sodic clays. Given the difficulty of repairing tunnel erosion, management effort is focused on prevention of tunnel formation through increased understanding and awareness of the issues associated with construction and development on dispersive soils.

Figure 1. Tunnel and gully erosion resulting from construction of a stormwater culvert in dispersive clay.

2.0 WHERE DO DISPERSIVE SOILS OCCUR?

Dispersive soils and tunnel erosion occur in all municipalities in southern Tasmania, as well as parts of the Northern Midlands, Tamar Valley and Break O'Day municipalities. Dispersive soils are generally associated with soils derived from Triassic sandstone, or Permian mudstone. The location and extent of dispersive soils has not been specifically mapped in Tasmania, although broad scale land systems mapping indicates that approximately 103,000 ha of private freehold land in Tasmania contains a tunnel erosion hazard.

Tunnel erosion mostly occurs on;

- Dispersive, or sodic soils.
- Soils derived from Triassic sandstone and Permian mudstone.
- Deep sedimentary soils.
- North and northeast facing slopes.
- Drainage lines.
- Areas in which vegetation, soils or hydrology have been disturbed.
- Areas with less than 700 mm annual rainfall.

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3.0 IDENTIFICATION OF DISPERSIVE SOILS

- Dispersive soils can be identified by dribble patterns and pitting (Figure 2).
- Early stages of tunnel erosion can be identified by the development of 'spew holes' and fans of dispersed material ejected from tunnels (Figure 3).
- Simple field tests can be used to identify the presence of dispersive soils.
- For engineering works or infrastructure development, a combination of analytical and physical tests may be required to predict dispersive behaviour in soils.

Figure 2 (a). Example of dribble pattern on an exposed subsoil, the photograph was taken from within an actively eroding tunnel system. (b) Dribble patterns on sodic soil ped.

Figure 3. Sediment fans or 'spew holes' are often the first obvious sign of tunnel erosion

SIMPLE TEST FOR IDENTIFYING DISPERSIVE SOILS.

Field testing for dispersive soils can be conducted by observing the behaviour of air dried soil aggregates in distilled water or rainwater.

1) Collect soil aggregates (1-2 cm diameter) from each layer in the soil profile.
2) If moist, dry the aggregates in the sun for a few hours until approximately air dried.
3) Place the aggregates in a shallow glass jar or dish of distilled water or rainwater (not tap water). It may help to place the jar on black card or a dark surface. (Distilled water can be purchased at most supermarkets).
4) Leave the aggregates in water without shaking or disturbing them for 1 hour.
5) Observe and record if you can see a milky ring around the aggregates. Don't worry if the soil collapses or bubbles (figure 4).

Caution: Aggregates may not disperse when they should if they haven't been sufficiently dried. Importantly, while the presence of a milky halo indicates the presence of dispersion, the absence of a milky halo does not necessarily mean that soil will not disperse, especially after disturbance. Further testing using an approved Australian Standard technique may be required.

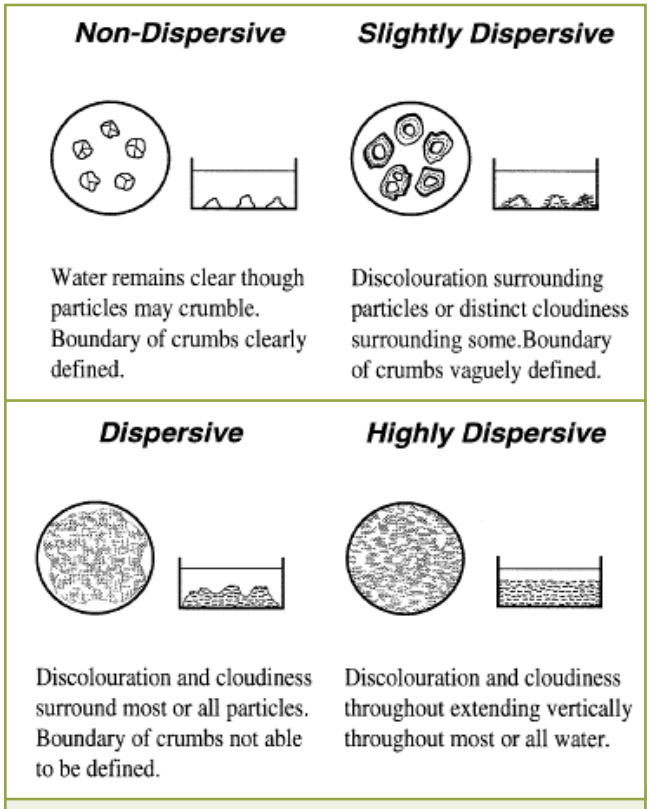

Figure 4. Field test for aggregate dispersion (Sorensen 1995).

4.0 ACTIVITIES THAT INCREASE THE RISK OF INITIATING TUNNEL EROSION

In almost all cases tunnel erosion results from some form of disturbance which allows rainwater to come into direct contact with dispersive subsoils. Activities that increase the risk of exposing dispersive subsoils to rainfall include;

- Removal of topsoil.
- Subsoil excavations (cut and fill).
- Supply of services by trenches.
- Construction of roads and culverts in dispersive soils
- Sewage and grey water disposal systems in dispersive soils
- Dam construction from dispersive clays.

Changes to hydrology, such as concentration of flow in culverts, runoff from hardened areas and ponding of rainfall may also increase the likelihood of tunnel erosion.

Figure 5. Piping failure or tunnel erosion in a dam constructed from soils derived from Permian mudstone. This dam is known to have failed on first filling. The image was taken from the dam floor.

5.0 STRATEGIES TO REDUCE RISK ASSOCIATED WITH DISTURBANCE OF DISPERSIVE SOILS

In order to prevent or repair tunnel erosion it is important to understand that unlike other forms of erosion, tunnel erosion results from chemical processes associated with dispersion of sodic subsoils. The risk of initiating tunnel erosion during construction or development of land containing dispersive soils can be minimised by;

- Identifying and avoiding disturbance to areas with dispersive subsoils.
- Minimising excavation of dispersive soils.
- Not allowing water to pond on the soil surface, or exposed subsoils.
- Keeping dispersive soils buried under topsoil.
- Maintaining vegetation cover.
- Use of gypsum or hydrated lime at appropriate rates.

Figure 6 (a). Tunnel erosion resulting from construction of a culvert in dispersive clay (b). Tunnel erosion caused by installation of optical fibre cable in dispersive soil.

RECOMMENDATIONS FOR REDUCING THE RISK OF TUNNEL EROSION IN PERI-URBAN AREAS

- Where possible do not remove or disturb topsoil or vegetation.
- Ensure that dispersive subsoils are covered with an adequate layer of topsoil.
- Avoid construction techniques that result in exposure of dispersive subsoils.
- Do not allow rainwater to pond or sit on exposed dispersive subsoils.
- Use alternatives to 'cut and fill' construction such as pier and post foundations.
- Where possible avoid the use of trenches for the supply of services i.e., water & power.
- If trenches must be used, ensure that repacked spoil is properly compacted, treated with gypsum and topsoiled.
- Consider alternative trenching techniques that do not expose dispersive subsoils.
- Ensure runoff from hard areas is not discharged into areas with exposed dispersive soils.
- If necessary create safe areas for discharge of runoff.
- If possible do not excavate culverts and drains in dispersive soils.
- Ensure that culverts and drains excavated into dispersive subsoils are capped with non-dispersive soil / spoil mixed with gypsum and vegetated.
- Avoid use of septic trench waste disposal systems. Consult your local council about the use of above ground treatment systems.
- Where possible do not construct dams from dispersive soils, or in areas containing dispersive soils.
- If dams are to be constructed from dispersive clays, ensure you consult an experienced, qualified civil engineer or soil specialist before commencing construction.

With all forms of construction on dispersive soils, ensure you obtain advice and support from a suitably experienced and qualified soil professional or civil engineer before commencing work.

6.0 FURTHER INFORMATION

Comprehensive information on the management of dispersive soils in Tasmania is available in the companion document '*Dispersive Soils and Their Management : Technical Reference Manual*'. Hardie 2008, DPIW, Tasmania

Dispersive soils - high risk of tunnel erosion. Fact Sheet 2. Soil and water management on construction sites series, Department of Tourism, Arts and the Environment (DTAE).

Seek advice from your local council, the Department of Primary Industries and Water (DPIW), a suitably qualified and experienced soil specialist, or a civil engineer.

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