GEO-ENVIRONMENTAL SOLUTIONS

CONTAMINATION MANAGEMENT PLAN (CMP)

2 Invermay Road, Invermay. June 2019

For the Proposed *UTAS Building 3*

For John Wardle Architects

Proposed Building 3 – Student Services and Library Building,
design by John Wardle Architects

DOCUMENT CONTROL

Title	Version	Date	Author	Reviewed
Construction Management Plan, *Footprint of Building 3*; 2 Invermay Road, Invermay Tasmania	Version 1	20 June 2019	Sarah Joyce	John Paul Cumming

1 Introduction

Geo-Environmental Solutions Pty. Ltd. (GES) of 29 Kirksway Place, Battery Point, Tasmania were engaged by *John Wardle Architects* (the 'Client') on behalf of their client *University Of Tasmania* to prepare a site Contamination Management Plan (CMP) for 2 Invermay Road, Invermay in the footprint of Building 3 – the proposed student services building - hereby referred to as 'The Site'.

Given the contamination risks, as per the Launceston City Council and Tasmanian Interim Planning Scheme (IPS), there is a requirement that this CMP document is implemented and followed to mitigate any adverse impact upon human health or the environment as a result of the proposed works.

1.1 Background

Historically the entire site hosted Inveresk Railyards. GES completed an Environmental Site Assessment (ESA) report for the site in June 2019 which included a health risk assessment to determine potential soil contamination risks which may arise from the proposed commercial building development and associated works.

1.2 Site Details

Site details are presented in Table 1 and the site investigation area is presented in Figure 1.

Table 1 Site Details

INVESTIGATION AREA LOCATED: Footprint of Proposed Building 3
APPROXIMATE INVESTIGATION AREA approximately 1,490m^2
TITLE REFERENCES PID 3389971 Title Reference 174633/2
SITE OWNER LAUNCESTON CITY COUNCIL
SITE ELEVATION & GRADIENT Elevation at the range from 2.2 to 2.5m AHD.
SITE SURFACING The surface of the site is an asphalt carpark.
PREVIOUS LANDUSE Commercial – formally hosted the Inveresk Railyards.
SITE ZONING The site is *Particular Purpose use* under the Launceston Interim Planning Scheme, 2015. Precinct Map: Cultural and Public Purpose
SITE LAND USE Commercial premises
PROPOSED LAND USE Commercial
SURROUNDING LAND USE: *Particular Purpose use* consistent with zoning

Figure 1 Aerial Photograph of Current Site Conditions (c/o Google Earth).

1.3 Objectives

The objective of this CMP is to comply with LCC IPS requirements. The purpose of this CMP is to:

- Identify the site hazards associated with contaminated soil exposure;
- Minimise risks to site workers and the environment; and
- Provide advice on and advise of safety measures to be adopted during future excavation or construction works at the site.

1.4 Scope of Works

The scope of work for the CMP is to produce a guidance document that includes information in relation to identifying measures and outlining procedures to minimise human health hazards and potential environmental impacts during all phases of site works including demolition of the existing carpark, additional soil testing for soil disposal purposes, excavation, construction and post construction future trench works at the site. This report is intended to;

- Minimise potential adverse environmental consequences associated with exposing contaminated soils. The most significant and direct pathway is through soil erosion into stormwater drains which feed into the marine environment of the North Esk River and the River Tamar.
- Minimise potential health risks from the exposure of contaminated soil during demolition and excavation works. Contaminated soil may be spread onsite and offsite through various mechanisms including foot traffic, vehicle movements, dust erosion as well as stormwater erosion.
- Provide guidance for management of soil for onsite reuse or off-site soil disposal in accordance with IB105 guidelines.

1.5 Environmental Regulatory Requirements

Key regulations, legislation and policies considered most applicable to soil and groundwater management during any intrusive site works (excavation, construction or maintenance) include:

- Environmental Management and Pollution Control Act (1994).
- Environmental Management and Pollution Control (Waste Management) Regulations 2010.
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010
- Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (Version 3 2018), EPA Tasmania.
- NEPM (2013) National Environment Protection (Assessment of Site Contamination) Measure, 1999 as amended 2013.

- CRC CARE (2011) – Technical Report No. 10 – Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, September 2010. Friebel, E., Nadebaum, P. & GHD Pty Ltd.
- ANZECC (2000) – Australian and New Zealand Environment & Conservation Council – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- DPIWE (1997) – State Policy on Water Quality Management, 1997.
- Australian Standard: AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds
- Australian Standard: AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances

1.6 Responsibility of Implementation

It will be the responsibility of the owner(s) of the site to implement this CMP. The owner(s) of the site may at times expressly delegate responsibility for site management as appropriate. The site owner(s) retains overall responsibility for implementation of this CMP and any modifications required to this CMP should site conditions change.

The owner(s) of the site are responsible for the distribution of this CMP to any contractors working on site associated with the site redevelopment and these contractors must comply with the requirements of this CMP.

To manage potential health risks, the advice stipulated in this CMP should be followed by all persons involved in works or other activities at the site that may result in the disturbance and/or excavation of soil.

2 Background Environmental Site Assessment Information

2.1 Conclusions from the ESA

The following conclusion were made in the ESA (GES, 2019):

- The site hosted the former Inveresk Railyards.
- The investigation area is underlaid by quaternary sediments and is situated 2.2-2.5m above sea level.
- The footprint of the proposed Building 3 has contamination likely to be associated with the former rail line that intersected the site as well as two former underground fuel storage tanks that were situated approximately 20m north of Building 3's footprint. It was previously reported that surface material was removed at the time the railway infrastructure was removed in 1995 (SEMF, 1995).
- The following trends were observed in the soil results:
    - Shallow samples; 0.5-0.6m bgs had consistently higher levels of Arsenic, Copper and Zinc and hydrocarbons;
    - Deeper samples; 1.5-1.6m bgs has consistently higher levels of Beryllium and Chromium;
    - BH01 and BH07 had the highest levels of hydrocarbons and to a lesser extent but noticeably BH02.
    - There was one health investigation level exceedances for land use C recreational use, this was for Arsenic at 0.5-0.6 m bgs in BH03.

2.2 Soil Assessment Criteria

The reported soil analytical results were compared to the following relevant investigation guidelines suitable for assessment of soil contamination:

NEPM (2013) Schedule B1, Guideline on Investigation Levels for Soil.

- Health Investigation Limit (HIL D) – Commercial Land Use (assessing dust inhalation & soil ingestion risk)
- Health Screening Limit (HSL D) – Commercial Land Use (assessing petroleum hydrocarbon vapour inhalation risk)
- Health Investigation Limit (HIL C) – Recreational Land Use (assessing dust inhalation & soil ingestion risk to neighboring site users during the carpark demolition, excavation phase)
- Ecological Investigation Levels (EIL's) - have been developed for selected metal and organic substances in and commercial & industrial setting. Threshold limits are specific to select sample physical and chemical properties.
- Ecological Screening Levels (ESL's) - have been developed for organic petrochemical substances in urban residential and open spaces land use setting. Threshold limits are specific to select sample physical properties.

EPA Tasmania (2018) Information Bulletin 105 (IB105).

- Classification and Management of Contaminated Soil for Disposal, Version 3 (2018)

CRC CARE Technical Report No. 10 (Friebel & Nadebaum 2011)

- Health Screening Limit (HSL D) – Commercial Land Use (assessing petrochemical dermal contact risk in an industrial setting)
- Health Screening Limit (HSL C) – Recreational Land Use (assessing dust inhalation & soil ingestion risk to neighboring site users during the carpark demolition, excavation phase).

2.3 Invasive Site Investigations

One site visit was conducted to complete the ESA. Site investigation works comprised of soil bore drilling and sampling which is summarised in Table 2 and Figure 2. A total of 16 primary soil samples were collected and selected for analysis. QA/QC samples included 1 '*duplicate*', 1 Intra-lab duplicate split and 1 *Rinsate blank*.

Table 2 Summary of Site Investigation Work Dates

Scope	Data	Details
Drilling/ Sample collection	31th May 2019	Sampled BH01 – BH08; 16 Primary Samples collected and analysised Secondary Laboratory samples (ES1917553): Intra-lab duplicate split

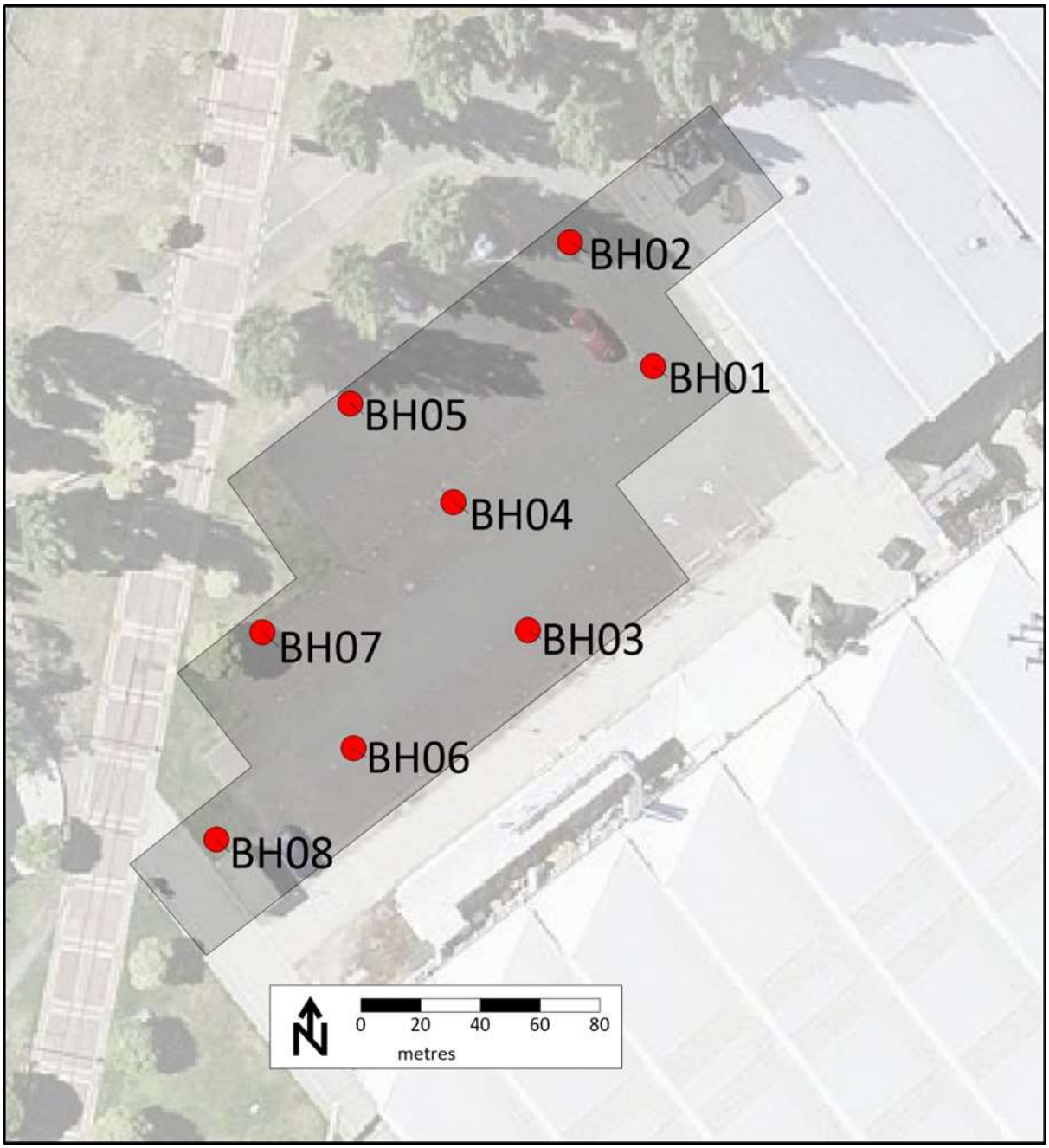


Figure 2 Borehole Plan Soil Assessment Results

2.3.1 Environmental

Ecological Screening Level Guidelines

Shallow soil (0.5-0.6 m bgs) samples had hydrocarbon contamination in most boreholes and only exceeding ESLs for TPH Fractions C^{16}-C^{34} in Borehole # 1 and to a greater depth in this hole. Historical documents that the worst of the contaminated material has already been excavated and removed.

Ecological Investigation Level Guidelines

There were four shallow soil samples, 0.5-0.6m bgs that had heavy metal detections that exceeded EIL guidelines. Details are as follows:

- BH01 copper 1x the limit
- BH02 copper 5-20x the limit
- BH03 copper, zinc 1x the limit; and Arsenic 2-5x the limit
- BH07 copper 5-20x the limit

Environmental Risks

There are no onsite ecological receptors identified. The following offsite ecological receptors have been identified:

- North Esk River, approximately 200m to the east of the investigation area which feeds into the River Tamar.

Once pavement is removed from the site, soil erosion into the stormwater system may result in environmental impact to the intertidal waters of North Esk River This will need to be managed to ensure that soil is not washed into stormwater culverts and ultimately the marine environment.

The potential for leaching has been determined to be LOW. Soil leaching into groundwater is considered LOW risk given the silty clay medium and surface water monitoring will be required to ensure discharged water does not exceed nominated ANZECC guideline limits.

Mitigation measures relating to the identified risks are detailed in Section 4.

2.3.2 Human Health

Health Screening Levels – Dermal Contact

Although there were many low level detections of hydrocarbons, there were no HSL D guidelines for *commercial land use or HSL C recreational use* for Dermal Contact in any of the samples.

Health Investigation Levels (HIL) – Dust Inhalation and Soil Ingestion

There was one HIL exceedances for land use HIL C recreational use, this was for Arsenic at 0.5-0.6m bgs in BH03. There were no HIL D commercial land use exceedances.

Health Screening Levels – Vapour Intrusion/ Trench worker

There were no *HSL D* or trenchworker guideline exceedances for assessing petroleum vapour intrusion risks.

Human Health Risks

Based on the proposed land-use and layout, the Tier 1 ESA concluded the following with respect to human health risks:

- There was an absence of volatile hydrocarbons which rules out a risk to indoor vapour risk, a risk to trench workers and/ or a dermal contact risk to construction workers.

- A low level risk of dust inhalation and soil ingestion exists to recreational users from the isolated elevated level of Arsenic in BH03 at 0.5-0.6m bgs. Which suggests that across the site there may be other instances of elevated metals.

Once pavement is removed from the site, potential offsite human health receptors will need to be considered during the carpark demolition, excavation and construction phases of the work. Consideration to wind dispersion of soil and water movement to neighbouring properties. Mitigation measures relating to the identified risks are detailed in Section 5.

2.3.3 IB105

Soil samples collected at the site were compared against EPA Tasmania (2018) Information Bulletin 105 (IB105) to assess disposal options. Findings from the assessment are presented in borehole logs (Appendix 3) and tables in Appendix 4. Most of the material was classified as Level 2 Material – Low Level Contaminated Soil due to the presence of multiple heavy metal detections and hydrocarbons in three samples.

Elevated metals above Level 1 classification included arsenic, beryllium, cadmium, copper, lead (in two samples only) and zinc. The following metals only exceeded IB105 in one sample; barium, manganese, mercury and nickel.

Material in two boreholes were classified as Level 3 material for Arsenic in BH03 0.5-0.6 and copper in BH07 0.5-0.6. Leachate testing confirmed that the leachable fraction of this material did not exceed Level 2 classification; therefore, this material can also be considered as Level 2 material.

Following leachate testing;

- All material tested is either Level 1 (clean fill) or Level 2 material (low level contaminated soil).
- The leachate testing of arsenic and copper indicates that the heavy metals present have limited mobility in water and material can be disposed of as Level 2 Material.

3 Potential Receptors

3.1 Ecological Receptors & Environmental Considerations

No sensitive terrestrial or freshwater ecosystem receptors have been identified on or near the site. The closest ecological receptor is the water source of North Esk River, approximately 200m to the east of the investigation area which feeds into the River Tamar. It is anticipated that given the proximity to the urban centre of Launceston and the greater former Inveresk Railyard will impact the water quality of the river. It will be realistic to compare groundwater/ surface water against the following guidelines during the site redevelopment:

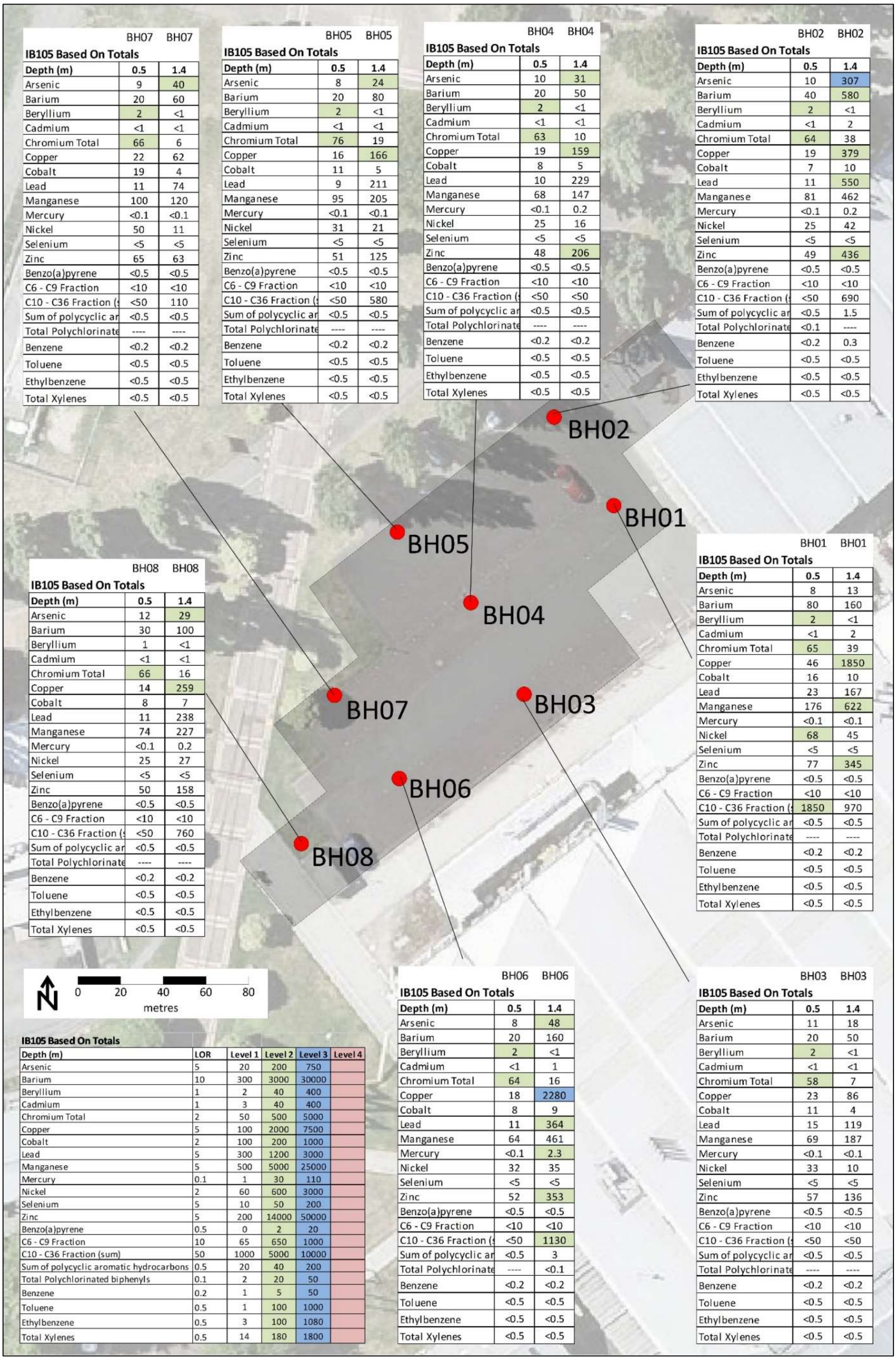
- ANZECC 2000 ecosystem protection guidelines for 90% protection of Freshwater Ecosystems
- ANZECC 2000 ecosystem protection guidelines for 90% protection of Marinewater Ecosystems

Insitu water testing is recommended to monitor groundwater and surface water across the site. If exceedances are detected, measures will need to be put in place to manage disposal of stormwater from the site.

3.2 Human Receptors and Exposure Routes

As a result, from the previous land use activities and reclamation of land, there is contamination around the across the site. Potential health exposure risks may be associated with soil excavation and management as well as general movement of soil around the site caused by foot & vehicle traffic, mobile machinery, as well as natural elements including wind and rain. Onsite and offsite exposure pathways include ingestion of contaminated soil/water and inhalation of dust.

This CMP will be put in place to minimise onsite erosion of contaminated soil to offsite human receptors which in this instance is recreational land users. All adjacent open spaces may be impacted by dust and noise during the site redevelopment work.



IB105 Based On Totals

Depth (m)	0.5	1.4
	BH07	BH07
Arsenic	9	40
Barium	20	60
Beryllium	2	<1
Cadmium	<1	<1
Chromium Total	66	6
Copper	22	62
Cobalt	19	4
Lead	11	74
Manganese	100	120
Mercury	<0.1	<0.1
Nickel	50	11
Selenium	<5	<5
Zinc	65	63
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	110
Sum of polycyclic ar	<0.5	<0.5
Total Polychlorinate	----	----
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH05	BH05
Arsenic	8	24
Barium	20	80
Beryllium	2	<1
Cadmium	<1	<1
Chromium Total	76	19
Copper	16	166
Cobalt	11	5
Lead	9	211
Manganese	95	205
Mercury	<0.1	<0.1
Nickel	31	21
Selenium	<5	<5
Zinc	51	125
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	580
Sum of polycyclic ar	<0.5	<0.5
Total Polychlorinate	----	----
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH04	BH04
Arsenic	10	31
Barium	20	50
Beryllium	2	<1
Cadmium	<1	<1
Chromium Total	63	10
Copper	19	159
Cobalt	8	5
Lead	10	229
Manganese	68	147
Mercury	<0.1	0.2
Nickel	25	16
Selenium	<5	<5
Zinc	48	206
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	<50
Sum of polycyclic ar	<0.5	<0.5
Total Polychlorinate	----	----
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH02	BH02
Arsenic	10	307
Barium	40	580
Beryllium	2	<1
Cadmium	<1	2
Chromium Total	64	38
Copper	19	379
Cobalt	7	10
Lead	11	550
Manganese	81	462
Mercury	<0.1	0.2
Nickel	25	42
Selenium	<5	<5
Zinc	49	436
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	690
Sum of polycyclic ar	<0.5	1.5
Total Polychlorinate	<0.1	----
Benzene	<0.2	0.3
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH08	BH08
Arsenic	12	29
Barium	30	100
Beryllium	1	<1
Cadmium	<1	<1
Chromium Total	66	16
Copper	14	259
Cobalt	8	7
Lead	11	238
Manganese	74	227
Mercury	<0.1	0.2
Nickel	25	27
Selenium	<5	<5
Zinc	50	158
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	760
Sum of polycyclic ar	<0.5	<0.5
Total Polychlorinate	----	----
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH01	BH01
Arsenic	8	13
Barium	80	160
Beryllium	2	<1
Cadmium	<1	2
Chromium Total	65	39
Copper	46	1850
Cobalt	16	10
Lead	23	167
Manganese	176	622
Mercury	<0.1	<0.1
Nickel	68	45
Selenium	<5	<5
Zinc	77	345
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	1850	970
Sum of polycyclic ar	<0.5	<0.5
Total Polychlorinate	----	----
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	LOR	Level 1	Level 2	Level 3	Level 4
Arsenic	5	20	200	750	
Barium	10	300	3000	30000	
Beryllium	1	2	40	400	
Cadmium	1	3	40	400	
Chromium Total	2	50	500	5000	
Copper	5	100	2000	7500	
Cobalt	2	100	200	1000	
Lead	5	300	1200	3000	
Manganese	5	500	5000	25000	
Mercury	0.1	1	30	110	
Nickel	2	60	600	3000	
Selenium	5	10	50	200	
Zinc	5	200	14000	50000	
Benzo(a)pyrene	0.5	0	2	20	
C6 - C9 Fraction	10	65	650	1000	
C10 - C36 Fraction (sum)	50	1000	5000	10000	
Sum of polycyclic aromatic hydrocarbons	0.5	20	40	200	
Total Polychlorinated biphenyls	0.1	2	20	50	
Benzene	0.2	1	5	50	
Toluene	0.5	1	100	1000	
Ethylbenzene	0.5	3	100	1080	
Total Xylenes	0.5	14	180	1800	

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH06	BH06
Arsenic	8	48
Barium	20	160
Beryllium	2	<1
Cadmium	<1	1
Chromium Total	64	16
Copper	18	2280
Cobalt	8	9
Lead	11	364
Manganese	64	461
Mercury	<0.1	2.3
Nickel	32	35
Selenium	<5	<5
Zinc	52	353
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	1130
Sum of polycyclic ar	<0.5	3
Total Polychlorinate	----	<0.1
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

IB105 Based On Totals

Depth (m)	0.5	1.4
	BH03	BH03
Arsenic	11	18
Barium	20	50
Beryllium	2	<1
Cadmium	<1	<1
Chromium Total	58	7
Copper	23	86
Cobalt	11	4
Lead	15	119
Manganese	69	187
Mercury	<0.1	<0.1
Nickel	33	10
Selenium	<5	<5
Zinc	57	136
Benzo(a)pyrene	<0.5	<0.5
C6 - C9 Fraction	<10	<10
C10 - C36 Fraction (s	<50	<50
Sum of polycyclic ar	<0.5	<0.5
Total Polychlorinate	----	----
Benzene	<0.2	<0.2
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5

Figure 3 IB105 Information

Note leachate testing for BH03 0.5-0.6 (Arsenic) and BH07 0.5-0.6 (Copper) confirmed the material can be reclassified as Level 2 Material.

4 Minimising of Potential Environmental Impacts

Potential environmental impacts during any subsurface works or excavations may be associated with:

- Soil excavation and management
- Movement of soil
- Off-site disposal of soil
- Where relevant, groundwater and surface water extraction, removal and disposal
- Importation of fill to the site
- Dust and odour
- Stormwater management and sedimentation

To minimise potential environmental impacts, all work must be conducted in accordance with the:

- The Environmental Management and Pollution Control Act (EMPCA, 1994)
- Environmental Management and Pollution Control (Waste Management) Regulations (2010),
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010, and
- The guidance set out in this plan.

4.1 Soil

4.1.1 Soil Excavation and Management

The relevant sections of the CMP should be referred to during the following phases of site work: prior to commencement, carpark demolition, additional soil testing for soil disposal, excavation, construction and ongoing future trenchwork at the site.

Prior to Commencement

Contractors and workers must be made aware of the potential soil and groundwater contamination and be familiar with the requirements of the CMP and they should also know that there may be environmental or human health consequences that result from noncompliance which may incur a fine from the EPA Tasmania.

Contractors must prepare one or more of the following: a site-specific Health and Safety Plan, a Job Safety Analysis (JSA) or a Safe Work Methods Statement (SWMS) covering their workers at the site for any reasonably anticipated risks.

Work procedures conducted on the site must be in accordance with relevant Occupational Health and Safety (OH&S) Regulations. It is the responsibility of the principal contractor that site workers are made aware of the OH&S issues at the site.

For best practices of soil and water management; Fact Sheets have been included in Appendix 2.

Carpark Demolition

The time between site demolition and site resurfacing is a period where there is a heightened risk of offsite spread of contaminated soil. During this time there is expected to be the greatest chance of offsite spread of contaminates through soil leaching, dust generation, as well as soil erosion from vehicle and foot traffic, precipitation and stormwater runoff.

Limiting the exposure of soil surfaces by keeping pavement in place for as long as possible, this includes limiting the length of time the service trenches and foundation excavations remain open. Demolition site work may involve the relocation of underground service infrastructure.

It should be noted that asphalt surfaces often have hydrocarbon contamination, so any asphalt surface material should be managed separately to other materials.

Additional Soil Testing

If additional testing is required the following procedures must be carried out prior to, during and following the completion of any soil excavation and/or surface cover disturbance at the site. Note, Surface coverings of concrete and asphalt should remain intact during this phase of work as much as practically possible.

Soil Excavation & Stockpiling

Soil exposed and excavated from the site must be managed so as not to cause environmental harm in accordance with the Environmental Management and Pollution Control (Waste Management) Regulations (2010) and the Environmental Management and Pollution Control Act (EMPCA, 1994). Harm can be caused from contaminated soils leaching further underground, leaving the site through wind (as dust), carried off site with rain (as runoff stormwater).

Stockpiles should be sampled by a suitably experienced and qualified environmental assessor and analysed using a NATA registered laboratory to determine their contamination status, consistent with the procedures described in Section 4.1.3.

In order to prevent soil leaving the site the following erosion control measures must be followed:

- Develop a stabilized site access (Fact Sheet 12 Appendix 2);
- Clean up any soil spilt on roads adjoining the site.
- Ensure vehicles and equipment are free from excess soil when leaving the site, to avoid tracking soil off-site.
- Establish an equipment wash down area if necessary (Fact Sheet 13 Appendix 2);

Soil stockpiles must be managed in accordance with the Environmental Management and Pollution Control (Waste Management) Regulations, 2010 and best practice guidelines. The following are recommended:

- It is recommended that separate stockpiles be constructed to separate varying levels of apparent soil contamination, if encountered. This will likely enable cost savings during disposal phases.
- The source area of stockpiled soil must be noted on a plan for reference to ensure the movement of potentially contaminated soil is tracked (see Section 4.1.2).
- Soil should be classified for disposal or reuse in accordance with EPA Tasmania (2018) Information Bulletin 105 (IB105) before being transported off site (see Section 4.1.3) unless being transported to a facility approved by the EPA;
- Always keep stockpiles covered and sealed if possible (refer Section 4.1.5 Dust and Odour Control & Fact Sheet 9 Appendix 2).
- If stockpiled for greater than 12 hours, should be covered with an impermeable layer (eg. PVC plastic 2mm thick) to prevent the contents being affected by wind or rain;
- All soil stockpiles must have sediment control devices (silt fencing) around any temporary or longer-term stockpiles (Fact Sheet 14 Appendix 2)

Construction

If there are any changes to the plans during the construction phase and additional excavations are required, the CMP should be revisited. Additional soil and water testing may be required, or current results may need to be reassessed against different criteria.

Soil and water measures must remain in place as long as soil is exposed at surface or in excavations including footing for the lift, stairs and service trenches.

Following Completion of Excavation Works

Equipment used for excavation of potentially contaminated soil must be cleaned of loose soil prior to use in another area. The loose soil must be contained within the stockpiles at the site.

Future Trench Work

It is anticipated that over time, future trench workers or contractors will visit the site from time to time as services require repairs or new infrastructure is required. All contractors should be made aware of the potential contamination that may be encountered at the site and should be provided with a copy of this document.

4.1.2 Movement of Soil

If soil is going to be removed from site is to be assessed and sampled by an Environmental Consultant and results compared against Information Bulletin 105 (IB105) for Classification and Management of

Contaminated Soil for Disposal. It is not necessary for undisturbed soil that remains on site to be classified against IB 105.

Movement of soil at the site must be tracked to ensure its origin, contamination status and fate is documented. An example soil tracking form is provided in Appendix 5. Soil tracking forms are to be completed by the Site Foreman/supervisor of the site.

The source and destination of any soil moved around the site or off-site can be identified using references to development features, or a site grid. The appearance of soils encountered during excavation must be noted and checked to confirm they are consistent with those materials noted in the preliminary assessment. Soil appearance checks must be conducted by the Site Foreman or delegated to a suitably experienced and trained person.

4.1.3 Off-site Disposal of Soil

Waste soil generated at the site must be managed, transported and disposed in accordance with the Environmental Management and Pollution Control (Waste Management) Regulations 2010 and the Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010.

Aspects of these regulations related to classification and disposal of contaminated soils are summarised in Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (November 2018), published by EPA Tasmania.

See Appendix 5 for the comparison of soil analytical results from the ESA against IB105 plus IB105 in full. It is anticipated some heavy metal contamination will be encountered across the site.

Although minimal excavation is anticipated, given the elevated levels of metals encountered at the site, GES recommends that all soil excavated at the site is stockpiled systematically. Unclassified material will require systematic sampling for contamination levels. Soil flagged for landfill disposal is to be assessed by an Environmental Consultant and results compared against *Information Bulletin 105 (IB105) for Classification and Management of Contaminated Soil for Disposal.*

Soil samples would need to be obtained from the excavated soil and must comply with the sampling frequency in the EPA guidelines for off-site soil disposal.

Where excavated soil requires off-site disposal, the following is required:

- Communicate with the environmental consultant as early as possible. This will enable classification to be undertaken and relevant documentation prepared, prior to the proposed disposal date.
- Ensure that excavated soil volumes and origins are documented, to assist with classification for off-site disposal.
- Separate soils based on appearance and location of excavation. This will minimise the volume of higher category waste for dispose, and in turn minimise costs associated with disposal.
- Soils must be classified in accordance with Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (November 2018), published by EPA Tasmania or as updated.
- Where applicable, an application to transport excavated soil to an approved intermediate soil waste transfer facility for offsite IN105 characterization as approved by the Director, EPA Tasmania for review in accordance with Environmental Management and Pollution Control (Waste Management) Regulations, 2010 and the Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010.
- An application for disposal to an approved waste facility must be submitted to the Director, EPA Tasmania for review in accordance with Environmental Management and Pollution Control (Waste Management) Regulations, 2010 and the Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010.
- If approved, waste soils must be transported to the approved facility by a Controlled Waste Handler approved by EPA Tasmania.
- The Controlled Waste Handler must meet requirements for waste collection as well as disclosure of tracking information.

4.1.4 Importation of Fill Material

Fill imported to the site must meet Tasmanian EPA (IB105) "Fill Material" and NEPM HIL 'A' criteria (NEPM, 2013). Fill must be adequately sampled and analysed to demonstrate it meets Tasmanian EPA (IB105) "Fill Material" criteria prior to import to the site, as set out in this plan. A suitably qualified environmental consultant must conduct sampling and analysis.

A qualified environmental consultant must assess that the contamination status of the fill is suitable for use at the site. The environmental consultant shall inspect the source location of the fill. The material must be sampled and analysed at a minimum rate of one sample per 25 m^3 bulk soil volume and a minimum of 3 samples.

4.1.5 Dust and odour control

Generation of dust can spread contaminated soil and pose a risk to human health risk onsite and offsite and off-site ecological receptors. Fact Sheet 18 in Appendix 2 should be used as a guide for managing dust onsite. Measures that can be undertaken to assist in minimising the generation of dust and limit the amount of soil leaving the site include:

- Minimise movement of equipment on the site.
- Minimise excavation and movement of soils.
- Use a water spray sparingly to dampen work areas if excess dust is generated.
- Use a water spray sparingly to dampen soil prior to and during excavation if excess dust is generated.
- Avoid soil excavations that create dust on windy days.
- Always keep soil stockpiles covered where possible, with an impermeable membrane (eg. plastic sheeting) to minimise generation of dust, release of odours and to limit runoff of sediment.
- Avoid extended stockpiling of soil.
- Consider the use of dust barriers such as hessian or cloth screening.

4.2 Groundwater & Stormwater Management

To minimise potential migration of contaminants into the marine environment, all work must be conducted in accordance with the State Policy on Water Quality Management 1997 and the guidance set out in this plan.

Whilst groundwater was not encountered during site drilling to depths of 2m below the ground surface there is a possibility that shallow seasonal groundwater maybe encountered during any deeper excavations.

The following needs to be put in place to manage groundwater and surface water at the site (if the site asphalt cover is removed and the soil exposed):

- Surface water at the site will need to bypass a main primary surface water sample collection point which will be used to test water before it enters the stormwater system;
- Sampled by an Environmental Consultant and compared against ANZECC 2000 guidelines for 90% protection of marine water ecosystems and freshwater ecosystems and TasWater's disposal requirements.
- Sampling should occur when rainfall exceeds 10 mm within a 24 hour period for the Launceston gauging.
- In the event there is a trigger, management measures will need to be put in place to collect water existing the site to ensure compliance with identified ANZECC 2000 guidelines.

4.3 Surface Water and Sediment Control

Measures to minimise the potential for contamination of stormwater and migration of contaminants include:

- Silt fencing is required around the perimeter of the site to reduce the extent of soil erosion from wind and rain (Fact Sheet 14 Appendix 2).
- Where possible overland flow should be diverted away from excavation workings to reduce the risk of surface waters becoming impacted as a result of mixing with contaminated soil (Fact Sheet 7 Appendix 2);
- The site will need to be regularly inspected for signs of scour including around all earthen drains (Fact Sheet 11 Appendix 2) and site slopes. Where scour is identified, erosion should be controlled with the use of erosion control matts and blankets (Fact Sheet 8 Appendix 2)
- Collect stormwater on-site and allow suspended solids to settle before disposal in accordance with EMPCA and/or local Water Authority requirements (Fact Sheet 17 Appendix 2).
- Control measures such as cut-off drains/mounds and or sand bags will be required to prevent soil and water from existing the site boundary at locations which are not identified as a legal point of discharge (LPOD). Measures will need to be put in place to ensure that water does not exist on to neighbouring properties.
- Silt traps will be required around all drainage pits to prevent soil from entering the stormwater system (Fact Sheet 15 Appendix 2). Soil collected around the pits will need to be excavated and placed into skip bins for disposal with other excavated soil. The silt traps will need to be regularly maintained and checked to ensure they are not discharging sediments into the stormwater.
- Install drainage and/or grade soil surfaces to minimise pooling of water on exposed soils. Pooling surface water may be contaminated and can be managed through placement of aggregate.

4.4 Spill Avoidance

The following measures are recommended to manage preventable spills and contamination during site redevelopment works:

- Avoid conducting vehicle or machinery maintenance on-site.
- Ensure any fuel, oil or other chemicals are stored safely and securely in a temporary bunded area and that storage containers are absent from leaks and cracks.

- Repair or remove any leaking containers or machinery from the site immediately.
- Always have a complete spill kit onsite during site works.
- Clean up any spilt fuel, oil or other chemicals as soon as practically possible.
- Check sediment control measures regularly (at least daily) and clean and maintain as necessary.
- Inspect sediment control measures more frequently during rain periods, to check they are adequate for site conditions.

5 Minimisation of Risk to Health of Site Workers

Work procedures conducted on the site must be in accordance with relevant Occupational Health and Safety (OH&S) Regulations. It is the responsibility of the principal contractor that site workers are made aware of the OH&S issues at the site.

Engaged companies/contractors must prepare a site-specific Health and Safety Plan covering their workers at the site. In terms of managing exposure risks, given the complexity in defining where soil and contamination risks are located onsite, workers need to assume that all soil and water encountered at the site is contaminated.

5.1 Exposure Routes

5.1.1 Soil

Potential hazards for site workers associated with the presence of contaminants primarily in fill material at the site may be encountered during excavation or construction works must be considered as part of the overall Health and Safety Plan for the site, including low risk to the following:

- Ingestion of contaminated soil.
- Inhalation of dust.
- Dermal (skin) contact

5.1.2 Groundwater and Surface Water

Although groundwater was not encountered, it is anticipated that there may be a potential hazard from contact with any water on site encountered during excavation works for site workers associated with the presence of contaminants in soil mixing with surface or groundwater. This must be considered as part of the overall Health and Safety Plan for the site, including:

- Ingestion of contaminated water.
- Dermal (skin) contact.
- Inhalation of petroleum hydrocarbon vapours (low risk)

5.2 Control measures

Personnel working at or visiting the site during any construction (including carpark demolition and excavation) works must be provided with an induction briefing, based on the example Site Induction Record and GES cover note is provided in Appendix 6. This induction record may be incorporated into the general site induction procedure. The principal contractor is responsible for ensuring that workers are aware of contamination issues at the site.

Measures that must be undertaken to manage exposure of site workers to contaminants include:

- Avoid handling of potentially contaminated soil and/or water.
- Wash hands before eating, drinking or smoking.
- Avoid activities that may introduce soil and/or water to the mouth, such as nail biting.
- Store and consume food and drink in a designated clean area.
- Remove soiled clothing and footwear before entering a designated clean area and before leaving the site.
- Use personal protective equipment (PPE) as required. In addition to hard hats, safety boots, safety glasses and hearing protection, this equipment may include:
    - Impermeable (latex or nitrile) gloves, if handling potentially contaminated soil and/or water

  - Long sleeved shirt and long trousers
  - Dust masks
  - Vapour masks
- Store personal protective equipment in a clean place to avoid contamination.
- Replace gloves and masks regularly, and other equipment as required.
- The principal contractor must ensure that site workers and visitors are provided with:
  - Site safety induction briefing.
  - Adequate hand washing facilities.
  - A designated clean area for storage and consumption of food and drink.
  - Adequate personal protective equipment, as described above.

6 Mitigation measures for development

Based on the findings of the ESA (GES, 2019) it was concluded that risk mitigation measures would be required to control soil ingestion and dust inhalation risks to recreational users of the site during construction and post construction.

6.1 Physical separation layers

In the areas of the site not covered by a permanent hardstand surface (such as bitumen, concrete or building slabs) capping measures for the various landscaping finishes are required to prevent contact with the underlying soil as a precautionary measure.

The physical cap must ensure that future site users do not meet the potentially contaminated soil. The construction of the cap can be tailored to the specific area use, considering the potential for incidental digging and the action of erosion or tree roots. Some examples of suitable capping layers are described in Table 3 below.

Table 3 Examples of Capping Layers

Surface Landscape Type	Area/ Land Use	Characteristic	Capping Requirements
Concrete Path	Footpaths and high wear areas	High traffic areas	Suitable in a range of areas due to the ability to provide a level surface. Provides effective barrier to underlying soils.
Asphalt / Bitumen	Carpark and driveway area	High traffic areas	Suitable in a range of areas due to the ability to provide a level surface. Provides effective barrier to underlying soils.
Re-instated Grass	Around footpaths and high wear areas	High traffic area for general public and dust/soil exposure risks from maintenance	At least 0.2m of clean soil and development and maintenance of good grass cover.
Garden Bed	Around footpaths and high wear areas	Maintenance/gardening is conducted. Covers small areas and includes plants and shrubs that stabilize soil movement.	In relatively flat areas, clean fill and topsoil should be placed to the depth of likely digging and root penetration (approximately 0.3 m). If contaminated soil remains beneath the garden beds (i.e. it is not all removed from the area) then a geotextile should be placed between the clean fill and contaminated soil. Tanbark / timber mulch would be placed over clean fill and topsoil mixture.

7 CMP review and reporting

7.1 Review

Following changes in the understanding of site contamination conditions, work requirements, legislation, or work scope (including excavation or construction), this CMP must be revised and reviewed by a competent person prior to use for the proposed works. In the event that no changes to the above-mentioned conditions occur, the CMP should be reviewed every 2 years. The CMP must be revised to reflect any changes and provide adequate procedures for ensuring continued worker, public and environmental safety and compliance with legislation.

7.2 Reporting

It is recommended that Site Management maintain documentation demonstrating that the requirements of this CMP have been met. Such documentation is likely to include:

- Site survey levels.
- Soil tracking records.
- Repair details to vapour barrier or venting system (if required).
- Volumes of fill removed and imported to the site.
- Records of complaints, notices or breaches of the CMP requirements and an outline of actions taken.
- Signed induction records to the site which demonstrate workers commitment to following the CMP.
- Evidence that imported fill meets Tasmanian EPA (IB105) "Fill Material" and HIL C' criteria (NEPM, 2013).
- Evidence that excavated fill was disposed of in accordance with EMPCA (1994) requirements.

8 Concluding Statement

It is concluded that provided that specific remediation and protection measures identified in this document are implemented before any use and/or excavation commences:

- The land is suitable for the intended use;
- The proposed excavation works will not adversely impact on human health or the environment.

9 SUMMARY OF ROLES AND RESPONSIBILITY

Site Owner	The owner(s) of the site are responsible for the distribution of this CMP to any building or development contractors working on site and these contractors must also comply with the requirements of this CMP. There is a responsibility to ensure the soil and water prescriptions are put in place prior to site carpark demolition works, and that they remain in place when surface coverings are removed. Post the site redevelopment, the site owner(s), who may delegate to a site operator is responsible and must inform future site contractors and trench workers of the CMP and the requirements to follow its contents.
Site Manager during site redevelopment (including following phases of site work: prior to commencement, carpark demolition, additional soil testing, excavation, construction and future trenchwork)	Responsible for the preliminary assessment of potential contamination discovered and assessing whether further action is required. The Site Manager is responsible for ensuring the induction of Site Operatives, assessing the adequacy of quarantine measures and contacting the relevant Consultant and/or Contractors where appropriate. Potential offsite migration of surface water and soil needs to be assessed. The site manager is to contact the Environmental Consultant to arrange for surface water to be tested in accordance with ANZECC (2000) and Stockpiled soil to be tested in accordance with IB105. The site manager is to become familiar with IB105 and determine the appropriate actions for soil transport and disposal following receiving final laboratory testing results. All soil must remain onsite until fate of the soil material is determined.
Site Operatives	During the works, the Site Operative will be vigilant for potential contamination. Where potential contamination is identified, Site Operatives will quarantine the area and inform the Site Manager. An Environmental Consultant may be required to assess the site. Potential offsite migration of surface water and soil needs to be assessed during and after rain events. The site operator is to notify the site manager when soil is ready for testing to discern the appropriate disposal actions.
Environmental Consultant	The services of an Environmental Consultant will be required for additional drilling and soil testing in accordance with IB105. The Environmental Consultant may also be required to sample temporarily stored groundwater. If unexpected or gross soil contamination is encountered (not identified in the ESA), an Environmental Consultant will need to be engaged to assess the potential contamination find, undertaking any necessary sampling and delineation, if required, developing a remedial scope and validating remediation. The Environmental Consultant must have appropriate qualifications and expertise in environmental assessment (e.g. an experienced environmental scientist, environmental soil scientist, environmental geologist or environmental engineer). All findings and conclusions will be reported, as appropriate, to the satisfaction of the Site Manager and the Site Owner

LIMITATIONS STATEMENT

This Contamination Management Plan has been prepared in accordance with the scope of services between Geo-Environmental Solutions Pty. Ltd. (GES) and *John Wardle Architects* (the 'Client') on behalf of their client. To the best of GES's knowledge, the information presented herein represents the Client's requirements at the time of printing of the Report. However, the passage of time, manifestation of latent conditions or impacts of future events may result in findings differing from that described in this Report. In preparing this Report, GES has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations referenced herein. Except as otherwise stated in this Report, GES has not verified the accuracy or completeness of such data, surveys, analyses, designs, plans and other information.

The conclusions described within this report are based the results of analysis from the Environmental Site Assessment by GES (2019) and an assessment of their contamination status. The scope of the ESA does not allow for the review of every possible soil and groundwater contaminant over the whole area of the site.

This report does not purport to provide legal advice. Readers of the report should engage professional legal practitioners for this purpose as required.

No responsibility is accepted for use of any part of this report in any other context or for any other purpose by third party.

REFERENCES

ANZECC (2000) Australian and New Zealand Environment & Conservation Council – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Australian Standard: AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds

Australian Standard: AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances

CRC CARE (2011) – Technical Report No. 10 – Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, September 2010. Friebel, E., Nadebaum, P. & GHD Pty Ltd.

DPIWE (1997) – State Policy on Water Quality Management, 1997.

Environmental Management and Pollution Control (Waste Management) Regulations 2010.

Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010

Environmental Management and Pollution Control Act (1994).

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Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (Version 3 2018), EPA Tasmania.

NEPM (2013) National Environment Protection (Assessment of Site Contamination) Measure, 1999 as amended 2013.

Stephenson EMF Consultants, Engineers and Managers [SEMF]; 1995. Inveresk Railway Workshops Development. Monthly Report No. 4 October 1995. ADV7 Pipeline Excavation

Stephenson EMF Consultants, Engineers and Managers [SEMF]; 1995. Inveresk Railway Workshops Development. Monthly Report No. 3 September. ADV6 Pipeline Excavation

Appendix 1 GES Staff

Geo-Environmental Solutions (GES) is a specialist geotechnical and environmental consultancy providing advice on all aspects of soils, geology, hydrology, and soil and groundwater contamination across a diverse range of industries.

Geo Environmental Solutions Pty Ltd:

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- Soil Technician
- 6 years' experience in hydrocarbon and heavy metal contamination sampling of soils and groundwater.

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- Soil & Environmental Scientist
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- Soil Scientist
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Appendix 2 Soil and Water Fact Sheets

Soil & Water Management on Large Building & Construction Sites

What is this?

Sediment and erosion control measures are typically required for subdivisions and larger sites. The construction of subdivisions involves breaking land into smaller lots and installation of related services (roads, water, sewerage, power etc.). Due to the scale of land clearance and excavation, subdivision construction activities can cause excessive erosion and sediment loads in runoff, compared with the disturbance of building single house lots.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 1

WHAT DO I NEED TO DO?

All works undertaken during subdivision construction are normally 'controlled' through the principle contractor and site manager. This means the risks of erosion can be readily managed through appropriate guidance and supervision. Compared with the allotment building phase where there are different building contractors and subcontractors present on any given allotment it is easier to manage erosion and prevent sediment runoff at the subdivision construction phase.

Submit a Soil and Water Management Plan:

Subdivisions or activities that create greater than 250 m^2 of ground disturbance may need to submit a drawn Soil and Water Management Plan (SWMP) to council as a requirement of their planning permit **(see Fact Sheet 3).**

On the SWMP clearly define and document who is responsible for maintaining the sediment and erosion control measures (installed during the subdivision phase) that will be used in the allotment building phase.

When designing subdivision works:

1) Ensure that the subdivision conforms to the natural limitations presented by the topography and the soil so as to reduce the potential for soil erosion.
2) Make sure that land clearing is only being undertaken in conjunction with the development of each stage.
3) Develop the site in increments of workable size such that adequate sediment and erosion control measures can be provided as the subdivision progresses. The smallest practical area of land should be exposed at any one period of time.
4) Coordinate the sediment and erosion control measures with the different subdivision construction phases.
5) Limit soil exposure to the shortest feasible period of time.
6) Keep removed topsoil for respreading over the developed area.
7) Retain and protect natural vegetation wherever practical.
8) Install larger sediment controls i.e. sediment basins if site conditions are suitable.
9) Manage wind-borne erosion.

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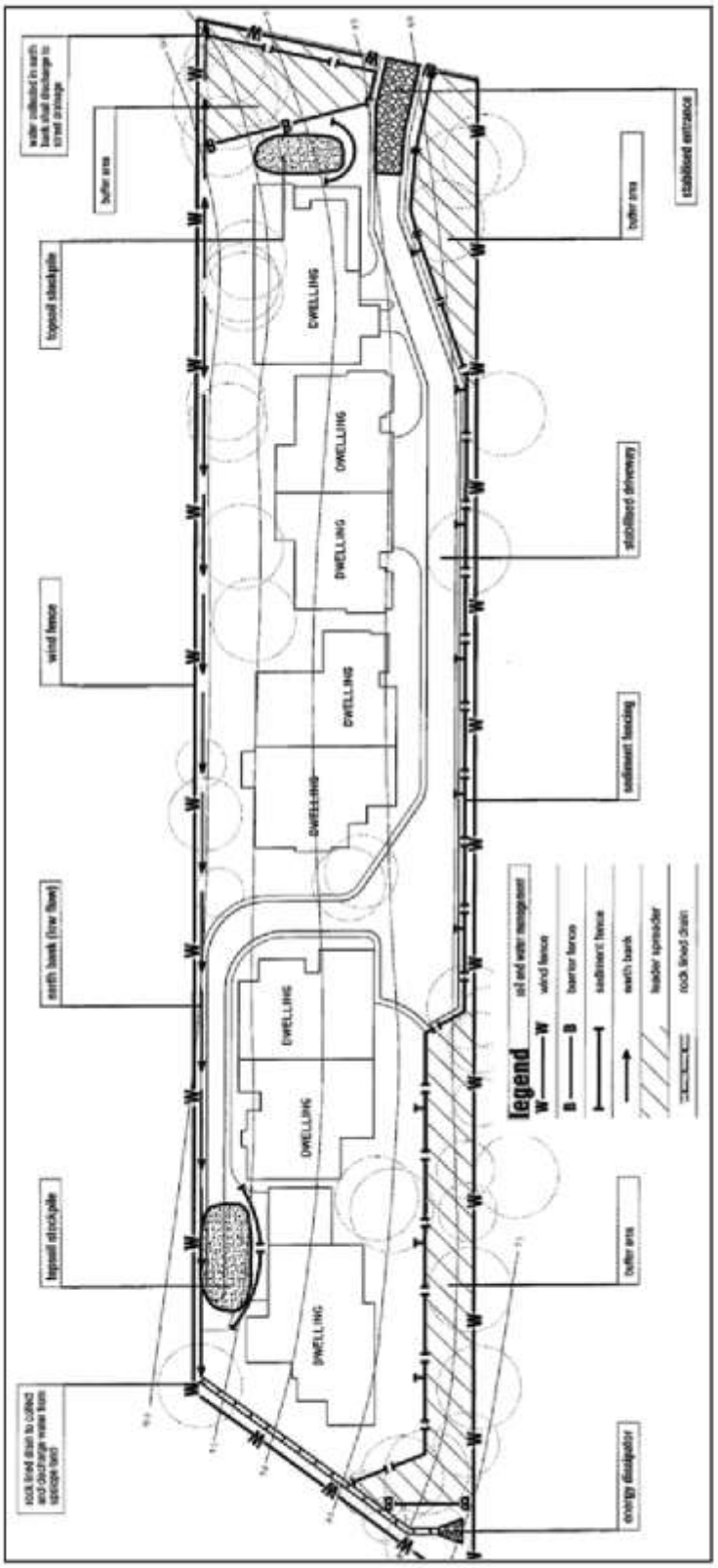

Figure 1A: SWMP for a subdivision.

List of fact sheets

1. **Soil & Water Management on Large Building & Construction Sites**
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 1A after Landcom 2004 "*Soils & Construction Volume I Managing Urban Stormwater (4th edition)*". Some of the text in this brochure has been obtained and modified from the Brisbane City Council 2008 "*Subdivision and Development Guidelines*".

Date of Issue: December 2008

Soil & Water Management on Standard Building & Construction Sites

What is this?

A general overview of sediment and erosion control measures that are typically required for single residential building lots including when certain control measures should be installed. Useful for planning and for determining what practices might be suitable for your site. For further details about each of the control measures mentioned go to the relevant fact sheet in the series.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 2

WHAT DO I NEED TO DO?

The timing of works and installation of control measures has a major influence on how effective soil and water management is in reducing on-site erosion and the amount of sediment that is carried off-site.

Before starting site works plan to:

1) Schedule earthworks in phases throughout the project so that the ground is disturbed for the shortest time possible **(see Fact Sheet 5).**
2) Avoid stripping and excavating until all necessary permits, licences and approvals have been obtained and you are ready to start work.
3) Install erosion and sediment control measures in accordance with an approved Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

Install erosion and sediment control measures in sequence:

1) Choose a single, stabilised site access point **(see Fact Sheet 12).**
2) Install sediment fences or fibre rolls at the low end of the site to trap sediment **(see Fact Sheet 14).**
3) Divert up-slope catchment runoff around the site by installing a diversion drain and level spreader **(see Fact Sheet 7).**
4) Keep as much vegetation as possible to minimise soil erosion and reduce rainwater running across the site **(see Fact Sheet 6).**
5) Designate a location where topsoil and other excavation material will be stockpiled during building and construction. Provide suitable controls to prevent erosion **(see Fact Sheet 9).**
6) Stabilise areas of exposed soil with vegetation or erosion control blankets and mats **(see Fact Sheet 8).**
7) Protect the nearby stormwater system including any stormwater pits on and below the site from blocking up with sediment **(see Fact Sheet 15).**
8) Designate an appropriate location within the site where sediment-generating activities can be managed (e.g. wheel wash, brick cutting) **(see Fact Sheet 16).**

Once site works have commenced:

1) Monitor sediment and erosion control measures at least once a week and after each rainfall event.
2) Construct service trenches away from where water is likely to concentrate. Try not to have service trenches open any longer than necessary **(see Fact Sheet 9).**
3) Prevent clean rainwater running across the site by connecting downpipes to the stormwater system as soon as the roof is on the building frame **(see Fact Sheet 10).**

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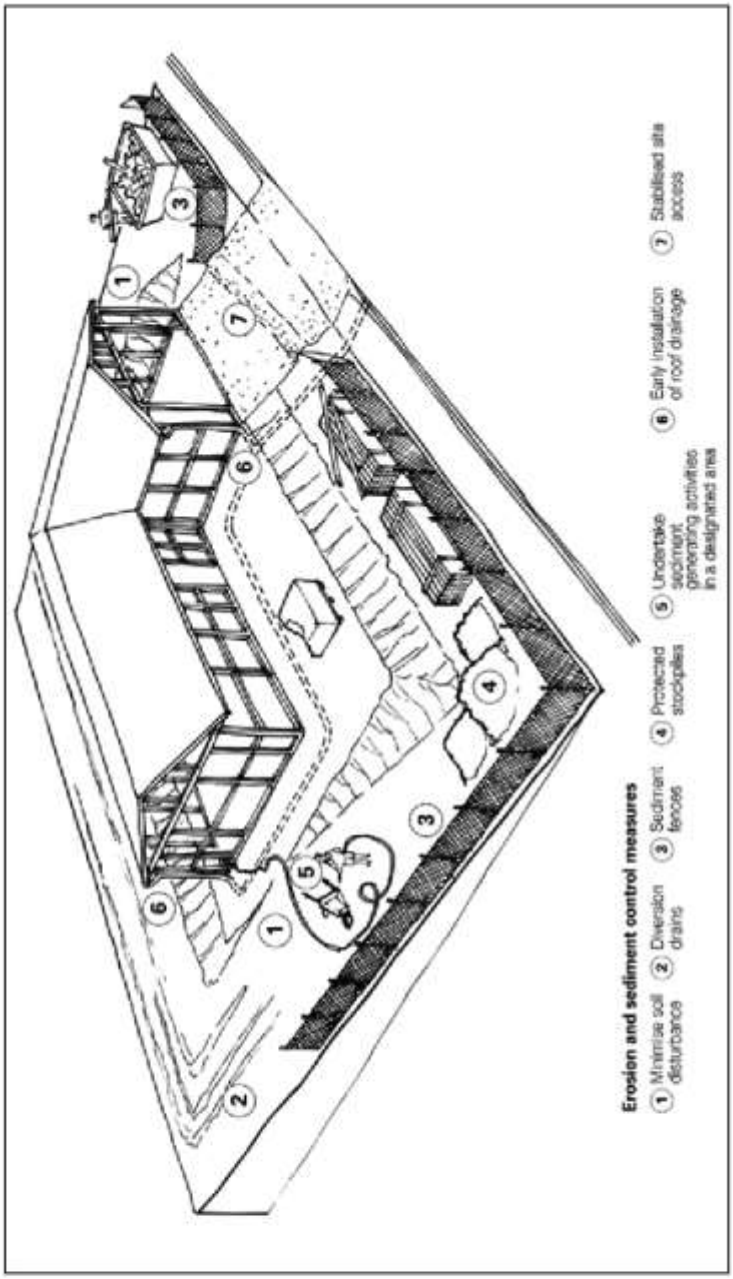

Figure 2A: *Appropriate sediment and erosion control measures for single residential building lots.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. **Soil & Water Management on Standard Building & Construction Sites**
3. Soil & Water Management Plans
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13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 2A was kindly provided by South East Queensland Healthy Waterways Partnership and Brisbane City Council. Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Soil & Water Management Plans

What are these?

Soil and water management plans are specific site plans or drawings that detail sediment and erosion control measures on building and construction sites. The Soil and Water Management Plan (SWMP) shows the type, location, design, installation and maintenance schedule for all these measures and should be considered as the blueprint for controlling all anticipated erosion and for preventing sediment from leaving a site.

Subdivisions or activities that create greater than 250 m^2 of ground disturbance typically need to submit a SWMP to council with their building or development proposals prior to any site disturbance. Once approved by council, all building and construction works need to be conducted in accordance with the SWMP.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 3

WHAT DO I NEED TO DO?

Prepare a SWMP (see Figure 3A):

A SWMP can easily be developed by overlaying information on a copy of the engineering site drawings. The plan must detail the site development and all the systems intended to minimise erosion and trap sediment. On the SWMP show the following:

1) Date and author.
2) North point and scale.
3) Property boundaries.
4) General soil description.
5) Location and amount of ground disturbance.
6) Initial and final contours, location of watercourses, surface drainage and existing stormwater infrastructure.
7) Stormwater discharge point, if proposed.
8) Location of all proposed temporary drainage control measures.
9) Construction details (e.g. building or subdivision layout).
10) Location of vegetation to be retained and removed.
11) Location of stabilised site access.
12) Location of soil, sand or other material stockpiles.
13) Location and details of all proposed erosion control measures.
14) Location and details of all proposed sediment control measures.
15) A statement of who is responsible for establishing and maintaining all erosion and sediment control measures.
16) The installation sequence of the different sediment and erosion controls.
17) The maintenance program of the sediment and erosion controls.
18) The revegetation and rehabilitation program.

Note: Other details may be required depending on the specific requirements of the site, scale of the development and level of ground disturbance. Contact your local council for what information you are required to submit on your SWMP.

Submit the SWMP to council for approval:

A SWMP may be a requirement of your planning or building permit. Ensure that the council has approved your SWMP; otherwise you may be in breach of your permit.

Implement the SWMP and update as needed:

1) Keep a copy of the council-approved SWMP at the site at all times.
2) Ensure that all on-ground workers understand the SWMP.
3) Implement, update and maintain the control measures shown in the SWMP.

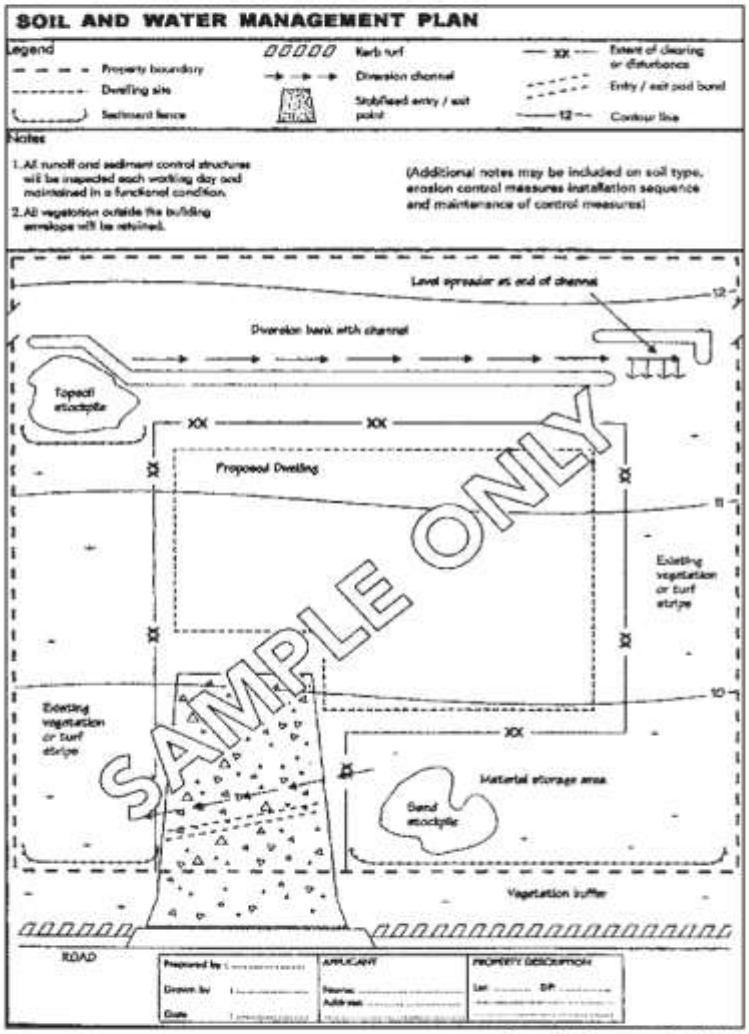

Figure 3A: Example of a SWMP

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. **Soil & Water Management Plans**
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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Acknowledgement:

Figure 3A from Gold Coast City Council *"Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Dispersive Soils – High Risk of Tunnel Erosion

What is it?

Dispersive soils, or **sodic soils**, collapse or disperse to form dissolved slurry when in contact with fresh water (rain). These soils are highly prone to erosion often leading to **tunnel** and **gully erosion**. Unlike other forms of erosion, dispersion and tunnel erosion result from an imbalance in soil chemistry.

1) Tunnel erosion occurs in all municipalities in Southern Tasmania.
2) Tunnel erosion results from a combination of both chemical dispersion and physical transport of dispersed clay particles.
3) Soils with greater than 6% exchangeable sodium are prone to dispersion.

Dispersion and tunnel erosion usually occurs in subsoils making early detection difficult. Building activities such as excavation, topsoil removal and ponding of rainwater all increase the risk of initiating tunnel erosion. Whilst wind, rain and water runoff are the typical causes of soil erosion on construction sites, the soil chemistry can also determine how prone it is to erosion. Chemistry of the soil determines how well it stays bound together when fresh water is added. Dispersive soils can be caused by high sodium content (i.e. >6% exchangeable sodium); hence they are sometimes called sodic soils. Typically dispersive soils are found in the subsoil as the topsoil is usually non-dispersive. All southern municipalities have dispersive soil risks and tunnel erosion is not uncommon. Dispersive soil can be very patchy in distribution with soil types changing over a few metres in distance, thus it is **very important** to look and test for signs of dispersive soil!

Fact Sheet 4

Why is it important?

Building and construction activities may increase the risk of soil dispersion and can result in the formation of tunnel erosion. Tunnel erosion initially results from the dispersion of clay soils in rainwater, but once the tunnels have formed they can quickly enlarge to form underground drainage paths. When the tunnels collapse they create gullies. Development of tunnel erosion in residential areas has resulted in damage to buildings, roads and septic systems leading to increased public health risks and major impacts on the environment.

During building and construction the runoff from areas of disturbed dispersive soils will contain large amounts of clay and will appear very cloudy. It is very difficult to remove this clay from freshwater without the addition of chemicals (e.g. gypsum). If this runoff enters local waterways it will reduce light levels and decrease water quality. Follow the practices discussed in this fact sheet and you will prevent erosion of dispersive soils from your site, meet your legal requirements and help protect our waterways.

WHAT DO I NEED TO DO?

Before starting site works:

Always ask if there has been soil testing for dispersive or sodic soils, especially in the subsoils where they are more prevalent. An appropriate soil specialist can do this.

Installing the control measures:

1) Minimise disturbance to topsoil and vegetation.
2) Choose building and construction methods that minimise the need for excavation and subsoil exposure.
3) Avoid concentrating water flow over areas that have dispersive topsoil or subsoils. If possible divert water to areas where the soil is not dispersive (***Note:*** dispersive soils can be very patchy in distribution).

4) When diverting water, create diversion berms/banks by pushing the soil to create banks up hill, this maintains grass in the channel and reduces infiltration directly to the subsoil and the potential for tunnel erosion.
5) **Do not** create soakage pits in dispersive soils.
6) Immediately infill any trenches or holes to prevent collection and ponding of water on subsoil surfaces.
7) **Always** compact dispersive subsoils that have been disturbed or excavated. Dispersive soils require above average compaction. Consider using a 'whacker packer' for small areas or a sheeps foot roller for large areas. Apply gypsum or lime according to soil test recommendations during infilling and cover with topsoil and revegetate.
8) **Always** bury any exposed subsoils with topsoil and revegetate.
9) Top dress the surface of potentially dispersive soils with gypsum (if soil pH > 6.5) or lime (if soil pH <5) or a mixture of both (if soil pH is within the range of 5 to 6.5) according to soil test recommendations to reduce dispersion.
10) Cover dispersive soils with a minimum 100 mm layer of non-dispersive soil prior to revegetation, or the placement of rock gabions, or concrete.

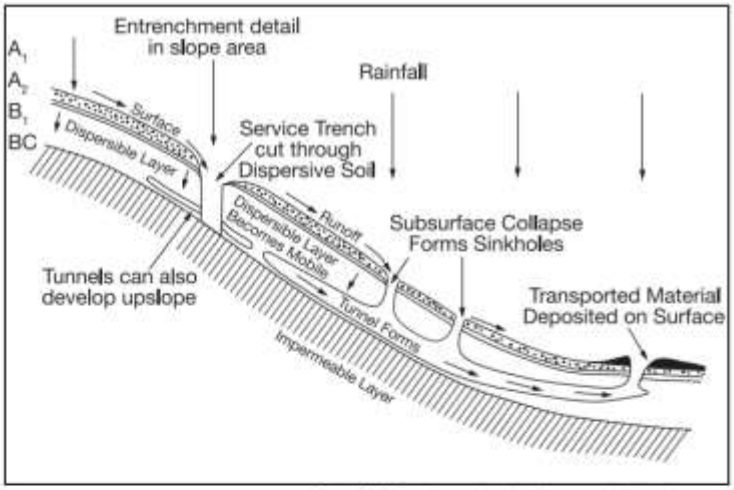

Figure 4A Tunnel erosion development in dispersive soils

Note: You can seek further information and advice on the issue of dispersive soils and tunnel erosion from several sources including: your local council, a soil surveyor, civil engineer or soil specialist, NRM South and the Land Conservation Branch of the Department of Primary Industries and Water (DPIW).

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. **Dispersive Soils – High Risk of Tunnel Erosion**
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figure 4A after Department of Construction and Environment, Land Protection Division, Victoria *"Field Erosion its Characteristics and Amelioration"*.

Date of Issue: December 2008

Minimise Soil Disturbance

What is it?

Minimise soil disturbance to the greatest extent practicable. Earthworks should be kept to a minimum and should be closely linked with the commencement of building and construction work. To minimise risks, preserve native topsoil and natural vegetation and implement suitable sediment and erosion control measures (see other fact sheets in this series). Areas of soil disturbance on slopes should be roughened and terraced to reduce erosion.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 5

WHAT DO I NEED TO DO?

Design considerations:

1) Avoid the need for earthworks by working with the natural contours of the site. Limit building or construction on steep inclines. On slopes choose a subfloor method that will minimise excavation.
2) Limit the area of soil disturbance (the excavation envelope) to the minimum required, i.e. the house only.
3) Identify suitable sediment and erosion control measures for the excavation envelope.
4) Staging works. Consider scheduling earthworks in phases throughout the project to reduce erosion potential and rehabilitate exposed areas quickly to reduce the amount of soil exposed at one time.
5) Retain as much stripped topsoil as possible for reuse during landscaping and site rehabilitation.

Before starting site works:

1) Ensure approval has been granted by council.
2) Identify vegetation, including grass buffers, around the construction site to preserve throughout the development. Mark this as a **No Go Area (see Fact Sheet 6)** on all work plans, including the Soil and Water Management Plan (if required) **(see Fact Sheet 3)**.
3) Install sediment and erosion control measures.
4) Ensure the operators of earthmoving equipment are aware of the excavation envelope and where stockpiles will be located.

Once site works have commenced:

1) Ensure vegetation buffers are protected.
2) Carry out staged excavation and stabilisation (if applicable).
3) Maintain sediment and erosion control measures.
4) Stabilise soil stockpiles by placing sediment fences around their lower edges, cover with fabric, plastic or vegetation.
5) Restrict vehicles and equipment to designated areas.

Soil roughening: when using heavy machinery (i.e. non-wheeled vehicles) on exposed slopes.

Don't smoothly grade slopes with compacted soils. This will increase runoff, is hard to revegetate and is highly susceptible to soil erosion.

Don't track heavy machinery across the slope. The track marks will create furrows that water will flow down when it rains.

Do track machinery (e.g. excavators) up and down the slope to create grooves from the wheels/or tracks that will catch seeds, fertilizer, and rainfall. The grooves will roughen the surface in a way that will slow runoff over the slope ***(see Figure 5A).***

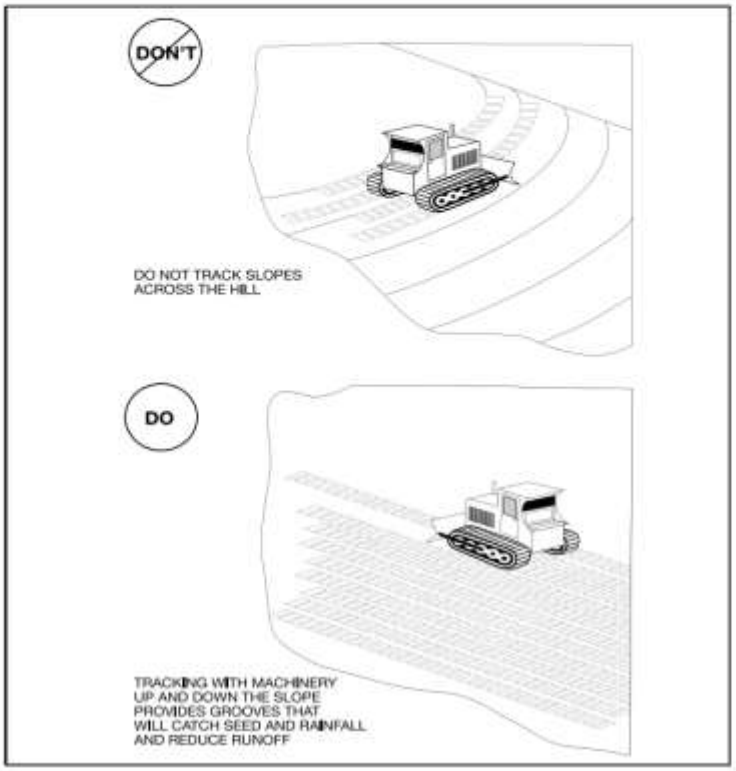

Figure 5A: *Avoid moving tracked vehicles across the slope, unless the final pass involves tracking up and down the slope.*

Maintaining control measures:

If topsoil has been removed it will need to be replaced ***(see Figure 5B).***

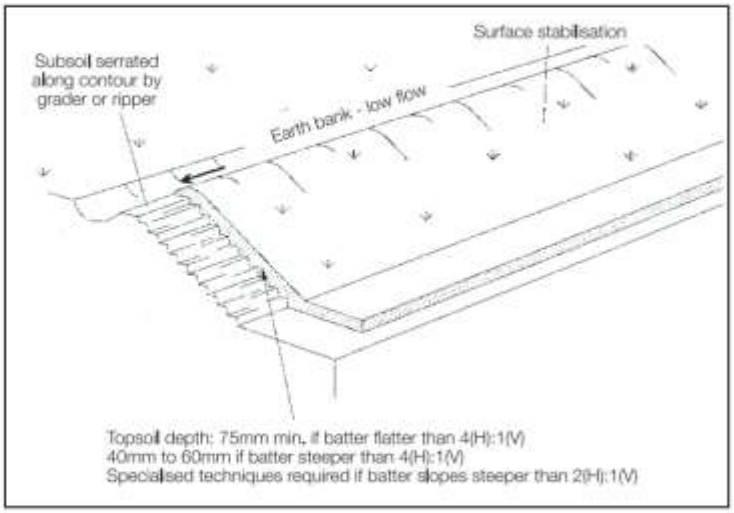

Figure 5B: *Replacing Topsoil.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. **Minimise Soil Disturbance**
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
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15. Protection of Stormwater Pits
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17. Sediment Basins
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Acknowledgement:

Figure 5A after California Regional Water Quality Control Board 1999 *"Erosion & Sediment Control Field Manual"*. Figure 5B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Preserve Vegetation

What is it?

Keep as much of the original vegetation (grass, trees, etc.) on the site by establishing **No Go Areas** for the building and construction phase as well as vegetated filter strips down-slope of the work site. Preserving grassed areas, trees and shrubs protects the soil from erosion and provides an effective filter for sediment runoff.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 6

WHAT DO I NEED TO DO?

Before starting site works:

Identify vegetation (trees, shrubs and grassed areas) on site which can be kept throughout the entire building and construction phase and mark this as a **No Go Area**. Include this information on the Soil and Water Management Plan if required **(see Fact Sheet 3)**.

Vegetation is the most effective soil stabiliser available on building and construction sites. Keep groundcover along surface drainage areas and on steeper slopes. Retain significant areas of healthy grass down-slope of the worksite, these strips can be highly effective for filtering out coarse sediment. The flatter and wider the strips are, the more effective they become. Native vegetation along streams and waterways should be retained and protected from sediment by installing additional sediment control measures up-slope e.g. fibre rolls and sediment fences **(see Fact Sheet 14)**. On exposed sites a 400 mm wide planted turf strip between the kerb and the footpath is a good last resort sediment control, filtering the runoff before it enters the stormwater system **(see Figure 6A)**.

Where vegetation needs to be removed, leave it in place for as long as possible and stage earthworks to minimise the amount of site cleared at any time.

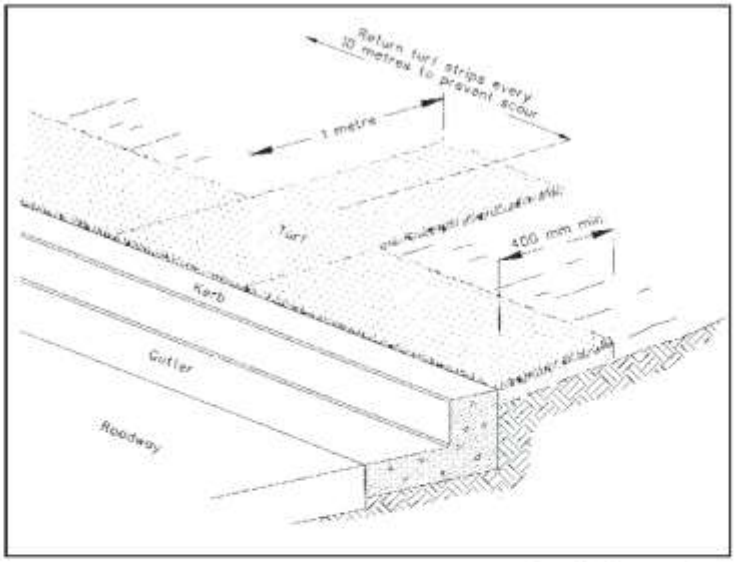

Figure 6A: Planted turf strip.

Installing the control measures:

Fence off the **No Go Area.** Place red tape or other bright materials around the trees, shrubs and grassed areas to be kept. Ensure staff and subcontractors know not to enter these areas or damage marked trees. Where practicable, maintain the planted turf strip in a healthy state during the building and construction process and ensure it is fenced-off to prevent traffic-induced damage.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
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3. Soil & Water Management Plans
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5. Minimise Soil Disturbance
6. **Preserve Vegetation**
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
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Date of Issue: December 2008

Divert Up-slope Water

What is it?

Design surface drainage up-slope of building and construction sites to divert runoff away from the site. Where practical and particularly where stormwater runoff from more than 0.5 hectares feeds into the work site, divert up-slope water around the disturbed or active work area.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 7

WHAT DO I NEED TO DO?

Before starting site works:

Look at the site plans to identify site areas where stormwater can be diverted around the disturbed or active work area. Stormwater can be diverted with the use of small diversion drains. Note that the stormwater must not be diverted onto adjacent properties; instead it must discharge the work site at a legal point of discharge. Diversion drains need to be properly designed to ensure that they can convey water without overflowing or accumulating sediment. Document the diversion drains on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).** Ensure workers on-site are aware of the need to maintain the diversion drains. Do not dig diversion drains on dispersive soils **(see Fact Sheet 4)**, instead build soil berms.

Installing the control measures:

Diversion drains: A diversion drain is a channel constructed on the high side of a site to divert surface runoff from rainwater that would otherwise flow down onto the disturbed or active work area.

1) The channel should be about 150 mm deep with a curved shape.
2) Place the excavated soil from the channel on the down-slope side to increase the diversion drain's capacity.

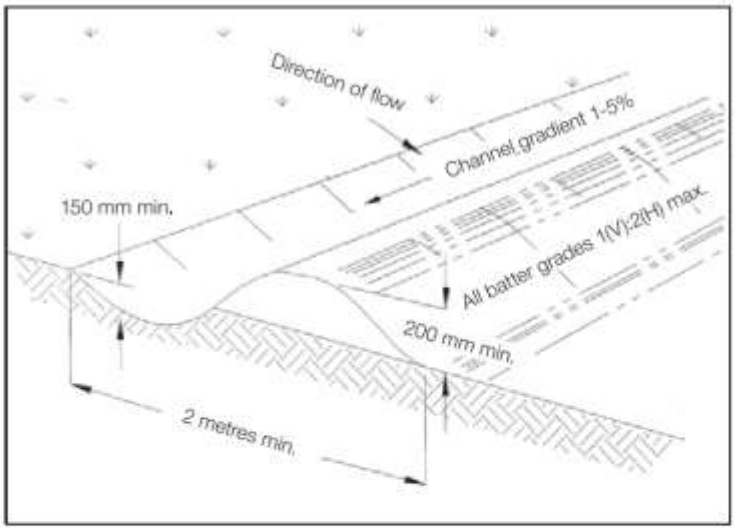

Figure 7A: *Example of a diversion drain.*

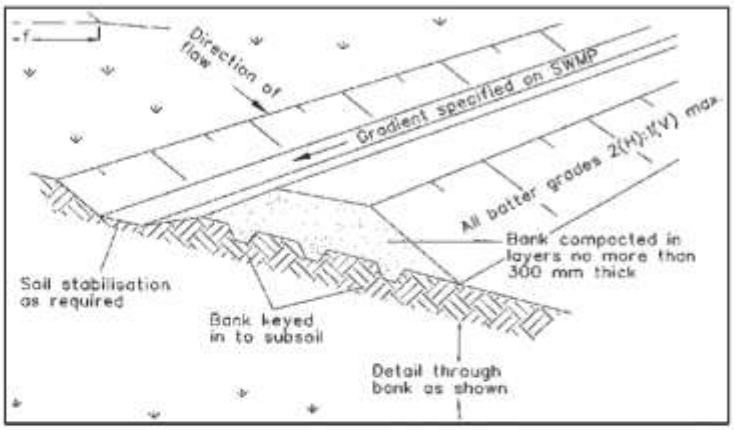

Figure 7B: Example of a diversion drain for high flow.

3) The diversion drain should divert flows to a stable drainage line to ensure that the channel does not itself cause erosion where it discharges.
4) The diversion drain should be kept clean and free of plantings and mulch as this will lead to the deposition of sediment that obstructs water flow and causes water to breach the channel and create unwanted erosion.

Level spreader: Level spreaders are generally used at the outlet of diversion channels. A level spreader is a wide, level overflow sill built across a slope. It allows even spread of water flow so velocities are reduced and soil erosion is avoided. This should only be constructed to release water to areas where the:

1) Water flow will not become concentrated.
2) Soil is stabilised and the site is not within the path of construction activities.
3) Ground remains well-vegetated.
4) Discharged water flow will be slow moving.

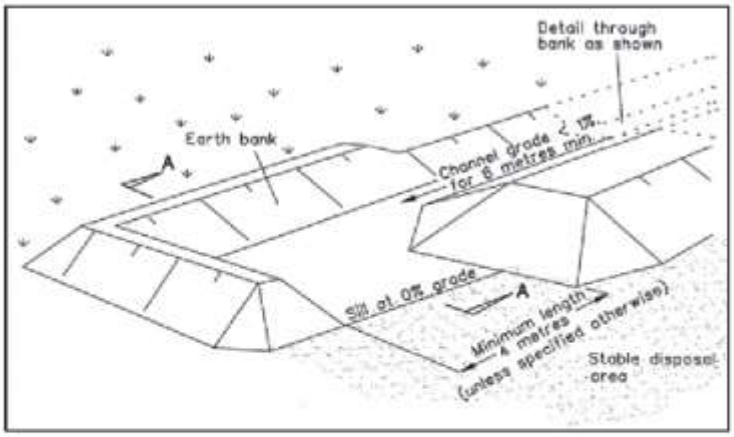

Figure 7C: Example of a level spreader used to release minor concentrated flows as sheet flow.

In some cases such as on steep slopes or where there are high flow velocities, a grass or geotextile fabric lined channel may be required to return the diverted flow to the stormwater system or a stable drainage line.

Maintaining the control measures:

Check diversion drains, level spreaders and discharge areas for signs of erosion.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. **Divert Up-slope Water**
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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16. Manage Concrete, Brick & Tile Cutting
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Date of issue: December 2008

Erosion Control Mats & Blankets

What are these?

Erosion mats and blankets are used as a soil cover and a protective barrier for vegetation establishment. They are applied on soils with a high erosion risk, on steep sites or for site rehabilitation. When applied correctly, they are one of the most effective and practical means of controlling runoff and erosion on disturbed land prior to vegetation establishment.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 8

WHAT DO I NEED TO DO?

Before starting site works:

Identify where erosion is likely to occur i.e. areas of bare soil, especially on slopes steeper than 3:1 or when there is a delay in building and construction work or site rehabilitation. Select erosion control mats or erosion control blankets.

Erosion control mats: are heavier, synthetic and non-degradable, they are designed to add stability to soils and are often filled with topsoil, and vegetated when installed. Erosion control mats are suitable on slopes and in channel-lining applications.

Erosion control blankets: are light-weight and open-weave made from mulch, straw and wood fibre and held together by natural or synthetic netting. They are used for establishing and reinforcing vegetation. Their application depends on the blanket materials. Synthetic netting and wood fibre is stronger and can be used on steeper slopes compared to jute and straw blankets, which rapidly degrade and are more suitable for flatter areas. Check with suppliers of erosion control blankets about the applications of their different products.

Erosion control blankets can be used in conjunction with soil seeding, preventing the seed washing away and erosion of the prepared seedbed. Once established, the vegetation provides permanent erosion control.

Document erosion control mats and blankets on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

Installing the control measures:

Erosion control mats should be installed immediately on exposed soils, while erosion control blankets should be fitted on newly seeded or landscaped areas. **See Figures 8A and 8B** for their installation guidelines.

Maintaining the control measures:

Close inspection after rainfall events and major runoff occurrences is essential. Check for damage due to water running under the mat or blanket or if it has been displaced by wind. Restabilise with anchor pins or wooden spikes. If significant erosion has occurred repair the fabric. Grading and reseeding may also be necessary. Continue inspections until vegetation is firmly established.

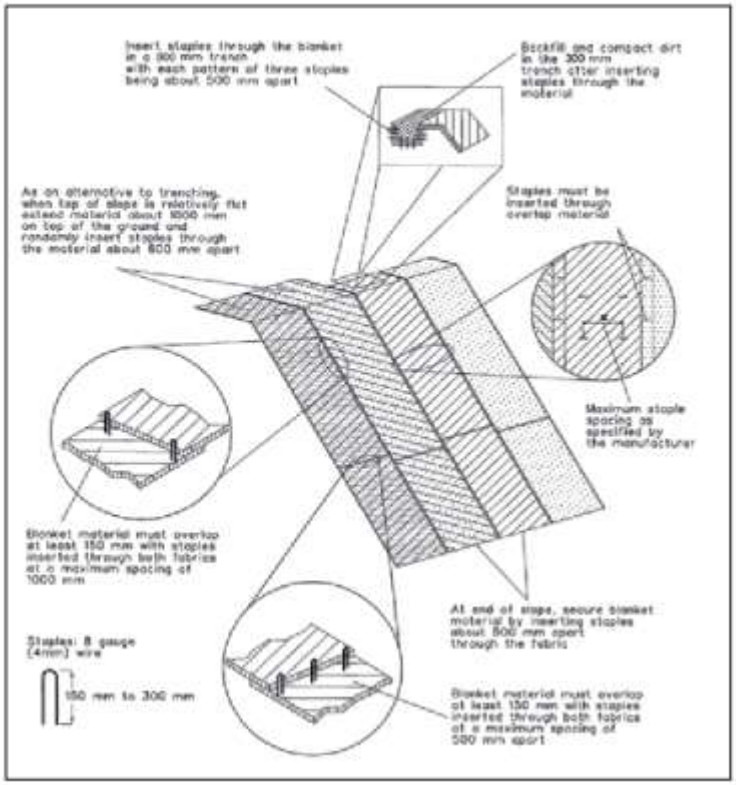

Figure 8A: Installation of an erosion control blanket on a hillside.

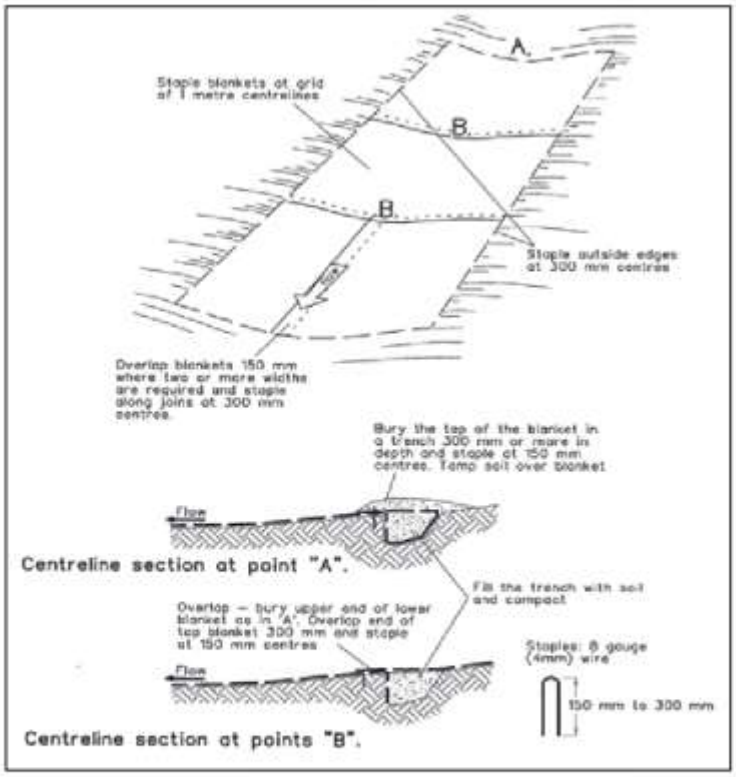

Figure 8B: Erosion control mat used to line a channel.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. **Erosion Control Mats & Blankets**
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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Acknowledgement:

Figures 8A & 8B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)".*

Date of Issue: December 2008

Protect Service Trenches & Stockpiles

What is it?

When excavated, service trenches can concentrate runoff and cause rapid soil erosion. This fact sheet discusses methods to install service trenches in a manner that does not cause soil erosion.

Temporary stockpiles are at risk of being washed or blown away. This fact sheet discusses proper on-site storage of materials such as sand, gravel, topsoil, mulch and woodchips.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 9

WHAT DO I NEED TO DO?

Before starting site works:

Service trenches: if your site has fine soil, protection measures may be needed. Decide where the service trenches will need to go and document them on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)**. Ideally they should be away from areas where water flow is likely to concentrate. Where possible coordinate the various service connections so a single trench can be used and quickly backfilled. Also try scheduling the work when rainfall is low. Be aware if you have dispersive soil **(see Fact Sheet 4)**.

Stockpiles: avoid stockpile loss and stormwater pollution by limiting the amount of material on-site and remove all materials when work is complete.

Identify a protected storage area for building material stockpiles away from on-site drainage or stormwater flow paths. Place control measures such as diversion drains up-slope or sediment fences down-slope. Cover the stockpiles with fabric, plastic or a temporary grass cover. Drivers delivering stockpile material should always use the protected storage area as the drop-off. Document your storage area on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure staff are aware of its importance.

Note: Don't stockpile sediment or building materials (sand, gravel, mulch) on roadways or within drainage areas.

Installing the control measures:

Service trenches:

1) Remove and store vegetated topsoil so it can be replaced after works to provide immediate erosion protection.
2) Place the soil on the uphill side of trenches to divert water flow away from the trench line. Temporary bunds can be used.
3) The trench should be open for the shortest time practicable and avoid opening them when the risk of rainfall is high.
4) Once completed, backfill trench with subsoil and compact.
5) Replace top soil, level and top up to account for soil settling.
6) If trenches are on steep slopes, install earthbanks along the backfill surface at 6 metre intervals to divert flows and prevent erosion.
7) Excess soil should be used or disposed of in such a way that it does not create a wind or water erosion hazard.

Stockpiles:

1) Locate stockpiles at least 5 metres from stormwater flow paths, roads and hazard areas.
2) Place on gently sloping ground (not level areas which tend to be overland low paths) as a low, flat, elongated mound.

3) Stockpiles should preferably be less than 1.5 metres high.
4) Construct an earth bank on the up-slope side to divert runoff around the stockpile and install a sediment fence 1–2 metres down-slope of the stockpile. The height of the sediment fence should be equal to the stockpile height and the length equal to the stockpile length at the base.
5) Stockpiled materials should be covered during windy conditions, rain or unattended periods. Topsoil stockpiles left for extended periods should be revegetated.

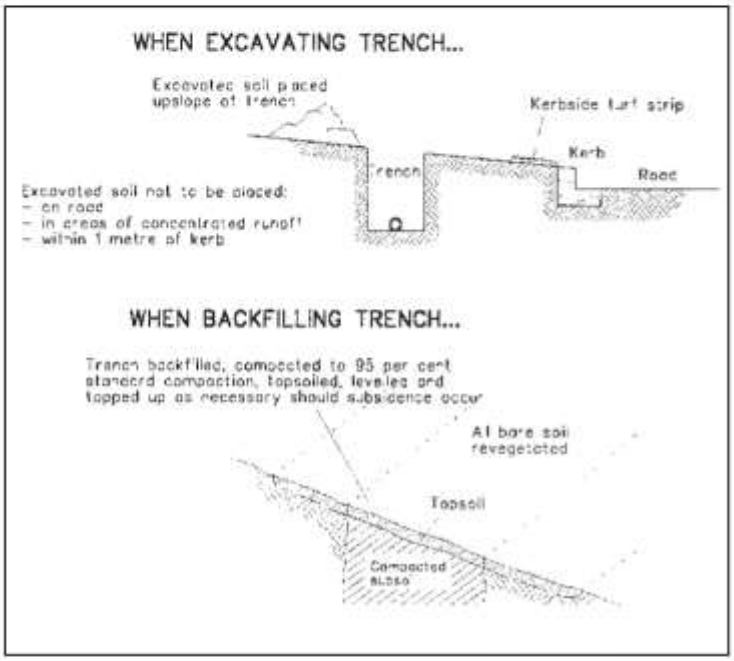

Figure 9A: Example of a service trench.

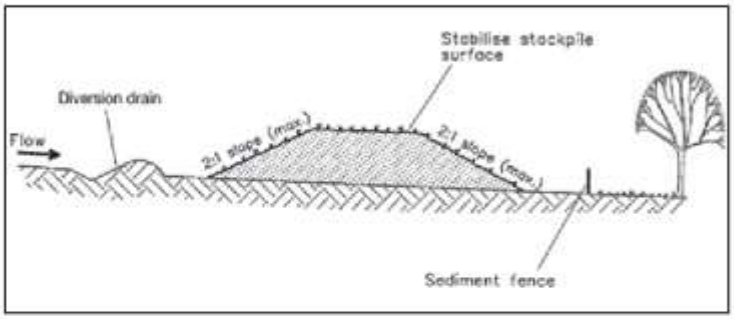

Figure 9B: Keep building materials in protected stockpiles.

Maintaining the control measures:

Service trenches: if they fill with water, pump water evenly over a stabilised vegetated area that will filter out the suspended clays. If this is not possible, add a small amount of gypsum to the water and allow the suspended clays to settle before pumping the water out.

Stockpiles: should be covered and checked regularly. Sediment and erosion controls (diversion drains and sediment fences) associated with stockpiles also need to be monitored and maintained.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. **Protect Service Trenches & Stockpiles**
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils. Figure 9A from the NSW Department of Housing as in Hobart Regional Councils *'Guidelines for Soil & Water Management 1999'*. Figure 9B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*.

Date of Issue: December 2008

Early Roof Drainage Connection

What is it?

Connect the downpipes to the stormwater system as soon as the roof is on the building frame. This control measure prevents 'clean' rainwater running through the disturbed or active work area.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 10

WHAT DO I NEED TO DO?

Before starting site works:

Aim to have the roof and downpipes in place as soon as possible.

Document this on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure all on-ground staff are aware of its importance.

Installing the control measures:

Connect the permanent downpipe or temporary ones such as flexible tubing. If pipes to the road can not be installed, pipe the water to a turfed area, or infiltration trench, where it can soak into the ground.

Maintaining the control measures:

Check that the pipes are still connected whenever rain is forecast.

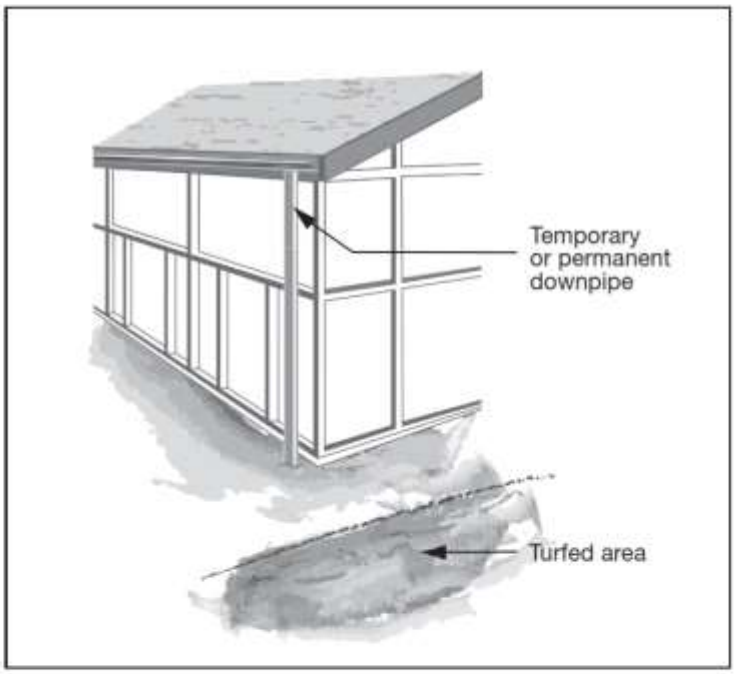

Figure 10A: Early installation of roof drainage.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. **Early Roof Drainage Connection**
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
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17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Date of Issue: December 2008

Scour Protection – Stormwater Pipe Outfalls & Check Dams

What is this?

At stormwater pipe outfalls or along open drainage channels use rocks, vegetation, or other materials to break up concentrated flows, reduce the velocity of flows to non-erosive rates and to stabilise the outflow point.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 11

WHAT DO I NEED TO DO?

Before starting site works:

Stormwater pipe outfalls: should be located in areas where there is a low potential for soil erosion (e.g. areas of naturally occurring rock). If this is not possible, create a hard rock scour protector **(see Figure 11A).** If the pipe is highly visible (e.g. along a creek-side walking trail), natural rock and vegetation placement can conceal the outfall. If the outfall becomes council infrastructure, appropriate design approvals are required.

Check dams: are semi-pervious (typically loose rock) dam constructions that are placed in a series along open drainage channels to detain and reduce the velocity of stormwater runoff. They are particularly useful on gently sloping channels up to 10% (10:1) grade, but only effective for draining small areas of land (less than 4 hectares). If high flows are anticipated it may be necessary to line the entire base of the drainage channel with rocks.

Check dams can be temporarily used until a drainage channel has become revegetated. Alternatively, check dams can be a permanent feature if water detention is required. However, the drainage channel must still be able to effectively convey water.

Don't place check dams in channels that are already grass-lined, unless erosion is expected.

Don't construct check dams using sediment fences or straw bales.

Installing the control measures:

Stormwater pipe outfalls:

1) Fill material needs to be compacted to the density of the surrounding undisturbed material.
2) Place geotextile fabric over fill material.
3) Ensure that the rock work used for scour protection conforms to the required limits for water flow energy dissipation. (Ensure that the underlying geotextile does not sustain serious damage during the rock work phase.)
4) Repair any damage to geotextile areas with patches of geotextile (ensuring a 300 mm overlap with surrounding intact fabric).

Note: If low water flow has been determined for the stormwater pipe outfall, leave gaps in the rock work and plant into cuts in the geotextile.

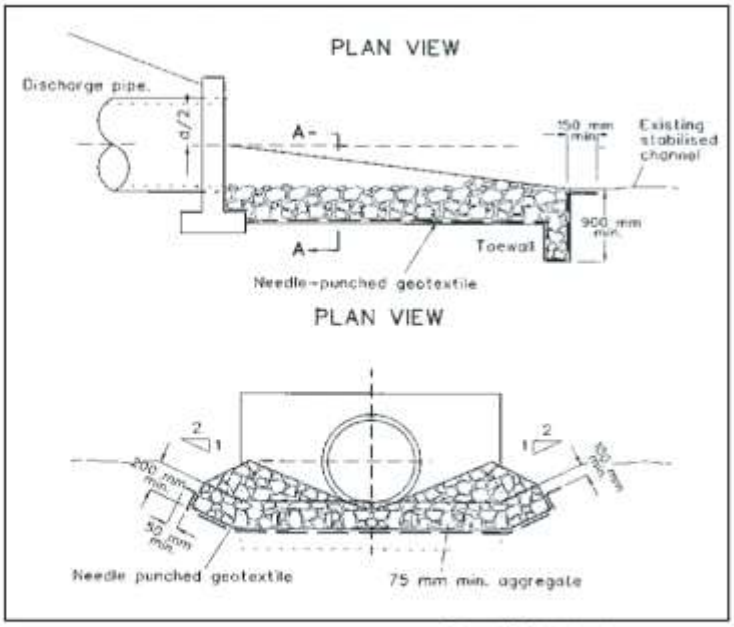

Figure 11A: Hard rock scour protector.

Check dams: these are appropriate for small channels with low flows that are susceptible to erosion (for larger channels or higher flows, specialist design may be required). A number of check dams will probably need to be built.

1) Excavate a shallow (200 mm) trench perpendicular to the drainage channel.
2) Construct the dam from aggregate (washed sand/gravel), placed in sandbags (for easy deconstruction). Place bags within the trench and build up the dam wall.
3) Ensure that the height of the dam spillway is less than 1 metre above the base of the drainage channel.
4) Ensure the dam height and spillway height does not dramatically impede water conveyance.
5) Space individual check dams so the toe of the upstream dam is level with the spillway of the next downstream dam. Otherwise extend downstream toe to provide erosion protection.
6) Check dams require regular maintenance as accumulated sediment needs to be removed, to prevent it becoming resuspended during subsequent storms.

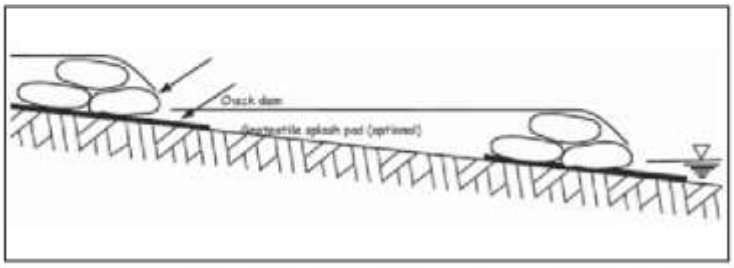

Figure 11B: Example of a check dam.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. **Scour Protection – Stormwater Pipe Outfalls & Check Dams**
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

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Acknowledgement:

Figure 11A from Landcom 2004 "*Soils and Construction Volume I Managing Urban Stormwater (4th edition)*". Figure 11B from South East Queensland Healthy Waterways partnership 2006 "*Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites*". Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Stabilised Site Access

What is it?

A stabilised site access is a single entry/exit point for building and construction sites that is designed to reduce the tracking of sediment off-site. It provides a clean, dry surface for vehicles to enter and unload during all weather conditions without destroying vegetation or carrying large amounts of sediment onto paved road surfaces.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 12

WHAT DO I NEED TO DO?

Before starting site works:

Identify the best location to place the stabilised site access – ideally it should be in an elevated position with little or no water flowing to it from up-slope and away from any down-slope stormwater pits. All deliveries should be able to be made through this point. Document it on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure on-site staff are aware of its importance.

Installing the control measures:

The recommended construction method for the stabilised site access is laying down 200 mm of aggregate or recycled concrete greater than 40 mm in size (crushed sandstone is not suitable). Where the site access slopes toward the road, a diversion hump should be installed across the stabilised area to direct stormwater runoff to the side where it can be filtered by a sediment fence. If the construction process enables it, a permanent driveway can be laid and used as the access point.

Stabilised site access:

1) Strip at least 150 mm of topsoil, level area and stockpile in the space available.
2) Compact infill.
3) Cover the area with geotextile.
4) Construct a 200 mm thick pad over geotextile using aggregate at least 40 mm in size, ideally from kerb to building.
5) Construct a trafficable diversion hump immediately within the boundary to divert water to a sediment fence or other sediment control measure.

Note: On larger sites cattle grids or shaker grids can also be installed at the access point. These allow the wheels to turn a couple of times and shake off excess sediment. If sediment is still being tracked off-site then a wheel wash should be installed **(see Fact Sheet 13)**.

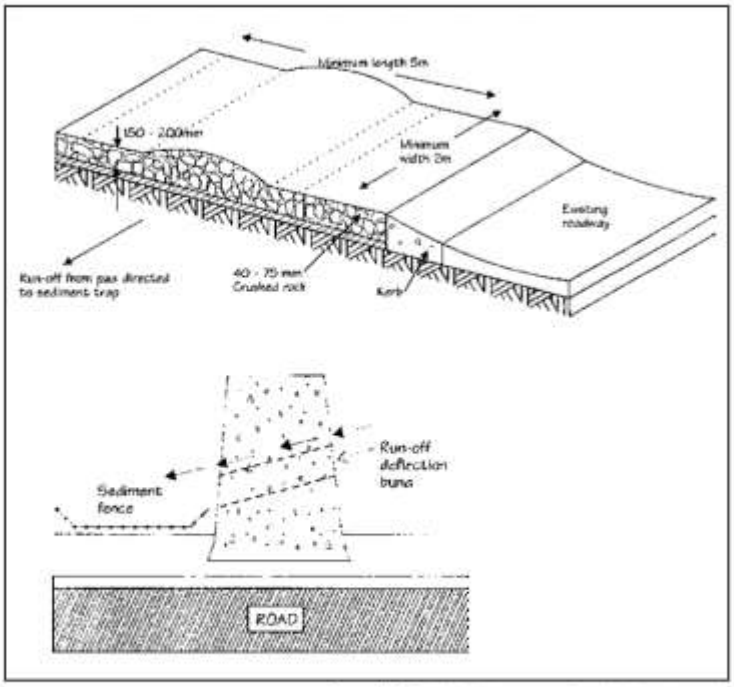

Figure 12A: Stabilised site access for building sites only.

Maintaining the control measures:

As vehicles use the stabilised site access they will slowly compact the gravel or rock. When it becomes too compacted the voids between the rock and gravel disappear and the stabilised site access will no longer trap mud and dirt.

Monitor the surface of the stabilised site access and ensure that it drains to the sediment fence or other sediment control measures. Add new gravel or rock as needed. Roads should be inspected for any sediment that has escaped the site at the end of each day and swept up if necessary. This should also be done whenever rain looks likely.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. **Stabilised Site Access**
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figure 12A and text in this brochure has been obtained and modified from the "Do It Right On Site" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Wheel Wash

What is it?

A wheel wash reduces the amount of sediment transported onto paved roads by vehicles.

They should be installed on larger building and construction sites or when the stabilised site access is not preventing sediment from being tracked off the site.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

WHAT DO I NEED TO DO?

Installing the control measures:

1) Identify the best location to place the wheel wash. It should be incorporated with the stabilised site access **(see Fact Sheet 12).**
2) Construct a pad by evenly spreading a 200 mm layer of coarse aggregate or recycled concrete greater than 40 mm in size (crushed sandstone is not suitable) at a minimum depth of 300 mm.
3) Install a wash rack that is suitable for the anticipated traffic and weight loads.
4) The water used to wash the wheels of the vehicles shall not be discharged into stormwater system at any time. Provide a drainage channel that will convey the runoff from the wash area to a suitable on-site sediment control measure i.e. sediment basin **(see Fact Sheet 17)**, sediment settling tank, or a flat vegetated area.
5) Ensure that the drainage channel used to transport the sediment to the sediment control measure is of adequate size and proper gradient to carry the wash runoff.
6) Makesure that the sediment control measure is also of adequate size.
7) Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
8) Require all employees, subcontractors and others that leave the site with mud or dirt caked tyres and undercarriages to use the wash facilities.
9) If weeds and plant disease are an issue for your site refer to *"Tasmanian Washdown Guidelines for Weed and Disease Control 2004"* from the Tasmanian Department of Primary Industries and Water, Forestry Tasmania and the Agricultural Contractors Association of Tasmania.

Fact Sheet 13

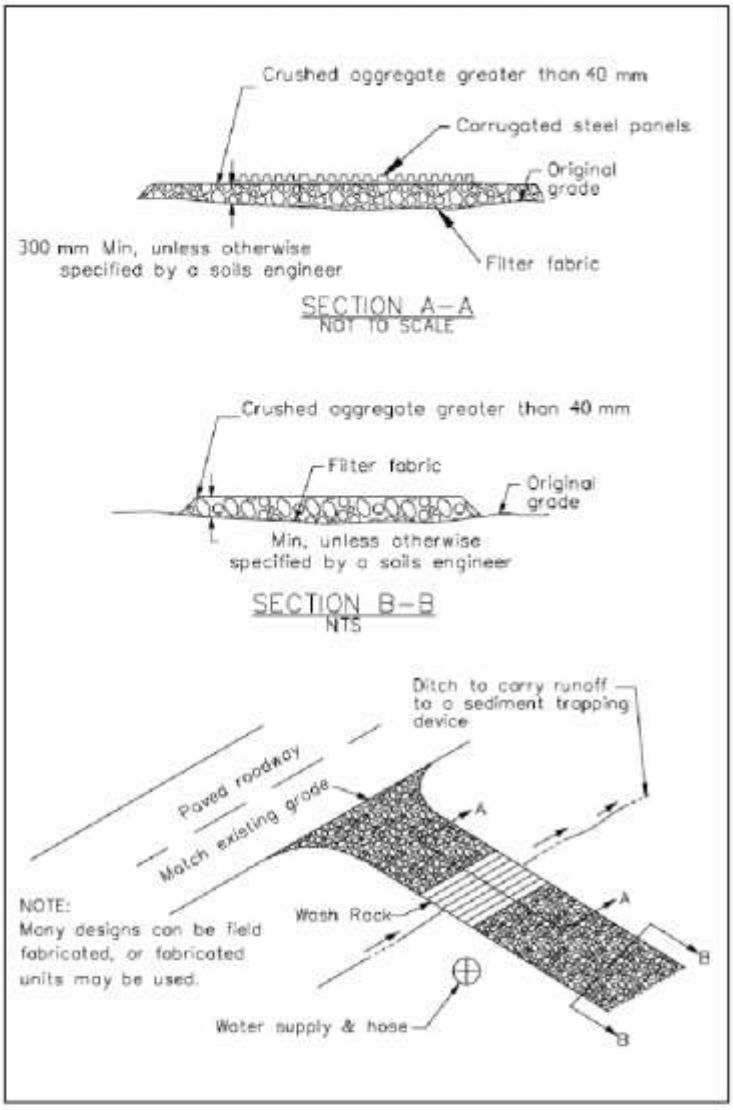

Figure 13 A: Wheel wash design

Maintaining the control measures:

The wheel wash should be inspected weekly and after a major rainfall event. Remove accumulated sediment from the wash rack to maintain system performance. This sediment should be collected and may need to be disposed to landfill.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. **Wheel Wash**
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figure 13A after California Stormwater Quality Association 2003 *"California Stormwater BMP Handbook Construction"*.

Date of Issue: December 2008

Sediment Fences & Fibre Rolls

What are these?

Sediment fences and fibre rolls are sediment control measures installed across slopes or along the parameter of building and construction sites. Fibre rolls are a range of organic products (coconut fibre, straw, flax) that are rolled into large diameter logs. Sediment fences are vertical barriers made from woven geotextile that are held in place by star pickets and a backfilled trench.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 14

WHAT DO I NEED TO DO?

Fibre Rolls: are log-like products commonly consisting of biodegradable fibres. They vary from biodegradable rolled coir (coconut fibre) and hessian socks filled with straw or mulch, to non-biodegradable geotextile tubes filled with mulch or straw. Biodegradable fibre rolls can be left permanently onsite to assist stabilisation and will support vegetative growth if left in place.

Sediment fences: are a commonly used sediment control measure constructed from heavy-duty geotextile. Although a sediment fence looks like shade cloth it is very different (shade cloth is not appropriate because it cannot slow water flow enough to adequately pond water up-slope of the fence and allow sediment to settle under gravity).

Before starting site works:

Identify drainage flow pathways that will intercept runoff from the site. Decide whether to use fibre rolls or sediment fences. Use fibre rolls at the base of an embankment, on slopes that are exposed, or on vegetated slopes where vegetation is failing to control erosion. Sediment fences should be used on small drainage areas and placed down-slope of potential areas of erosion. Document these measures on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)**.

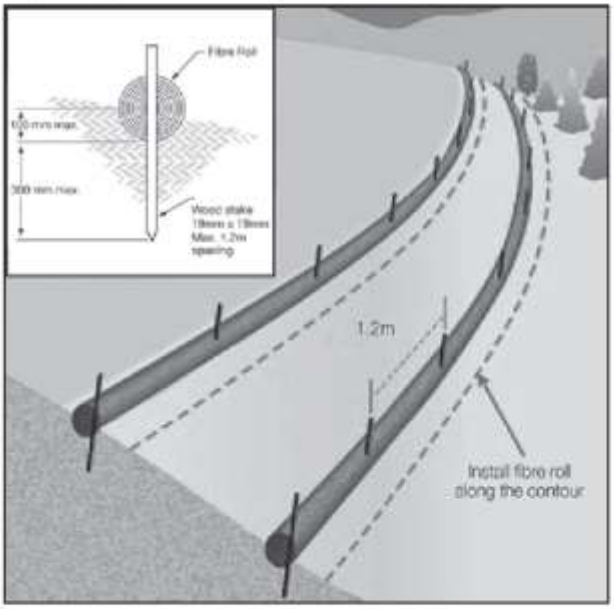


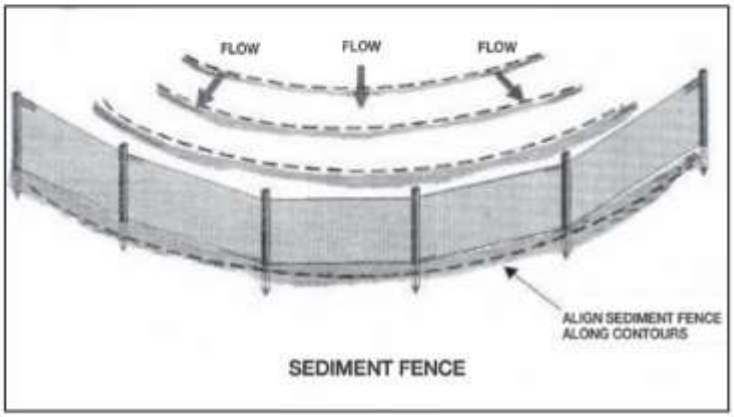
Figure 14A: Installation of fibre rolls

Installing the control measures:

Sediment control measures need to be in place prior to the start of site works. They can be altered after ground disturbance activities and if the site's drainage patterns change.

Installing fibre rolls:

1) Find a suitable installation site (if on a slope, place parallel to contours).
2) Remove large rocks and debris, and prepare a shallow concave trench (50–100 mm deep) to inset the fibre roll. (***Note:*** Place excavated material on the upside of the fibre roll to prevent undercutting.)
3) Place the fibre roll in a shallow trench and stake through the fibre roll every 30 cm.
4) Place further stakes on both sides of the fibre roll to within 2 m from the end of the roll.



Installing sediment fences:

1) Survey and mark out location of sediment fence, ensure it is parallel to the contours of the site.
2) Dig a 150 mm trench immediately above the proposed fence line.
3) Place the bottom of the fabric to the base of the trench and run fabric up the down-slope side of the trench.
4) Backfill the trench and compact to secure anchorage of the fabric.
5) Drive 1.5 m star pickets into ground, 2 m apart to support the sediment fence fabric. Tension and fasten fabric to pickets using UV stabilised zip ties or wire ties.
6) Join sections of fabric at a support post with a 2 m overlap.
7) Angle the ends of the sediment fence upslope to reduce scouring.

Don't place sediment fences across creeks or major drainage lines.

Maintaining the control measures:

Fibre rolls and sediment fences should be checked regularly, especially after every rain event and cleaned or repaired. For sediment fences check that all the pickets and the bottom of the fence are secure and that there are no tears in the fabric.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. **Sediment Fences & Fibre Rolls**
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figures 14A and 14B after California Regional Water Quality Control Board 1999 *"Erosion & Sediment Control Field Manual"*.

Date of Issue: December 2008

Protection of Stormwater Pits

What is it?

Protect the stormwater system from blocking with sediment and building materials by placing control measures around or inside any stormwater pits on and below the site. Stormwater pit protection is an important last resort sediment control measure that should be used in conjunction with other on-site practices.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 15

WHAT DO I NEED TO DO?

Before starting site works:

Identify any stormwater pits and drains on and below the site. Plan the layout of the work site so that any wash-down areas and tile or brick cutting areas are not near them. Clearly mark all the stormwater pits and drains on the site plan and choose appropriate methods that will protect them. Install these sediment control measures before site work commences. Document them on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure staff are aware of its importance.

Note: the placement of sediment control measures on road reserves (i.e. off the work site) will normally require approval from the owner of the road, i.e. council or the Department of Infrastructure, Energy and Resources (DIER).

Installing the control measures:

There are a range of sediment control measures to protect stormwater pits including, sediment fence traps, filter socks and stormwater pit traps. Those that collect sediment above the stormwater pit are easier to clean but have low storage capacity compared to controls that are installed inside the stormwater pits. Place cones around controls in the gutters or on roads to prevent vehicles damaging them.

Sediment fence trap: these are sediment fences staked around the stormwater pit to trap sediment. Fabric must be partially buried so that water and sediment does not just flow underneath. The more space between the fence and the pit, the more chance of sediment settling and the greater the capacity of the trap **(see Figure 15A).**

Filter socks: are woven tubes filled with compost or bioremediation media that separate sediment, hydrocarbons, nutrients and heavy metals from site runoff. Filter socks are more effective than sandbags or geotextile sausages filled with gravel. Filter socks are able to treat runoff at higher flow rates with significantly less ponding.

Filter socks can be installed in the kerb and gutter below the work site, while longer socks can be used as a barrier around the stormwater pit **(see Figure 15B).**

Stormwater pit traps: are baskets, trays, bags or screens placed just below the entrance of the stormwater pit. They prevent sediment from entering the stormwater system. Fine mesh or fabric filters should be used to capture sediment **(see Figure 15C).**

Maintaining the control measures:

All sediment control measures should be inspected, especially after rainfall events and cleaned regularly to maintain effectiveness and prevent bypass. The built up material can be re-stockpiled and used on-site (if it is not contaminated), or otherwise disposed to landfill.

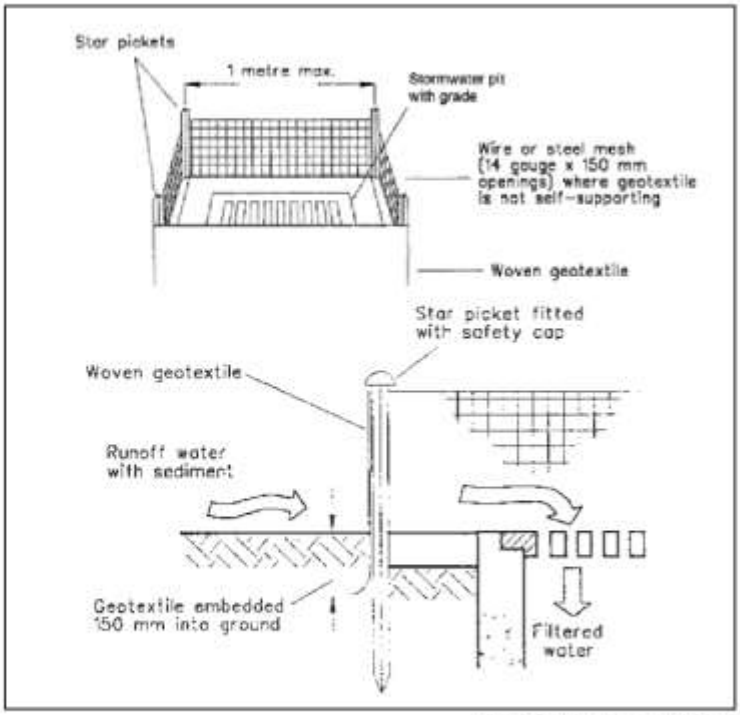

Figure 15A: A sediment fence trap.

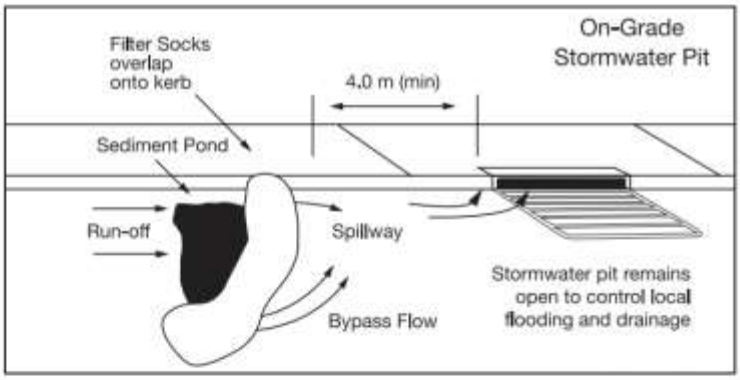

Figure 15B: A filter sock.

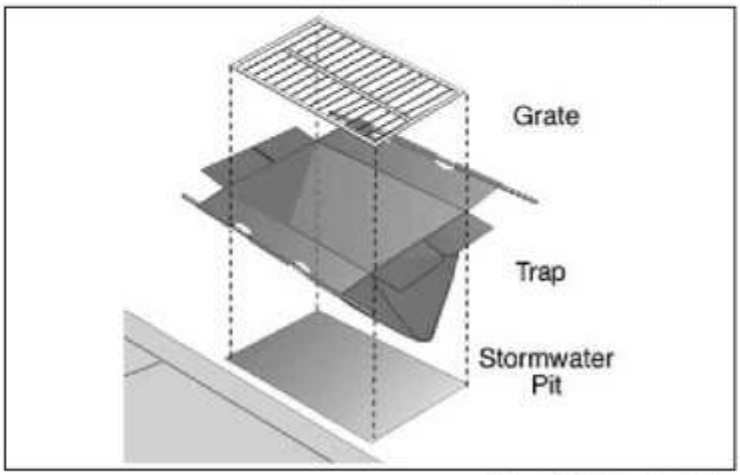

Figure 15C: Stormwater pit trap.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. **Protection of Stormwater Pits**
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
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Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 15A from Landcom 2004 "*Soils & Construction Volume I Managing Urban Stormwater (4th edition)*". Figure 15B after South East Queensland Healthy Waterways Partnership 2006 "*Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites*". Figure 15C after California Regional Water Quality Board 1999 "*Erosion & Sediment Control Field Manual*". Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Protected Concrete, Brick & Tile Cutting

What is this?

Concreting, bricklaying, brick and tile cutting must be conducted in such a way that ensures no waste products enter the stormwater system. If washed into the stormwater system, brick and tile cutting, concrete and mortar slurries will harden and block stormwater pipes and potentially cause flooding. Cement also raises the pH of waterways making it alkaline which is deadly to aquatic animals.

Why is it important?

Sediment generated from building and construction activities can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 16

WHAT DO I NEED TO DO?

Before starting site works:

Find a location on the site away from stormwater pits and drains to undertake these activities, including mixing cement and mortar. This area should be large enough to contain all excess water, residues and waste.

Designate where associated building materials should be stockpiled, as this typically determines where this activity will occur. If the nature of the job requires cutting in a location close to stormwater pits or drains such as cutting a footpath then controls need to be put in place to ensure that no material enters the stormwater system. Identify site requirements and list them on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)** before starting site works.

Installing the control measures:

The designated brick or tile cutting area should have a diversion channel up-slope and sediment collection devices such as a sediment fence below it. If cutting in an area near a stormwater pit, use temporary collection devices such as filter socks, bunding or skirts suitably installed to direct the slurry onto a land area where it can soak into the earth. If this is not possible and the slurry is likely to flow to the stormwater system, filtering will be required. There are filtration systems available that work in the brick cutting machine with built in slurry containment systems, while for the kerb and gutter there are filter socks and for stormwater pits insert traps can be used **(see Fact Sheet 15)**. The filtered water must not be cloudy when discharged to the stormwater system. Install a series of filtration systems for best results.

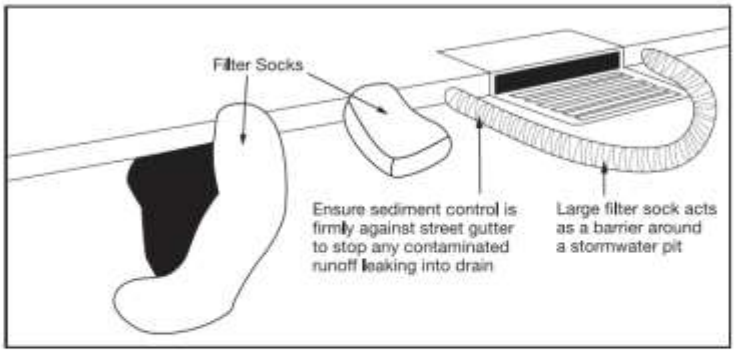

Figure 16A: Installing a series of filtration systems.

When equipment is washed down, use a designated wash-down area on-site e.g. wheel wash **(see Fact Sheet 13)**. Waste concrete slurry can be safely disposed of by tipping small amounts into plastic or geotextile-lined ditches **(see Figure 16C)**. This will enable the water to evaporate or soak in to the earth and the solids can then be disposed to landfill or reused as clean fill in construction or as road base.

Maintaining the control measures:

All sediment control measures will require regular cleaning to maintain effectiveness and over time may need to be replaced. Remove the built up sediment and check for holes, other breaks, clogging and blockages in the control measures.

Shovel or vacuum concrete, brick or tile cutting slurry to an area well away from the stormwater system. **Do not** hose down. If there is no designated disposal area, place slurry into a 40 gallon drum that is half full of water. Solid materials will settle to the bottom of the drum for later disposal and the water can be reused when concreting.

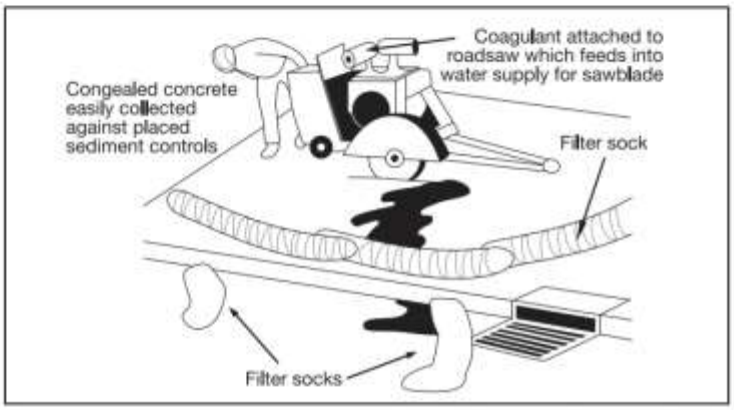

Figure 16B: Acceptable concrete slurry disposal method.

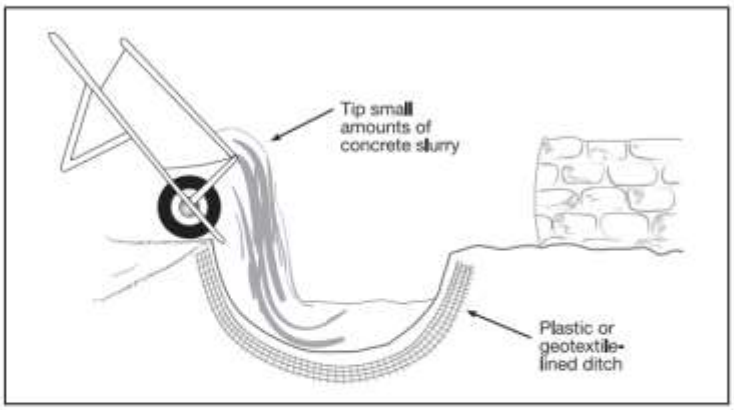

Figure 16C: Disposing concrete slurry into a lined ditch.

List of fact sheets

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Acknowledgement:

Figures 16A, 16B and 16C after NSW Department of Conservation 2004 *"Environmental Best Management Practice Guideline for Concrete Contractors"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Sediment Basins

What is it?

Sediment basins are dams or ponds that capture sediment runoff from building and construction sites. They allow sediment to settle out and sink rather than be transported away with the runoff.
Sediment basins are formed by constructing an embankment of compacted soil at the lowest downstream point on the site and installing an outlet structure and overflow spillway. They are one of the most useful and cost-effective measures for treating sediment-laden runoff.

Why is it important?

Sediment generated from building and construction activities can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 17

WHAT DO I NEED TO DO?

Before starting site works:

Sediment basins are typically required on large construction sites and subdivisions, or in areas of high seasonal rainfall. Sediment basins by no means trap all the sediment from a site. Therefore, sediment basins should be used in conjunction with other sediment and erosion control measures. Sediment basins should be constructed as a first step in any land disturbing activity and remain functional for as long as possible, ideally until the area contributing sediment is stabilised. Document the sediment basin on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)**. Detail on the plan how the basin will be maintained and decommissioned (if it is not a permanent on-site feature). Ensure that on-ground staff are aware of the need to maintain the sediment basin.

Design considerations:

Sediment basins require a considerable area to be effective. The two major factors determining the size of the basin are the settling velocity of the sediment and design flows in regards to rainfall. Sediment basins should be designed to cater for peak flow runoff from a design storm having an average reoccurrence interval of 10 years.

Sediment basins need to be positioned so if failure occurs they will not cause damage or nuisance to property, people or the environment. **Do not** install sediment basins on major drainage pathways. Locate sediment basins off-line and up-stream of the stormwater system, natural and constructed water bodies.

Preferably construct basins at the lowest downstream point to intercept most of the runoff from the site. Access for machinery to remove sediment is crucial, as is an area designated for stockpiling the removed sediment so it can dry out (preferably with this water seeping back into the basin). The dried sediment can eventually be reused or disposed to landfill.

Installing the control measures:

For suitable sediment basin design refer to the procedures in Chapter 4 of the *Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Southern Tasmania*, available from the Derwent Estuary Program web page:
http://www.derwentestuary.org.au/file.php?id=145

Note: For larger sediment basins a civil engineer can be used. They can provide detailed drawings to follow construction. It is essential that the engineer review/check the specifications of the proposed sediment basin to ensure it is correctly sized and down-stream risks are addressed in the event of basin failure. Sediment basins over one megalitre may require a dams permit.

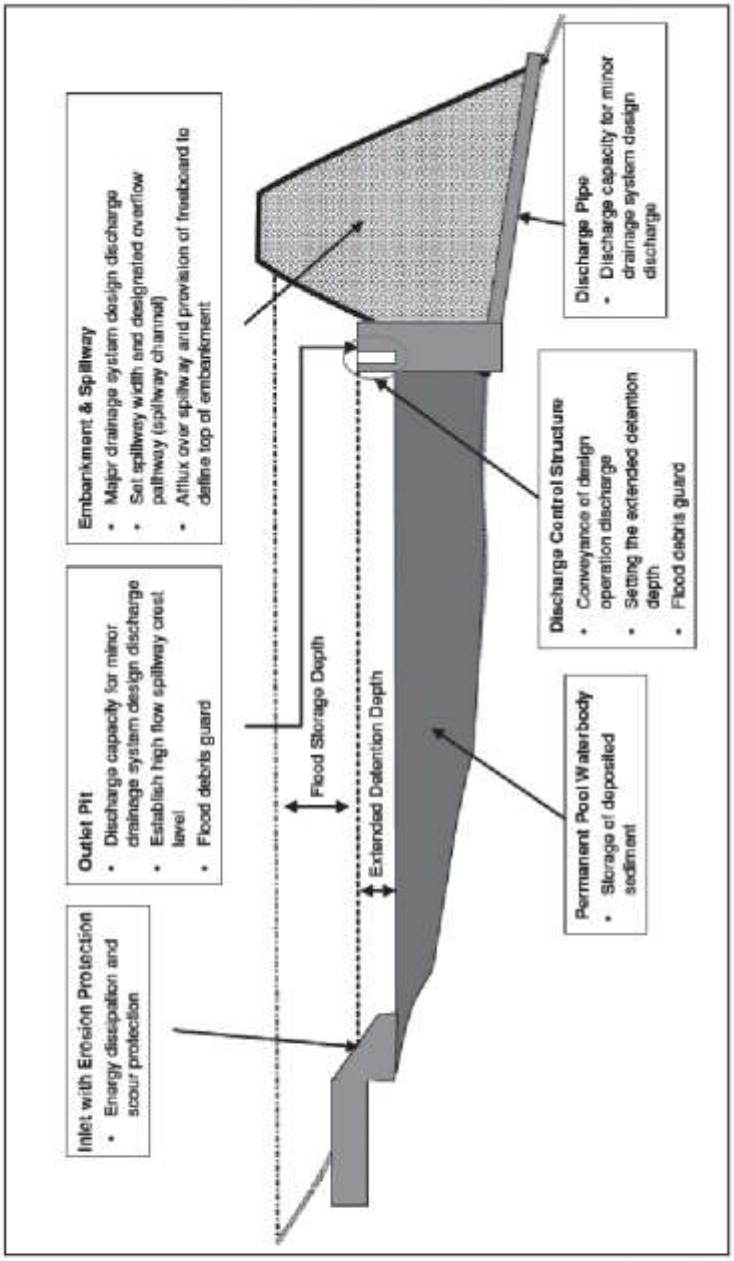

Figure 17A: Sediment basin.

Maintaining the control measures:

Sediment basins require regular inspection, especially after rain events and should be cleaned when more than half full of sediment. Litter and debris should be removed whenever observed in the sediment basin. If the water within the basin is cloudy and never clears, apply gypsum to allow the sediment to settle out.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. **Sediment Basins**
18. Dust Control
19. Site Revegetation

Remember:

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Acknowledgement:

Figure 17A from Derwent Estuary Program 2006 *"Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Southern Tasmania"*.

Date of Issue: December 2008

Dust Control

What is it?

Minimise the amount of dust (soil, building materials and residues) generated by wind erosion on building and construction sites. Research shows that average dust emission rates of over 2.5 tonnes per hectare per month occur on sites which have no dust control measures in place. The control measures discussed can be used on any building or construction site where dust may be generated and where dust may cause on or off-site damage.

Why is it important?

Sediment generated from wind erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise wind erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 18

WHAT DO I NEED TO DO?

Before starting site works:

Good site planning can eliminate dust being a problem.

1) Assess the dust potential of your site. Dust generating activities include major soil disturbances or heavy construction activity, such as clearing, excavation, demolition, cutting concrete or excessive vehicle traffic.
2) Decide upon dust control measures. A number of methods can be used to control dust from a site. The developer or builder will have to determine which practices are suitable based on specific site and weather conditions.
3) Document dust control measures on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure everyone working on the site understands them.

Installing the control measures:

These control measures will help to reduce the amount of soil and building materials loose on the site and therefore the dust that can be generated.

1) Stage works and disturb only small areas of the site at a time.
2) Maintain as much vegetation as possible. Existing trees and shrubs act as wind breaks, slowing wind velocities and provide coverage to surface soils.
3) Install constructed wind barriers if there is high risk of dust generation. Wind fences divert the wind up and over the site. Ensure that it is semi-permeable otherwise down-wind turbulence can make erosion worse.
4) Dampen the site slightly with a light application of water during excavation or when dust is being raised (be careful to only moisten ground surface, do not wet it to the point of creating mud).
5) Apply mulch to recently disturbed areas. Mulch can reduce wind erosion by 80%.
6) Where vegetative cover and mulching cannot be used (i.e. on site roads and entrances) apply rocks and stones.
7) For large open areas deep ploughing (tillage) brings soil clods to the surface where they rest on top of the dust, preventing it from becoming airborne.
8) Install a wheel wash where vehicles and/or equipment exit the site. Alternatively, a stabilised site access can be used **(see Fact Sheet 12)**.

9) Cover sand and soil stockpiles with fabric, plastic or vegetation.
10) Ensure that relevant equipment and machinery have dust suppressors fitted.

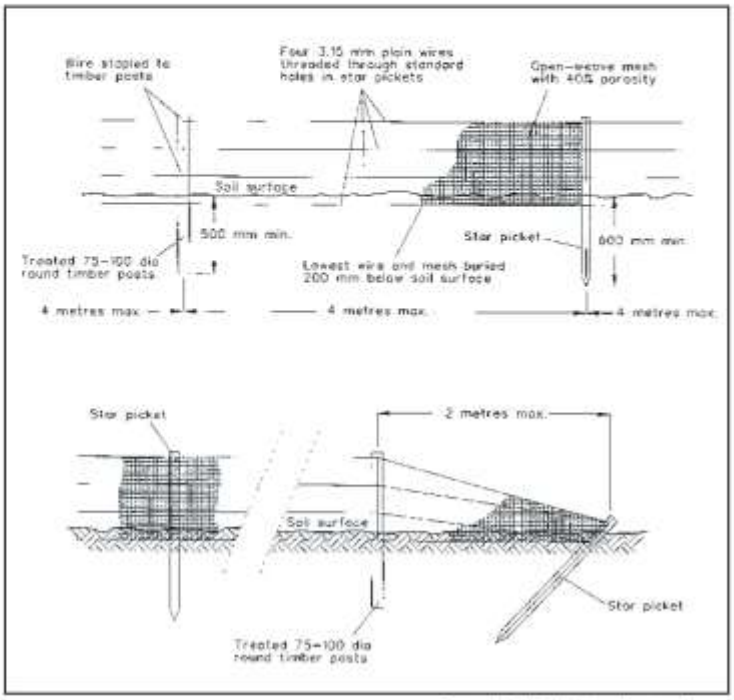

Figure 18A: Installation of a wind fence.

Maintaining the control measures:

Dust control measures involving the application of water require more monitoring than structural or vegetative controls to remain effective. If structural controls are used, they should be inspected for deterioration on a regular basis to ensure that they are still achieving their intended purpose.

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Acknowledgement:

Figure 18A from Landcom 2004 "*Soils & Construction Volume I Managing Urban Stormwater (4th edition)*". Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Site Revegetation

What is it?

All areas disturbed by building and construction activities should be promptly and progressively stabilised through revegetation and landscaping to reduce the potential for erosion.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the management practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 19

WHAT DO I NEED TO DO?

Installing the control measures:

As you finish works in one part of the site, revegetate it. Vegetation is an ideal and usually inexpensive method of stabilisation because it reduces soil erosion by:

1) Absorbing the impact of raindrops.
2) Reducing the volume and velocity of runoff.
3) Binding the soil with the roots.
4) Protecting the soil from the erosive effects of the wind.

Note: Revegetation should not be expected to provide all the soil erosion protection required on your site. Other erosion control measures will be required if the soil is not stable due to its composition or slope. Erosion control mats and blankets should be used on steep slopes to provide temporary protection until the vegetation is fully established **(see Fact Sheet 8).**

Temporary revegetation: annual grass species (e.g. rye) are effective temporary ground cover because they are fast growing and can quickly establish a root system. They can be planted to prevent erosion where:

1) Exposed soil needs to be stabilised until permanent revegetation grows.
2) Temporary protection (between 6-8 months) is required until landscaping occurs.
3) A disturbed area will be left and then be re-disturbed as part of the site works (e.g. topsoil stockpiles).

Note: These annual grasses do not provide effective erosion control during their early growth phase (first few weeks) unless the soil is prepared with a mulch layer. Annual grasses die within one season providing limited soil coverage after about 6-8 months. They require watering until established, and may need mowing (without the collection of the cut grass) at least once before they can provide adequate soil coverage.

Permanent revegetation: options include seeding with perennial grasses (that will over time succeed the annual species), installing turf strips, and planting of native plants from seed, tube stock or invasion from surrounding bushland. If local seed stock is to be used for propagation it needs to be collected in advance. Advice on native plants and/or sources of seed stock can be obtained from your local council.

Seed the exposed topsoil, not the subsoil as the biological, physical and chemical characteristics of many subsoil materials inhibit the establishment of plants. Where practical to do so, a seedbed should be cultivated and

moistened before sowing seed **(see Figure 19A).** This may require deep ripping to 300 mm where there is a compacted layer.

Include native species endemic to the region to enhance the ecological values and create an aesthetically pleasing environment. Native species have evolved to local environment and can establish themselves more quickly and vigorously than exotic species.

Some revegetation options may require mulching. Planting trees and shrubs tends to be more successful if combined with weed suppressing mulching and installation of tree guards and stakes. Apply mulch at a depth between 75-100 mm.

Note: Seeding, turf strips and native plants require sufficient irrigation for germination and to sustain plant growth if rainfall is poor. If the plants are slow growing other erosion control measures may be required until the vegetation is established and is able to prevent erosion.

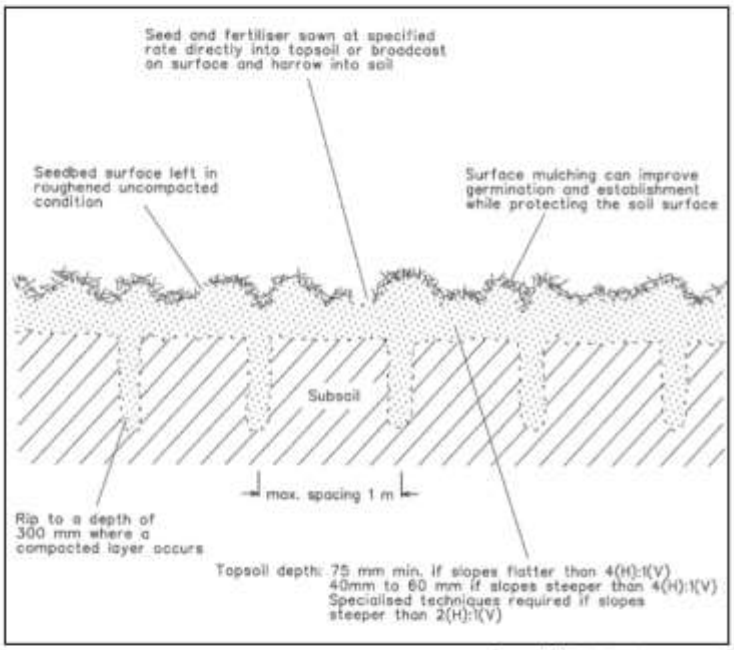

Figure 19A: *Seedbed preparation.*

Maintaining the control measures:

A monitoring and maintenance program for site revegetation should be developed and implemented. It needs to include irrigation, mowing, weeding and appropriate remedial action such as replacing any lost topsoil and re-sowing the site. Once the site has been revegetated and is established to the satisfaction of the council it can be handed over to the new homeowner.

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Date of Issue: December 2008

Appendix 3 IB105 Borehole Logs

GES GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH01

EASTING:	511718	GDA94	
NORTHING:	5413766	GDA94	
BORING LOCATION:	2 Invermay Road	ELEVATION AND DATUM:	2.22 m AHD
DRILLING CONTRACTOR:	Geo-Environmental Solutions P/L	TOTAL DEPTH (m):	2
EQUIPMENT/METHOD:	Geoprobe 540UD	LOGGED BY: G. McDonald	NATURAL (m): WATER TABLE (m): N/A
SAMPLING:	Direct Push	DATE:	31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.5	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH01 0.5-0.6		Arsenic 1, Barium 1, Beryllium 1, Cadmium 2, Chromium 2, Chromium VI 1, Copper 1, Cobalt 1, Manganese 1, Mercury 1, Molybdenum 1, Nickel 1, Selenium 1, Silver 2, Tin, Zinc, Aldrin+Dieldrin, DDT+DDE, Endosulfan I, Phenol, TPH C6 - C9 1, TPH C10 - C36 2, PAH SumTEQ 1, PCBs, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1, Cyanide, Fluoride		0.5 ✕
0.5–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH		0.9			1.2
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH01 1.4-1.5		Arsenic 1, Barium 1, Beryllium 2, Cadmium 1, Chromium 2, Chromium VI 1, Copper 1, Cobalt 1, Manganese 1, Mercury 1, Molybdenum 2, Nickel 1, Selenium, Silver 1, Tin, Zinc, Aldrin+Dieldrin, DDT+DDE, Endosulfan I, Phenol, TPH C6 - C9 1, TPH C10 - C36 2, PAH SumTEQ 1, PCBs, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1, Cyanide, Fluoride		0.8

Tas EPA IB105 CLASSIFICATION: Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH02

EASTING:	511711	GDA94
NORTHING:	5413776	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.8	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH02 0.5-0.6	6.5	Arsenic 1, Barium 1, Beryllium 1, Cadmium 1, Chromium 1, Chromium VI, Copper, Cobalt, Lead 1, Mercury 2, Molybdenum 1, Nickel 1, Selenium 1, Silver, Tin, Zinc 2, Aldrin+Dieldrin, DDT etc, Benzo(a)pyrene 1, Phenol, TPH C6 - C9 1, TPH C10 - C36 1, PAH Sum/TEQ 1, PCBs, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1, Cyanide, Fluoride		2.0–1.6
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.4–1.2
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH02 1.4-1.5	6.3	Arsenic 1, Barium 1, Beryllium 2, Cadmium 1, Chromium 2, Chromium VI, Copper 1, Cobalt 1, Lead 1, Mercury 1, Molybdenum 1, Nickel 1, Selenium 1, Silver, Tin, Zinc 1, Aldrin+Dieldrin, DDT etc, Benzo(a)pyrene 1, Phenol, TPH C6 - C9 1, TPH C10 - C36 1, PAH Sum/TEQ 1, PCBs, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1, Cyanide 1, Fluoride 1		1.0–0.4

Tas EPA IB105 CLASSIFICATION: Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH03

EASTING:	511708	GDA94
NORTHING:	5413746	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances (Arsenic, Barium, Beryllium, Cadmium, Chromium, Chromium VI, Copper, Cobalt, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Tin, Zinc, Aldrin+Dieldrin, DDT etc, Benzo(a)pyrene, Phenol, TPH C6 - C9, TPH C10 - C36, PAH Sum/TEQ, PCBs, Benzene, Toluene, Ethylbenzene, Total Xylenes, Cyanide, Fluoride)	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.5	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH03 0.5-0.6	15.6	2 2 1 1 1 1 1 2 1 1 1 1 2 1 1 1 1 1 1 1 1		2.0, 1.8, 1.6
0.5–0.8		FILL	SM					1.6, 1.4
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.4, 1.2
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH03 1.4-1.5	9.3	1 1 2 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		1.0, 0.8, 0.6, 0.4

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH04

EASTING:	511702	GDA94
NORTHING:	5413756	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen		P					2.2
0.1–0.5	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH04 0.5-0.6	4.4	Arsenic 1, Barium 1, Beryllium 1, Cadmium 1, Chromium 1, Chromium VI, Copper 1, Cobalt, Lead 1, Mercury 1, Molybdenum 1, Nickel 1, Selenium, Silver, Tin, Zinc 1, Aldrin+Dieldrin, DDT etc, Benzo(a)pyrene 1, Phenol, TPH C6 - C9 1, TPH C10 - C36 1, PAH Sum/TEQ 1, PCBs, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1, Cyanide, Fluoride		2.0
0.5–0.8								1.8
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.6
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH04 1.4-1.5	3.5	Arsenic 1, Barium 1, Beryllium 2, Cadmium 1, Chromium 2, Chromium VI, Copper 1, Cobalt, Lead 1, Mercury 1, Molybdenum 1, Nickel 1, Selenium, Silver, Tin, Zinc 1, Aldrin+Dieldrin, DDT etc, Benzo(a)pyrene 1, Phenol, TPH C6 - C9 1, TPH C10 - C36 1, PAH Sum/TEQ 1, PCBs, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1, Cyanide, Fluoride		1.4
								1.2
								1.0
								0.8
								0.6
								0.4

Tas EPA IB105 CLASSIFICATION: Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH05

EASTING:	511694	GDA94
NORTHING:	5413763	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.8	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH05 0.5-0.6		Arsenic 2; Barium 1; Beryllium 1; Cadmium 1; Chromium 1; Chromium VI 1; Copper 1; Cobalt 1; Lead 1; Manganese 1; Mercury 1; Molybdenum 1; Nickel 1; Selenium 1; Silver 1; Tin 1; Zinc 2; Aldrin+Dieldrin 1; DDT etc 1; Benzo(a)pyrene 1; Phenol 1; TPH C6 - C9 1; TPH C10 - C36 1; PAH Sum/TEQ 1; PCBs 1; Benzene 1; Toluene 1; Ethylbenzene 1; Total Xylenes 1; Cyanide 1; Fluoride 1	X	1.8
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.4
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH05 1.4-1.5		Arsenic 1; Barium 1; Beryllium 2; Cadmium 1; Chromium 2; Chromium VI 1; Copper 1; Cobalt 1; Lead 1; Manganese 1; Mercury 1; Molybdenum 1; Nickel 1; Selenium 1; Silver 1; Tin 1; Zinc 1; Aldrin+Dieldrin 1; DDT etc 1; Benzo(a)pyrene 1; Phenol 1; TPH C6 - C9 1; TPH C10 - C36 1; PAH Sum/TEQ 1; PCBs 1; Benzene 1; Toluene 1; Ethylbenzene 1; Total Xylenes 1; Cyanide 1; Fluoride 1		0.8
								0.4

Tas EPA IB105 CLASSIFICATION: Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION X APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH06

EASTING:	511695	GDA94
NORTHING:	5413737	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.8	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH06 0.5-0.6		Arsenic 2; Barium 1; Beryllium 1; Cadmium 1; Chromium 1; Chromium VI 1; Copper 1; Cobalt 1; Lead 1; Manganese 1; Mercury 1; Molybdenum 1; Nickel 1; Selenium 1; Silver 1; Tin 1; Zinc 1; Aldrin+Dieldrin 1; DDT etc 1; Benzo(a)pyrene 1; Phenol 1; TPH C6 - C9 1; TPH C10 - C36 1; PAH Sum/TEQ 1; PCBs 1; Benzene 1; Toluene 1; Ethylbenzene 1; Total Xylenes 1; Cyanide 1; Fluoride 1		2.0, 1.8
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.4, 1.2
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH06 1.4-1.5		Arsenic 1; Barium 1; Beryllium 2; Cadmium 1; Chromium 2; Chromium VI 1; Copper 1; Cobalt 1; Lead 1; Manganese 1; Mercury 1; Molybdenum 1; Nickel 1; Selenium 1; Silver 1; Tin 1; Zinc 1; Aldrin+Dieldrin 1; DDT etc 1; Benzo(a)pyrene 1; Phenol 1; TPH C6 - C9 1; TPH C10 - C36 1; PAH Sum/TEQ 1; PCBs 1; Benzene 1; Toluene 1; Ethylbenzene 1; Total Xylenes 1; Cyanide 1; Fluoride 1		1.0, 0.8, 0.6, 0.4

Tas EPA IB105 CLASSIFICATION: Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH07

EASTING:	511688	GDA94
NORTHING:	5413746	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.8	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH07 0.5-0.6		Arsenic 2, Barium 1, Beryllium 1, Cadmium 1; Chromium 1, Chromium VI 1, Copper 2, Cobalt 1, Lead 2, Mercury 1; Molybdenum 1, Nickel 1; Selenium, Silver, Tin; Zinc 2; Aldrin+Dieldrin, DDT etc; Benzo(a)pyrene 1; Phenol, TPH C6 - C9 1, TPH C10 - C36 2, PAH Sum/TEQ 1, PCBs 1, Benzene 1, Toluene 1, Ethylbenzene 1, Total Xylenes 1; Cyanide, Fluoride		1.6
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.2
1.2–1.9	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH07 1.4-1.5		Arsenic 1, Barium 1, Beryllium 2, Cadmium 1, Chromium 2; Chromium VI 1, Copper 1, Cobalt 1, Lead 1, Mercury 1; Molybdenum 1, Nickel 1; Selenium, Silver, Tin; Zinc 1; Aldrin+Dieldrin, DDT etc; Benzo(a)pyrene 1; Phenol, TPH C6 - C9 1, TPH C10 - C36 1, PAH Sum/TEQ 1; PCBs, Benzene, Toluene 1, Ethylbenzene 1, Total Xylenes 1; Cyanide, Fluoride		0.8

Tas EPA IB105 CLASSIFICATION: Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: Inverest Student Services ESA

CLIENT: UTAS

Log of BH08

EASTING:	511684	GDA94
NORTHING:	5413730	GDA94
ELEVATION AND DATUM:	2.22	m AHD
TOTAL DEPTH (m):	2	
NATURAL (m):	WATER TABLE (m):	N/A

BORING LOCATION: 2 Invermay Road

DRILLING CONTRACTOR: Geo-Environmental Solutions P/L

EQUIPMENT/METHOD: Geoprobe 540UD LOGGED BY: G. McDonald

SAMPLING: Direct Push DATE: 31/05/2019

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0–0.1	FILL: Pavement - Bitumen	FILL	P					2.2
0.1–0.8	FILL: SILTY SAND trace clay, mixed, gravels and charcoal, moist medium dense	FILL	SM	BH08 0.5-0.6		Arsenic 2; Barium 1; Beryllium 1; Cadmium 1; Chromium 1; Chromium VI 1; Copper 1; Cobalt 1; Lead 1; Manganese 1; Mercury 1; Molybdenum 1; Nickel 1; Selenium 1; Silver 1; Tin 1; Zinc 1; Aldrin+Dieldrin 1; DDT etc 1; Benzo(a)pyrene 1; Phenol 1; TPH C6 - C9 1; TPH C10 - C36 1; PAH Sum/TEQ 1; PCBs 1; Benzene 1; Toluene 1; Ethylbenzene 1; Total Xylenes 1; Cyanide 1; Fluoride 1		2.0–1.6
0.8–1.2	SILTY CLAY: black, mixed high plasticity, moist firm consistency		CH					1.4–1.2
1.2–2.0	Clayey SILT: olive brown, moist medium dense consistency	Q	ML	BH08 1.4-1.5		Arsenic 1; Barium 1; Beryllium 1; Cadmium 2; Chromium 1; Chromium VI 1; Copper 1; Cobalt 1; Lead 1; Manganese 1; Mercury 1; Molybdenum 1; Nickel 1; Selenium 1; Silver 1; Tin 1; Zinc 1; Aldrin+Dieldrin 1; DDT etc 1; Benzo(a)pyrene 1; Phenol 1; TPH C6 - C9 1; TPH C10 - C36 1; PAH Sum/TEQ 1; PCBs 1; Benzene 1; Toluene 1; Ethylbenzene 1; Total Xylenes 1; Cyanide 1; Fluoride 1		1.0–0.4

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Appendix 4 Soil Tracking From

Footprint of *BUILDING 3* 2 Invermay Road, Invermay, Tasmania

Date excavated	Soil origin	Stockpile ID	Stockpile location	Soil description (colour, texture, moisture, odour, staining)	Samples collected	Laboratory analysis (list lab tests)	Final soil classification Fill, Level 1, Level 2, Level 3, Level 4	Final destination	Notes	Logged by

Appendix 5 Soil Results compared against IB105

The soil samples have been compared against IB105 guidelines for soil disposal, refer to Table 4

Table 4 Soil Analytical Results Compared Against IB105 Total Solids Investigation Limits for soil Disposal

Information Bulletin 105 **Classification and Management of Contaminated Soil For Disposal**		Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Copper	Cobalt	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Benzo(a)pyrene	C6 - C9 Fraction	C10 - C36 Fraction (sum)	Sum of polycyclic aromatic hydrocarbons	Total Polychlorinated biphenyls	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total Cyanide
Unit		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		5	10	1	1	2	5	2	5	5	0.1	2	5	5	0.5	10	50	0.5	0.1	0.2	0.5	0.5	0.5	1
Investigation Level Selected																								
IB105 Level 1		<20	<300	<2	<3	<50	<100	<100	<300	<500	<1	<60	<10	<200	<0.08	<65	<1000	<20	<2	<1	<1	<3	<14	<32
IB105 Level 2		20	300	2	3	50	100	100	300	500	1	60	10	200	0.08	65	1000	20	2	1	1	3	14	32
IB105 Level 3		200	3000	40	40	500	2000	200	1200	5000	30	600	50	14000	2	650	5000	40	20	5	100	100	180	1000
IB105 Level 4		750	30000	400	400	5000	7500	1000	3000	25000	110	3000	200	50000	20	1000	10000	200	50	50	1000	1080	1800	2500
31/05/2019	BH01 0.5-0.6	18	240	<1	4	65	411	12	228	377	<0.1	47	<5	283	<0.5	<10	1880	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH01 1.4-1.5	8	80	2	<1	65	46	16	23	176	<0.1	68	<5	77	<0.5	<10	1850	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH02 0.5-0.6	13	160	<1	2	39	1850	10	167	622	<0.1	45	<5	345	<0.5	<10	970	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH02 1.4-1.5	10	40	2	<1	64	19	7	11	81	<0.1	25	<5	49	<0.5	<10	<50	<0.5	<0.1	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH03 0.5-0.6	307	580	<1	2	38	379	10	550	462	0.2	42	<5	436	<0.5	<10	690	1.5	----	0.3	<0.5	<0.5	<0.5	
31/05/2019	BH03 1.4-1.5	11	20	2	<1	58	23	11	15	69	<0.1	33	<5	57	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH04 0.5-0.6	18	50	<1	<1	7	86	4	119	187	<0.1	10	<5	136	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH04 1.4-1.5	10	20	2	<1	63	19	8	10	68	<0.1	25	<5	48	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH05 0.5-0.6	31	50	<1	<1	10	159	5	229	147	0.2	16	<5	206	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH05 1.4-1.5	8	20	2	<1	76	16	11	9	95	<0.1	31	<5	51	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH06 0.5-0.6	24	80	<1	<1	19	166	5	211	205	<0.1	21	<5	125	<0.5	<10	580	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH06 1.4-1.5	8	20	2	<1	64	18	8	11	64	<0.1	32	<5	52	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH07 0.5-0.6	48	160	<1	1	16	2280	9	364	461	2.3	35	<5	353	<0.5	<10	1130	3	<0.1	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH07 1.4-1.5	9	20	2	<1	66	22	19	11	100	<0.1	50	<5	65	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH08 0.5-0.6	40	60	<1	<1	6	62	4	74	120	<0.1	11	<5	63	<0.5	<10	110	<0.5	----	<0.2	<0.5	<0.5	<0.5	
31/05/2019	BH08 1.4-1.5	12	30	1	<1	66	14	8	11	74	<0.1	25	<5	50	<0.5	<10	<50	<0.5	----	<0.2	<0.5	<0.5	<0.5	

Table 5 Soil Analytical Results Compared Against IB105 Leachate Investigation Limits for soil Disposal

Information Bulletin 105 **Classification and Management of Contaminated Soil For Disposal** **Leachable Fraction** *Italic/** - Based On Soil (Total) Limit **Bold** - Based On Leach Limit		Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Copper	Cobalt	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Aldrin + Dieldrin	DDT + DDD + DDE	Benzo(a)pyrene	C6 - C9 Fraction	C10 - C36 Fraction (sum)	Benzo(a)pyrene (TEQ)	Polychlorinated biphenyls (PCB's)	Benzene	Toluene	Ethylbenzene	Total Xylenes
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR		0.1	0.1	0.05	0.05	0.1	0.1		0.1	0.1	0.001	0.1	0.1	0.1	0.5	0.5	0.5			0.5	1	1	2	2	2
Investigation Level Selected																									
IB105 Level 1																									
IB105 Level 2		<0.5	<35	<1	<0.1	<0.5	<10		<0.5	<25	<0.01	<1	<0.1	<25	<3	<200	<0.5			<0.5	<1	<50	<1400	<3000	<5000
IB105 Level 3		0.5	35	1	0.1	0.5	10		0.5	25	0.01	1	0.1	25	3	200	0.5			0.5	1	50	1400	3000	5000
IB105 Level 4		5	350	4	0.5	5	100		5	250	0.1	8	1	250	30	2000	5				2	500	14000	30000	50000
31/05/2019	BH03 0.5-0.6	**<0.1**	*				*		*					*							----				
31/05/2019	BH07 0.5-0.6	*					**0.3**		*		*			*					*		<0.1				

Note:
Leachable fraction analysis will take precedence over soil analysis when calculating IB105 Limits.
There are no leachable fraction investigation limits for certain compounds eg. Cobalt, and therefore the solids limit is applied. Where solid Level 2 or greater exceedances are present, these are represented with a * in the sheet. Leachable fraction limits are not available for Level 1 classification, and therefore a minimum leachable fraction Level 2 limit is applied if the solid results exceed Level 1 guideline limits for solids, alternatively Level 1 is applied
Leachable fraction exceedances are represented with a bold and highlighted cell and Level 2 solid exceedances are defined with italics and bold highlighting
Where the benzo(a)pyrene (TEQ) limit is exceeded, the assessment is based on soil total limits

Level 6, 134 Macquarie Street, Hobart TAS
GPO Box 1550, Hobart, TAS 7001 Australia

ENVIRONMENT PROTECTION AUTHORITY

INFORMATION BULLETIN No. 105

Environmental Management and Pollution Control (Waste Management) Regulations 2010

CLASSIFICATION AND MANAGEMENT OF CONTAMINATED SOIL FOR DISPOSAL

1. Introduction

This bulletin defines the criteria used by the Environment Protection Authority (EPA) for the classification of contaminated soil that requires treatment and/or off-site disposal, and outlines the management of each classification in accordance with the *Environmental Management and Pollution Control (Waste Management) Regulations 2010* (the 'Regulations'). Although criteria set out in this bulletin have been determined for soil, they may be applicable to the classification of other solid waste material on an 'as needs basis' (see section 2.2.3). Please note, for the purposes of this Bulletin soil also includes dredge spoil (refer Section 2.2.5).

This bulletin is designed to be used by waste producers, consultants, local government, waste transporters and landfill operators that are responsible for determining whether potentially contaminated soil is suitable to be disposed of at a landfill, in assessing alternative options for contaminated soil management and how to make an application for disposal approval to the EPA.

The EPA encourages effective waste management by promoting on-site remediation, treatment and/or re-use, where appropriate, as the preferred options for dealing with contaminated soil. In accordance with the hierarchy of waste management options, direct disposal of soil to landfills should be used only when no other approved method of dealing with the contaminated soil is available. For further details on these waste management principles, see Section 1.2 of the *Landfill Sustainability Guide 2004* (DPIWE, 2004).

Treatment, re-use options and disposal of soil will be assessed and approved on a case by case basis by the Director, EPA ('the Director') or the Director's delegate.

2. Classification

The EPA uses 4 categories to classify contaminated soil: (Level 1) *Fill Material*; (Level 2) *Low Level Contaminated Soil*; (Level 3) *Contaminated Soil*; and (Level 4) *Contaminated Soil for Remediation*, Table 1 below summarises each classification.

Criteria in Table 2 below shows the maximum total concentration, and the maximum leachable concentration values for specific pollutants that are used to classify soil for off-site disposal. For soils classified as potentially acid sulfate soils (PASS), the criteria in Table 2 do not apply. Determination of risk associated with these soils should be conducted in line with the *Tasmanian Acid Sulfate Soil Management Guidelines* published by Department of Primary Industries, Parks, Water and Environment (refer Section 2.2.5).

For potential per and poly – fluoroalkyl substances (PFAS) contaminated soils, the criteria as detailed in the National Environmental Management Plan (NEMP 2018), section 14.6, should

be used for the classification and determination of risk associated with soils containing PFAS for disposal (refer to section 2.2.6 of this bulletin for further detail).

Potentially contaminated soils are classified by analysis of representative samples of the soil and comparison of the results to the chemical concentrations given in Table 2.

It is not necessary to sample for all contaminants listed in Table 2 for soil classification. However, all contaminants that are reasonably likely to be present in the soil above background levels should be included in the sample analysis.

Generally, where a leachable concentration is prescribed in Table 2 that value takes precedence over the total concentration and is used as the sole determinant of final classification for disposal (see section 2.2.4 for further information).

Please note that these values in Table 2 are ***not*** to be interpreted as clean up target levels for certain land uses.

Table 1. Summary of the classification process

	Classification (with reference to Table 2)	**Controlled Waste**[1]	**Comments**
Fill Material[2] **(Level 1)**	Soil that exhibits levels of contaminants below the limits defined under *Fill Material* in Table 2.	Unlikely	Soil classified as *Fill Material* can still be a 'pollutant' under the *Environmental Management and Pollution Control Act 1994* and needs to be responsibly managed.
Low Level Contaminated Soil (Level 2)	Soil that exhibits levels of contaminants above the limits defined under *Fill Material* but below the limits defined under *Low Level Contaminated Soil* in Table 2.	Likely	Where leachable concentrations have not been prescribed, maximum total concentrations will be used to classify the soil.
Contaminated Soil (Level 3)	Soil that exhibits levels of contaminants above the limits defined under *Low Level Contaminated Soil* but below the limits defined under *Contaminated Soil* in Table 2.	Yes	Where leachable concentrations have not been prescribed, maximum total concentrations will be used to classify the soil.
Contaminated Soil for Remediation (Level 4)	Soil that exhibits levels of contaminants above the limits defined under *Contaminated Soil* in Table 2 (regardless of the maximum total concentrations) is generally ***not*** considered acceptable for off-site disposal without prior treatment.	Yes	Soil that contains contaminants that do not have criteria for leachable concentrations (*e.g.* petroleum hydrocarbons), and the levels of contaminants exceed the maximum total concentrations listed in *Contaminated Soil*, are generally classified as *Contaminated Soil for Remediation*.

[1] Controlled Waste is defined in the *Environmental Management and Pollution Control Act 1994*.
[2] Criteria for *Fill Material* are the limits set by the Director for the purposes of R.9(2)(a)(ii) in the *Regulations*.

Table 2. Maximum total concentration and leachable concentration values permitted for waste classification (Note, does not apply for material classified as PASS (refer section 2.2.5) or PFAS (refer section 2.2.6))

	FILL MATERIAL Level 1	LOW LEVEL CONTAMINATED SOIL Level 2		CONTAMINATED SOIL Level 3	
CONTAMINANT	Maximum total concentration mg/kg dry weight	Maximum total concentration mg/kg dry weight	Maximum (TCLP) leachable concentration (pH 5.0 extract) mg/L	Maximum total concentration mg/kg dry weight	Maximum (TCLP) leachable concentration (pH 5.0 extract) mg/L
Arsenic	20	200	0.5	750	5
Barium	300	3,000	35	30,000	350
Beryllium	2	40	1	400	4
Cadmium	3	40	0.1	400	0.5
Chromium (total)	50	500	0.5	5,000	5
Chromium (VI)	1	200	NA*	2,000	NA
Copper	100	2,000	10	7,500	100
Cobalt	100	200	NA	1,000	NA
Lead	300	1,200	0.5	3,000	5
Manganese	500	5,000	25	25,000	250
Mercury (total)	1	30	0.01	110	0.1
Molybdenum	10	1,000	2.5	4,000	20
Nickel	60	600	1	3,000	8
Selenium	10	50	0.1	200	1
Silver	10	180	0.5	720	5
Tin (total)	50	500	NA	900	NA
Zinc	200	14,000	25	50,000	250
Tributyltin (reported as Sn)	0.005	0.07	0.05	0.7	0.5
Aldrin + Dieldrin	2	20	0.003	50	0.03
DDT + DDD + DDE	2	200	0.2	1,000	2
Benzo(a)pyrene	0.08	2	0.0005	20	0.005
Phenols	25	500	14	2,000	50
C_6-C_9 petroleum hydrocarbons	65	650	NA	1,000	NA
C_{10}-C_{36} petroleum hydrocarbons	1,000	5,000	NA	10,000	NA
Polycyclic aromatic hydrocarbons (total)	20	40	0.0005 TEQ**	200	NA
Polychlorinated biphenyls (PCBs)	2	20	0.001	50	0.002
Benzene	1	5	0.05	50	0.5
Toluene	1	100	1.4	1,000	14
Ethylbenzene	3	100	3	1,080	30
Xylene (total)	14	180	5	1,800	50
Cyanide (total)	32	1,000	1	2,500	10
Fluoride	300	3,000	15	10,000	150

*NA – a leachable concentration has not been prescribed (refer Table 1 above)
** For guidance refer to http://epa.tas.gov.au/Documents/Advisory_Note_for_classification_of_PAHs.pdf

2.1 Controlled waste

Contaminated soil may or may not be a controlled waste as defined in the *National Environment Protection Measure for the Movement of Controlled Waste between States and Territories* (NEPC, 1998) and the *Environmental Management and Pollution Control Act 1994* (EMPCA) and as further prescribed in the Regulations.

Soil and other material reasonably suspected to be a controlled waste must be sampled and analysed to determine whether it is a controlled waste before that waste can be removed from the site (R.6(3) of the Regulations). This generally includes, but is not limited to soil that is from a site that is used, or has been used, for an activity listed in Table 3 and is likely to be contaminated.

Special provisions apply to the management of controlled waste, as detailed in section 3 of this bulletin. As a general rule all *Low Level Contaminated Soil*, *Contaminated Soil* and *Contaminated Soil for Remediation* that is intended for treatment, re-use or disposal should be managed as controlled waste unless sampling proves otherwise.

2.2 Sampling and analysis

The waste producer is responsible for organising the sampling and analysis of potentially contaminated soil. It is recommended that a suitably qualified person perform all sampling. Additionally, all soil sampling should be conducted in accordance with the relevant Australian Standards, which include:

- AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds (and any subsequent editions)
- AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances (and any subsequent editions)
- In the case of potentially Acid Sulfate Soils, the *Tasmanian Acid Sulfate Soil Management Guidelines* published by Department of Primary Industries, Parks, Water and Environment should be consulted.

In-situ sampling is generally not recommended for classification of soils that are to be excavated later for disposal. However, if this method of classification is unavoidable, then the Australian Standards listed above should be adhered to in order to obtain a representative number of samples.

All sample analyses must be conducted by a laboratory registered with the National Association of Testing Authorities, accredited for the testing procedures undertaken ('NATA accredited'), or by a laboratory approved by the Director for the test.

2.2.1 Sampling density

The number of samples required for adequate classification of soil is dependent on the volume of material, the estimated standard deviation of contamination concentrations, and the estimated average concentration. However, as a general rule for homogeneous stockpiled soil one sample should be taken every 25 m^3.

2.2.2 Composite sampling

Generally, composite samples are not recommended for classification of soil for disposal. However, composite sampling may assist an environmental program by reducing sampling costs that could be spent elsewhere in the program. Composite sampling is only acceptable for stockpiled soil containing non-volatile contaminants

and is **not** an acceptable method for sampling of volatiles such as some hydrocarbon-contaminated soil.

All composite sampling should be undertaken by a suitably qualified person and in accordance with the Australian Standards AS 4482.1-2005 and the National Environmental Health Forum Monograph, Soil Series No. 3 – *Composite Sampling*, 1996.

2.2.3 Sampling materials other than soil

For materials such as contaminated construction materials there are no guidelines available for determining the representative number of samples for testing. Surface scrapings or bored samples may be required to classify the material. The person undertaking the sampling, preferably an environmental consultant should develop a sampling strategy and density that adequately classifies the material.

2.2.4 Leachable fraction

In order to classify soil for disposal, the leachable concentrations of metals and some organics should be undertaken. Where a leachable concentration is prescribed in Table 2, generally that value will take precedence over the total concentration value and will be used as the sole determinant of final classification for disposal.

The most appropriate procedure for determining the leachable fraction should be determined in consultation with an environmental consultant, the EPA and the analytical laboratory performing the procedures and with consideration of the waste management goals that are to be achieved. Accepted methods for determining leachable fractions are detailed below:

The Toxicity Characteristic Leaching Procedure (TCLP), in accordance with USEPA Method 1311 – SW 846, is used to simulate the leaching of contaminants into groundwater under conditions found in solid waste landfills.

The Multiple Extraction Procedure (MEP), in accordance with USEPA MEP Method 1320 – SW 846, is used to simulate leaching from repetitive acid washings and is a more rigorous test of the buffering capacity of the soil than the TCLP. In some circumstances (*e.g.* for remediation technologies that involve solidification with lime based agents), the MEP would be a more suitable test to determine the long-term stability of soil.

There is also an Australian Standard for the preparation of leachates: AS 4439-1997 (parts 1 to 3), *Wastes, Sediments and Contaminated Soils: Preparation of Leachates.*

2.2.5 Acid sulfate soils

Potentially Acid Sulfate Soils (PASS) underlie parts of Tasmania's coastline and may also underlie inland areas such as peat bogs, salt lakes and wetlands. They are natural soils that contain sulfides (mostly iron sulfides). In an undisturbed and waterlogged state these soils are harmless, but when disturbed (such as dredging estuaries etc), a process of oxidation can produce sulfuric acid in large quantities. As the acid moves through the soil profile it may 'mobilise' or cause the release of metals and other toxins from the soil, which eventually flow into surrounding waterways. Acid Sulfate Soil (ASS) runoff therefore has significant environmental, economic and social impacts. The *Tasmanian Acid Sulfate Soil Management Guidelines* provide guidance on the level of management required to minimise the risk associated with ASS. The *Guidelines* also provide criteria to characterise acid sulfate soils. The criteria in Table 2 of this Bulletin do not apply to any soils classified as PASS. Such soils should be managed as potentially acid sulfate soils. Acid Sulfate Soil predictive mapping is available for Tasmania at www.thelist.tas.gov.au. For further information regarding ASS, instructions on how to utilise the predictive mapping, or obtain a copy of the *Guidelines*, refer to:

http://www.dpiw.tas.gov.au/inter/nsf/WebPages/SWEN-83NVBG?open

2.2.6 Per and poly – fluoroalkyl substances (PFAS)

PFAS are a group of chemicals that have been used in applications such as fire-fighting foams, textile treatments for upholstery and clothing, paper products and electroplating. There are many types of PFAS, with the best known being Perfluorooctane sulfonate (PFOS), Perfluorooctane acid (PFOA) and perfluorohexane sulfonate (PFHxS). Some PFAS have been globally identified as chemicals of high concern, particularly due to their environmental persistence and bioaccumulation. Therefore, in addition to classifying soils using Table 2 of EPA Bulletin 105, the EPA has adopted the PFAS National Environmental Management Plan 2018 (NEMP). Section 14.6 of the NEMP is applicable to PFAS in soils and guides classification and determination of risk associated with disposal to landfill. Both total and leachable PFAS concentrations should be analysed.

Disposal of soils contaminated with PFAS requires the Director's approval. Applications for approval are assessed on a case by case basis in line with the NEMP (2018). To use or obtain a copy of the *NEMP*, refer to:

https://www.epa.vic.gov.au/your-environment/land-and-groundwater/pfas-in-victoria/pfas-national-environmental-management-plan

3. Re-use or disposal - waste management plan

A Waste Management Plan should be developed following the classification of soil to determine whether the soil can be remediated or re-used instead of, or prior to, disposal (see Figure 1, which summaries this process, and section 5 which details the information required).

It should be noted that a controlled waste will not be suitable for re-use in sensitive environments such as wetlands, agricultural areas or residential sites.

4. Disposal of contaminated material

Classification of soil (as defined in Table 2) will determine the category of landfill to which the soil can be disposed of in accordance with the landfill operator's permit conditions.

If disposal is the only viable management option, all possible efforts should be made to reduce the volume of material requiring disposal by minimising excavated volumes and segregating and sorting of wastes prior to disposal.

Waste Type	Category A landfill - **Solid Inert Landfill**	Category B landfill - **Putrescible Landfill**	Category C landfill - **Secure landfill**
Level 1 – *Fill Material*	✔	✔	✔
Level 2 – *Low Level Contaminated Soil*	✘	✔ (refer to Section 4.2.2)	✔
Level 3 - *Contaminated Soil*	✘	✘	✔
Level 4 - *Contaminated Soil for Remediation*	✘	✘	✘

See the *Landfill Sustainability Guide 2004* (DPIWE, 2004) for further details.

4.1 Disposal of fill material (Level 1)

4.1.1 The off-site disposal of *Fill Material* is not restricted and may be used as cover in landfills.

4.1.2 The definition of *Fill Material* includes inert construction material, soils and rocks, which have not been contaminated with any substance, and stable asphalt or bituminous pavement material, all of which are generally considered inert for use as 'fill'. However, soil and other material classified as *Fill Material* can still be a 'pollutant' under EMPCA and must be responsibly managed.

Re-use of fill material

4.1.3 The re-use of *Fill Material* must not result in environmental harm. *Fill Material* might contain contaminants above background levels and therefore may not be suitable for all uses, *e.g.* for sensitive uses such as child play areas, residential uses, or in protected nature reserves

4.1.4 In some cases, unwanted 'waste' soils or rock imported from another site to be used as fill may naturally contain contaminants at levels that are higher than *Fill Material* criteria due to regional geological characteristics. This material would be regarded as unsuitable for re-use if it posed a risk to human health or the environment in its new location.

The risk posed by importation of materials with naturally elevated levels of certain contaminants should be assessed by an environmental consultant and the evaluation and supporting information submitted to the Director for approval.

4.2 Disposal of low level contaminated soil (Level 2)*Low Level Contaminated Soil* may, in some cases, be suitable for disposal as intermediate landfill cover at nominated municipal landfills. Please note that the landfill operator should refuse soil that has not been classified and approved if there is likelihood that acceptance of the material may result in a breach of the landfill operator's permit conditions.

4.2.2 Approval for the disposal of *Low Level Contaminated Soil* must be sought from the landfill operator and the EPA. The information detailed in section 5 of this bulletin must be supplied to the EPA when making an application for approval to dispose of a waste.

Landfills at which *Low Level Contaminated Soil* (Level 2) may be accepted:

Council / Authority	Landfill
Circular Head Council	Port Latta Waste Depot
Dulverton Regional Waste Management Authority (DRWMA)	Dulverton Regional Waste Depot
Launceston City Council	Remount Rd Waste Depot
Copping Refuse Disposal Site Joint Authority	Copping Waste Depot

Re-use of low level contaminated soil

4.2.3 *Low Level Contaminated Soil* might be suitable for re-use as fill or levelling material on an industrial or commercial site, but will be judged on a case by case basis. In determining whether *Low Level Contaminated Soil* may be used as fill, an assessment of the environmental and human health hazards associated with the disposal option must be conducted by a suitably qualified environmental consultant. If the soil is classified as a controlled waste, approval must be sought from the Director as detailed in section 5.

4.3 Disposal of contaminated soil (Level 3)*Contaminated Soil* can only be disposed of at landfills that have the appropriate permit conditions and within a separate lined and contained cell.

4.3.2 Approval for the disposal of *Contaminated Soil* must be sought from the landfill operator and the EPA. The information detailed in section 5 of this bulletin must be supplied to the EPA in making an application for approval.

4.3.3 Only permitted landfills are allowed to accept Level 3 waste. Furthermore, it is at the landfill operator's discretion as to whether or not they will accept the waste. At the date of publication, no Tasmanian landfill is receiving level 3 waste for disposal.

4.4 Contaminated soil for remediation (Level 4)

4.4.1 *Contaminated Soil for Remediation* requires remediation or treatment prior to disposal to reduce total concentrations and/or leachable concentrations to levels acceptable for landfill disposal or re-use.

4.4.2 The producer (defined in the Regulations) of the *Contaminated Soil for Remediation* is responsible for identification of the treatment options, which will depend on the waste and pollutant type, waste volumes and the availability of suitable facilities in which to manage the remediation. Typical forms of treatment currently being used for remediation of contaminated soil include bioremediation, thermal treatment/desorption, soil washing, soil vapour extraction, red mud, chemical treatments and stabilisation. Specific treatment of hydrocarbon contaminated soil by bioremediation is encouraged under appropriate circumstances, as detailed in the EPA's *Information Bulletin 108: Landfarming of Petroleum Contaminated Soils*.

4.4.3 The suitable technologies for waste treatment may not be available in Tasmania and thus treatment may require transport to an interstate facility. Advice on interstate treatment options should be sought from the Controlled Waste Management Officer.

4.4.4 If the soil is to be disposed of after treatment, the EPA encourages treatment methods that minimise soil volumes prior to disposal to conserve landfill space.

4.4.5 If the remediation method has the potential to cause environmental harm, as defined in EMPCA, advice from the Director should be sought.

4.4.6 *Regulation 6 - General Responsibilities* of the Regulations requires that a person must not remove, receive, store, reuse, recycle, reprocess, salvage, incinerate, treat or use for energy recovery a controlled waste as defined within the Regulations unless approved to do so.

5. Approvals

5.1 Approval process

The waste producer, or consultant/contractor acting on behalf of the waste producer, is responsible for applying for approval for soil disposal, re-use options or remediation.

Applications are to be sent to the Director, EPA. Please allow up to ten working days for the Director to respond to an application. Please note that where it is intended to dispose of material to a landfill, an 'in principle' agreement from the landfill should be gained by the applicant prior to disposal.

Upon approval of the application, the Director, or a person authorised by the Director will provide written notification to the applicant of the approved classification of the waste where appropriate. The landfill authority will also be forwarded a copy of the

approval, along with a copy of the analytical results and any other relevant information so that they can monitor waste entering the landfill.

5.2 Information required

An application for approval to dispose of, re-use, treat, remediate, *etc*, soil must contain the following information:

Introduction:

- Details of the site(s) from which the soil is to be removed, including a brief site history and why the soil is thought to be contaminated, or likely to cause environmental harm;
- Description of the soil;
- Estimate of the volume of soil to be managed.

Sampling details:

- Sampling density and analytical suite to classify the soil;
- Sampling protocols followed;
- Scaled sampling plan showing, for example, soil stockpiles and sample locations and contamination sources;
- NATA endorsed laboratory reports.

Waste management plan:

- Proposal for the management of the soil that is in accordance with relevant guidelines and standards;
- If the soil is to be disposed of, provide justification for why re-use, on-site treatment, *etc* is not proposed;
- Details of the proposed management method, for example the name of the landfill facility that you wish to dispose of the soil at, or details of the treatment or re-use *etc*;
- The name of the waste transporter that you will be utilising (see Section 6 for further details); and
- If the soil is to be re-used, recycled, treated, *etc*, and is a controlled waste, the waste producer must apply for an environmental approval from the Director (R.12 of the Regulations). Relevant information required by the EPA to consider an application for an environmental approval is detailed in R.12(3) of the Regulations. A R12 application form can be accessed at:
- http://epa.tas.gov.au/regulation/required-approvals-and-authorisations

In situations where a site investigation report has already been lodged with the EPA, duplication of information provided in that report is not required. However, in all cases, the application will need to make reference to the specific sample numbers used for soil classification.

6. Transport of contaminated material

If a controlled waste is to be transported, a waste transport business holding a current relevant approval for that particular waste type and issued under EMPCA is required. For information regarding currently approved Waste Transporters, either contact the Controlled Waste Transport Officer (see below) or a list can be accessed at:

http://epa.tas.gov.au/regulation/document?docid=1063

Caution should be taken when transporting any material to ensure its safe transportation and prevention of secondary impacts (*e.g.* dust).

7. Further information

For further information relating to this bulletin or to make a contaminated soil or controlled waste disposal application contact:

Waste Management Section
GPO Box 1550
HOBART TASMANIA 7001

Controlled Waste Management Officer.....
Contaminated Sites Officer.....
Controlled Waste Transport Officer .....
Landfill Officer.....

EPA Division
Telephone: (03) 6165 4599

Legislation may be viewed on the Internet at http://www.thelaw.tas.gov.au.
General information can be viewed either on the EPA's website at http://www.epa.tas.gov.au

8. Currency of this bulletin

This bulletin may be subject to amendment and persons relying on this bulletin should check with an officer of the Waste Management Section or on the above EPA Division and EPA websites to ensure that it is current at any given time.

Disclaimer
The Crown gives no warranty, express or implied, as to the accuracy or completeness of the information provided in this Bulletin. The contents are based on the best information available to the Environment Protection Authority (EPA) at the time of publication and are subject to revision based upon further advice received by the EPA.

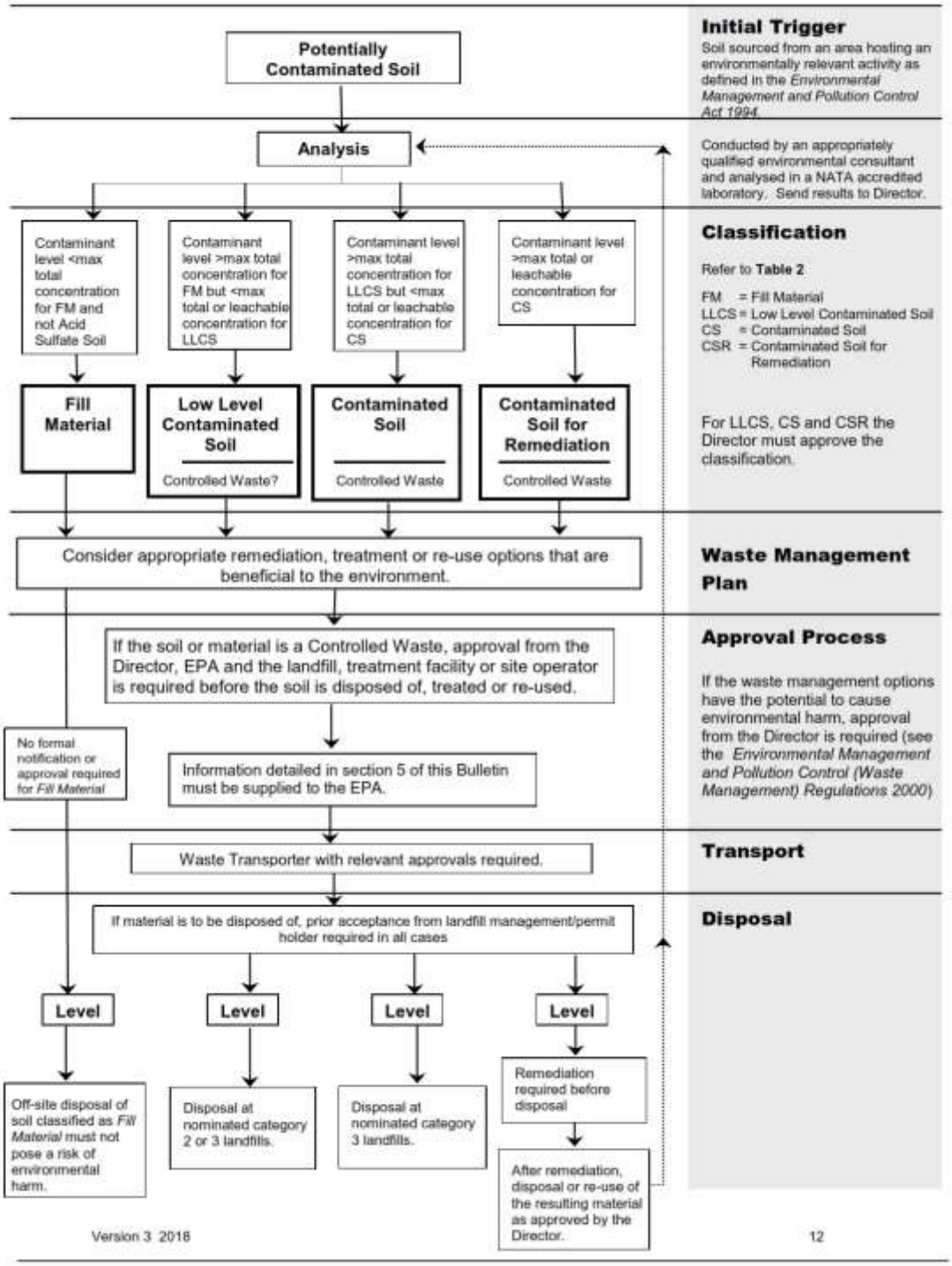
Please note that other national or state agencies may have additional requirements relating to the import/export and/or disposal of controlled wastes.

Table 3. Potentially Contaminating Activities

Potentially Contaminating Activities	
Acid / alkali plant and formulation	Landfill sites, including on-site waste disposal and refuse pits
Ammunition manufacture and usage (e.g. shooting ranges)	Lime burner
Asbestos production, handling or disposal	Metal treatments (e.g. electroplating) and abrasive blasting
Asphalt/bitumen manufacturing	Metal smelting, refining or finishing
Battery manufacturing or recycling	Mining and extractive industries
Boat/ship building, marinas, slip ways and associated boat yards	Oil or gas production or refining
Boiler or kiln usage	Paint formulation and manufacture

Chemical manufacture and formulation (e.g. fertilisers, paints, pesticides, photography, plastics, solvents)	Pesticide manufacture and formulation sites
Dewatering of sediments	Petroleum product or oil storage
Disturbance of potential acid sulfate soils	Pharmaceutical manufacture and formulation
Drum conditioning works	Power stations
Dry cleaning establishments	Printing
Electrical transformers	Radio-active material usage (e.g. hospitals)
Ethanol production plant	Railway yards
Engine works	Scrap yards and recycling facilities
Explosives industries and usage sites	Sewage treatment plant
Fertiliser manufacturing plants	Sheep and cattle dips
Fill material imported onto a site from a potentially contaminated source (includes dredge spoil)	Sites of fires involving hazardous materials, including fire fighting foam use
Foundry Operations	Spray mixing sites (e.g. for orchards)
Gas works	Spray painting industries
Herbicide manufacture	Tanning and associated trades
Hospitals	Textile operations
Sites of incidents involving release of hazardous materials	Tyre manufacturing and retreading works
Industrial activities involving chemicals that may have spilt	Wood preservation and storage or cutting of treated timber
Iron and steel works	Wool scouring
Laboratories	

Figure 1 **Summary of Waste Management for Contaminated Soil.**



Appendix 6 Site Induction Form & Cover Letter

GEO-ENVIRONMENTAL SOLUTIONS

***Footprint Building 3*; 2 Invermay Road, Invermay Tasmania**

An Environmental Site Assessment (ESA) report has been produced by Geo-Environmental Solutions for *Footprint of Building 3;* 2 Invermay Road, Invermay, Tasmania, hereby referred to as 'The Site'. Reporting identified the following risks at the site:

- During excavation & soil removal, there is a dust inhalation and soil ingestion risk to neighbouring recreational users
- Elevated heavy metals across the site that may dissolve when mixed with surface waters or groundwater.

Workers are to exercise caution when handling soil and water at the site and ensure that measures are put in place as identified with the Contamination Management Plan (CPM) which include and are not limited to:

- Ensuring that any dust occurrences are reported to the site supervisor and where necessary wearing dust masks to manage the risks;
- Wearing appropriate gloves when handling soil and water at the site;
- Ensuring that soil erosion at the site is managed in accordance with the site soil and water fact sheets which includes ensuring water and soil does not exit the site onto neighbouring recreational use areas.

***Footprint Building 3*; 2 Invermay Road,**
Invermay Tasmania

I …….…. of ……..…… have been inducted to *Footprint of Building 3;* 2 Invermay Road, Invermay, Tasmania and have been informed of the CMP and its contents on ……...(date)

I have been informed of the contents of the CMP and the responsibilities I have in ensuring that the CMP is adhered to relating to the following issues:

- Understanding the site contamination status
- Understanding the potential health impacts for site workers associated with site contamination
- Understanding the potential environmental impacts associated with site contamination
- Understanding how to reduce the risks to human health and the environment
- Maintaining documentation related to upholding the CMP

SOIL MANAGEMENT

- Excavation and stockpiling of soil at the site
- Movement of soil around the site
- Off-site disposal of soil
- Import of fill to the site
- Dust and sediment control

WATER MANAGEMENT

- Stormwater management and sediment control as outlined in the SWMP

I HEREBY ACCEPT THESE RESPONSIBILITIES.

NAME: ……COMPANY:…….……..…….

SIGNED ……..……DATE ……..……

INDUCTED BY: ……DATE ……