APPENDIX 8
Hawkesbury City Waste Management Facility EPA License and LEMP

Environment Protection Licence

Licence - 5293

Licence Details	
Number:	5293
Anniversary Date:	25-July

Licensee

HAWKESBURY CITY COUNCIL

PO BOX 146

WINDSOR NSW 2756

Premises

HAWKESBURY CITY WASTE MANAGEMENT FACILITY

THE DRIFTWAY

SOUTH WINDSOR NSW 2753

Scheduled Activity

Composting

Extractive activities

Waste disposal (application to land)

Waste processing (non-thermal treatment)

Fee Based Activity	Scale
Composting	> 5000-50000 T annual capacity to receive organics
Land-based extractive activity	> 50000-100000 T annual capacity to extract, process or store
Non-thermal treatment of general waste	Any annual processing capacity
Waste disposal by application to land	Any capacity

Region

Waste & Resource Recovery

59-61 Goulburn Street

SYDNEY NSW 2000

Phone: (02) 9995 5000

Fax: (02) 9995 5999

PO Box A290

SYDNEY SOUTH NSW 1232

Environment Protection Licence

Licence - 5293

Environment Protection Licence

Licence - 5293

Environment Protection Licence

Licence - 5293

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

Environment Protection Licence

Licence - 5293

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

HAWKESBURY CITY COUNCIL
PO BOX 146
WINDSOR NSW 2756

subject to the conditions which follow.

Environment Protection Licence

Licence - 5293

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Composting	Composting	> 5000 - 50000 T annual capacity to receive organics
Extractive activities	Land-based extractive activity	> 50000 - 100000 T annual capacity to extract, process or store
Waste processing (non-thermal treatment)	Non-thermal treatment of general waste	Any annual processing capacity
Waste disposal (application to land)	Waste disposal by application to land	Any capacity

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
HAWKESBURY CITY WASTE MANAGEMENT FACILITY
THE DRIFTWAY
SOUTH WINDSOR
NSW 2753
LOT 192 DP 729625

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with

the issuing of this licence.

A3.2 The Hawkesbury City Council Waste Management Facility Landfill Environment Management Plan (LEMP), October 2001 Rev B is not to be taken as part of the documentation in A4.1, other than those parts specifically referenced in this licence.

Note: For the purposes of this licence the abbreviation 'LEMP' is defined as the document titled Hawkesbury City Council Waste Management Facility Landfill Environment Management Plan, October 2001 Rev B submitted to the EPA.

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.

Air

EPA identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
2	Dust deposition		Dust gauge, as shown as D1 in the amended location figure attached to correspondence dated 19 November 1999 and referred to as P2018.055 Pt 15
3	Dust deposition		Dust gauge, as shown as D2 in the amended location figure attached to correspondence dated 19 November 1999 and referred to as P2018.055 Pt 15
4	Dust deposition		Dust gauge, as shown as D3 in the amended location figure attached to correspondence dated 19 November 1999 and referred to as P2018.055 Pt 15
14	Subsurface landfill gas		Bore labelled as BH1 on map titled "Figure 1: Site Plan Hawkesbury City Council Waste Management Facility" dated 10.10.07
15	Subsurface landfill gas		Bore labelled as BH2 on map titled "Figure 1: Site Plan Hawkesbury City Council Waste Management Facility" dated 10.10.07
16	Subsurface landfill gas		Bore labelled as BH3 on map titled "Figure 1: Site Plan Hawkesbury City Council Waste Management Facility" dated 10.10.07
17	Subsurface landfill gas		Bore labelled as BH4 on map titled "Figure 1: Site Plan Hawkesbury City Council Waste Management Facility" dated 10.10.07

18	Subsurface landfill gas	Bore labelled as BH5 on map titled "Figure 1: Site Plan Hawkesbury City Council Waste Management Facility" dated 10.10.07
19	Subsurface landfill gas	Bore labelled as BH6 on map titled "Figure 1: Site Plan Hawkesbury City Council Waste Management Facility" dated 10.10.07
20	Sub-surface gas monitoring	G1 - On the western boundary, 2-3 metres inside the site fence towards the northern end of the site. Approx. 10.1metres below surface.

P1.2 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

P1.3 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Leachate quality		The leachate collection system via the riser/collection sump described in Section 4.6 of the LEMP and the map series titled "Master Plan - Area 2; Sequence of Operation" in Section 6 of the LEMP
5	Discharge quality monitoring		Sedimentation dam shown in Figure 3 'Location map showing sampling sites' in the LEMP.
6	Groundwater quality monitoring		Ground water bore shown as GWM1 in Figure 3 'Location map showing sampling sites' in the LEMP.
7	Groundwater quality monitoring		Ground water bore shown as GWM2 in Figure 3 'Location map showing sampling sites' in the LEMP.
8	Groundwater quality monitoring		Ground water bore shown as GWM3 in Figure 3 'Location map showing sampling sites' in the LEMP.
9	Groundwater quality monitoring		Ground water bore shown as GWM4 in Figure 3 'Location map showing sampling sites' in the LEMP.

10	Groundwater quality monitoring	Ground water bore shown as GWM6 in Figure 3 'Location map showing sampling sites' in the LEMP.
11	Groundwater quality monitoring	Ground water bore shown as GWM7 in Figure 3 'Location map showing sampling sites' in the LEMP.
12	Groundwater quality monitoring	Ground water bore shown as GWM8 in Figure 3 'Location map showing sampling sites' in the LEMP.
13	Groundwater quality monitoring	Ground water bore shown as GWM9 in Figure 3 'Location map showing sampling sites' in the LEMP.

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Waste

L2.1 The licensee must not cause, permit or allow any waste to be received at the premises, except the wastes expressly referred to in the column titled “Waste” and meeting the definition, if any, in the column titled “Description” in the table below.
Any waste received at the premises must only be used for the activities referred to in relation to that waste in the column titled “Activity” in the table below.
Any waste received at the premises is subject to those limits or conditions, if any, referred to in relation to that waste contained in the column titled “Other Limits” in the table below.
This condition does not limit any other conditions in this licence.

Code	Waste	Description	Activity	Other Limits
NA	General solid waste (non-putrescible)	As defined in Schedule 1 of the POEO Act, in force from time to time	Waste disposal (application to land) Waste storage Waste processing (non-thermal treatment)	NA
NA	Waste tyres	As defined in Schedule 1 of the POEO Act, in force from time to time	Waste storage	Amount of waste tyres stockpiled at premises must not exceed 50 tonnes at any one time

NA	Waste	Any waste received on site that is below licensing thresholds in Schedule 1 of the POEO Act, as in force from time to time	Waste storage	NA
NA	General solid waste (putrescible)	As defined in Schedule 1 of the POEO Act, in force from time to time	Waste disposal (application to land)	NA

L2.2 Stockpiling of unprocessed wood and unprocessed vegetation at the premises must not exceed 4000 cubic metres (m3) at any one time.

L2.3 The quantity of any waste received at the premises which is to be stored in the Community Recycling Centre (CRC) does not contribute towards the total waste allowed under the authorised amount shown on this licence.

L3 Noise limits

L3.1 Noise from the premises must not exceed an LA 10 (15 minute) noise emission criterion of 50 dB(A). 5dB(A) must be added if the noise is tonal or impulsive in character.

L3.2 Noise from the premises is to be measured at any point within one metre of the boundary of the nearest residence or other noise sensitive premises to determine compliance with this condition.

L3.3 The hours of operation for waste receipt and compaction must be in accordance with Hawkesbury City Council Development Consent.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O1.2 The licensee must operate in accordance with the filling plan detailed in the LEMP.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

O4 Processes and management

O4.1 The licensee must take all practicable steps to control entry to the premises.

O5 Waste management

Waste Incineration

O5.1 There must be no incineration or burning of any waste at the premises.

Waste Tyres

O5.2 The licensee must ensure that stockpiles of used, rejected or unwanted tyres (including shredded tyres and tyre pieces) are located in a clearly defined area.

O5.3 The licensee must ensure that stockpiles of used, rejected or unwanted tyres (including shredded tyres and tyre pieces) are managed so as not to cause or to be likely to cause the spread of disease by vermin.

O5.4 The licensee must ensure that measures are taken to prevent stockpiles of used, rejected or unwanted tyres (including shredded tyres and tyre pieces) from catching on fire.

Recycling Area

O5.5 The licensee must provide facilities for recycling the following materials:

a) Glass – clear, brown and green;
b) Paper and cardboard;
c) PET plastic;
d) Aluminium and steel cans;
e) Bricks, tiles, concrete;
f) Reusable timber, firewood and garden waste;
g) Used engine oil; and
h) Chemicals collected as part of a chemical collection program.

Leachate Management

O5.6 A leachate barrier system described in Section 2.6 of the LEMP and leachate collection system described in Section 2.10 of the LEMP must be installed on each surface within the premises to be used for the

disposal of waste.

This condition does not apply to any surface used for the emplacement of waste before 1 August 1995 as shown in Area 1 on map titled "Figure 2. Existing Site Layout" in the LEMP.

O5.7 The leachate barrier system must be installed above the groundwater table.

O5.8 The leachate collection system must be capable of capturing all leachate generated from the waste disposed of at the premises.

O5.9 A leachate barrier system described in Section 2.6 of the LEMP must be installed on each surface within the premises to be used for the storage of leachate.

O5.10 The leachate collection system must be operated in accordance with Section 3.4 of the LEMP.

O5.11 The licensee must ensure that leachate is disposed of in accordance with Section 3.4.4 of the LEMP.

O5.12 The head of leachate on the clay liner must be maintained at less than 300mm at the leachate sump.

O5.13 To ensure continuity of drainage and avoid damage to the clay liner, materials of significant permeability, such as fine demolition rubble, must be placed within two metres of leachate drains.

O5.14 The licensee must cease leachate reinjection and leachate irrigation by 30 June 2021

Landfill Capping

O5.15 The licensee must ensure that the landfill cells are capped progressively as described in the LEMP.

O5.16 The licensee must ensure that the final capping of cells 1 to 5 is in accordance with Sections 2.7 and 5.2 of the LEMP and Appendix A Benchmark Technique Number 28 of the Environmental Guidelines: Solid Waste Landfills 1996.

Daily and Intermediate Cover

O5.17 Cover material must be virgin excavated natural material or other material approved in writing by the EPA.
a) Daily cover
Cover material must be applied to a minimum depth of 15 centimetres over all exposed landfilled waste prior to ceasing operations at the end of each day.
b) Alternative daily cover
The Licensee may deploy daily cover via the automatic tarping machine "Tarpomatic" as outlined in the Licensee's correspondence dated 4 June 2012, provided that they are properly secured and prevent infiltration of rainfall into the waste beneath.
c) Intermediate cover
Cover material must be applied to a depth of 30 centimetres over surfaces of the landfilled waste at the premises which are to be exposed for more than 90 days.
d) Cover material stockpile
At least two weeks cover material must be available at the premises under all weather conditions. This

material may be won on site, or alternatively a cover stockpile must be maintained adjacent to the tip face.

O5.18 The licensee must cover waste in accordance with Section 8 of the EPA's Environmental Guidelines: Solid Waste Landfills, Second edition 2016.

O5.19 The last licensee must prepare and submit to the EPA, three months prior to the last load of waste being landfilled, a closure plan in accordance with section 76 of the Protection of the Environment Operations Act 1997.

New Cell Construction

O5.20 The licensee must obtain approval from the EPA prior to constructing any landfill cells at the premises other than Landfill Cell Stage 5.

Final Landfilling in cells 1-4

O5.21 The licensee must not expose waste covered with an intermediate cover layer.

O5.22 The licensee must ensure any waste landfilled does not form perched leachate tables.

O5.23 The licensee must cease landfilling in cells 1-4 by 30 June 2021

O6 Other operating conditions

O6.1 The landfill surface must be contoured to prevent the run-on of surface waters onto areas where waste has been landfilled, except during storm events of not less than a 1 in 10-year recurrence interval of 24-hours duration.

O6.2 Wastes which have been collected in the Household Chemical Collection Program and/or delivered to the Community Recycling Centre must be stored in a bunded, roofed and secure location within the premises.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of

this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Air Monitoring Requirements

POINT 2

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Quarterly	Australian Standard 3580.10.1-1991

POINT 3

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Quarterly	Australian Standard 3580.10.1-1991

POINT 4

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Quarterly	Australian Standard 3580.10.1-1991

POINT 14,15,16,17,18,19

Pollutant	Units of measure	Frequency	Sampling Method
Carbon dioxide	parts per million	Special Frequency 1	Special Method 1
Methane	parts per million	Special Frequency 1	Special Method 1

M2.3 Water and/ or Land Monitoring Requirements

Environment Protection Licence

Licence - 5293

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Alkalinity (as calcium carbonate)	milligrams per litre	Quarterly	Grab sample
Aluminium	milligrams per litre	Yearly	Grab sample
Arsenic	milligrams per litre	Yearly	Grab sample
Barium	milligrams per litre	Yearly	Grab sample
Benzene	milligrams per litre	Yearly	Grab sample
Biochemical oxygen demand	milligrams per litre	Yearly	Grab sample
Cadmium	milligrams per litre	Yearly	Grab sample
Calcium	milligrams per litre	Quarterly	Grab sample
Chemical oxygen demand	milligrams per litre	Yearly	Grab sample
Chloride	milligrams per litre	Quarterly	Grab sample
Chromium (hexavalent)	milligrams per litre	Yearly	Grab sample
Cobalt	milligrams per litre	Yearly	Grab sample
Conductivity	microsiemens per centimetre	Quarterly	Grab sample
Copper	milligrams per litre	Yearly	Grab sample
Ethyl benzene	milligrams per litre	Yearly	Grab sample
Fluoride	milligrams per litre	Yearly	Grab sample
Lead	milligrams per litre	Yearly	Grab sample
Magnesium	milligrams per litre	Quarterly	Grab sample
Manganese	milligrams per litre	Yearly	Grab sample
Mercury	milligrams per litre	Yearly	Grab sample
Nitrate	milligrams per litre	Quarterly	Grab sample
Nitrite	milligrams per litre	Quarterly	Grab sample
Nitrogen (ammonia)	milligrams per litre	Yearly	Grab sample
Organochlorine pesticides	milligrams per litre	Yearly	Grab sample
Organophosphate pesticides	milligrams per litre	Yearly	Grab sample
pH	pH	Quarterly	Grab sample
Phosphate	milligrams per litre	Yearly	Grab sample
Phosphorus (total)	milligrams per litre	Quarterly	Grab sample
Potassium	milligrams per litre	Quarterly	Grab sample
Sodium	milligrams per litre	Quarterly	Grab sample
Sulfate	milligrams per litre	Quarterly	Grab sample
Toluene	milligrams per litre	Yearly	Grab sample
Total chromium	milligrams per litre	Yearly	Grab sample
Total dissolved solids	milligrams per litre	Quarterly	Grab sample
Total Iron	milligrams per litre	Yearly	Grab sample
Total organic carbon	milligrams per litre	Yearly	Grab sample

Environment Protection Licence

Licence - 5293

Total petroleum hydrocarbons	milligrams per litre	Yearly	Grab sample
Total Phenolics	milligrams per litre	Yearly	Grab sample
Xylene	milligrams per litre	Yearly	Grab sample
Zinc	milligrams per litre	Yearly	Grab sample

POINT 5

Pollutant	Units of measure	Frequency	Sampling Method
Alkalinity (as calcium carbonate)	milligrams of calcium carbonate per litre	Quarterly	Grab sample
Ammonia	milligrams per litre	Quarterly	Grab sample
Biochemical oxygen demand	milligrams per litre	Quarterly	Grab sample
Sulfate	milligrams per litre	Quarterly	Grab sample
Total Phenolics	milligrams per litre	Yearly	Grab sample

POINT 6,7,8,9,10,11,12,13

Pollutant	Units of measure	Frequency	Sampling Method
Alkalinity (as calcium carbonate)	milligrams of calcium carbonate per litre	Quarterly	Grab sample
Aluminium	milligrams per litre	Yearly	Grab sample
Ammonia	milligrams per litre	Quarterly	Grab sample
Arsenic	milligrams per litre	Yearly	Grab sample
Barium	milligrams per litre	Yearly	Grab sample
Benzene	milligrams per litre	Yearly	Grab sample
Biochemical oxygen demand	milligrams per litre	Yearly	Grab sample
Cadmium	milligrams per litre	Yearly	Grab sample
Calcium	milligrams per litre	Quarterly	Grab sample
Carbonate	milligrams per litre	Quarterly	Grab sample
Chemical oxygen demand	milligrams per litre	Yearly	Grab sample
Chloride	milligrams per litre	Quarterly	Grab sample
Chlorinated volatile compounds	milligrams per litre	Yearly	Grab sample
Chromium (hexavalent)	milligrams per litre	Yearly	Grab sample
Cobalt	milligrams per litre	Yearly	Grab sample
Conductivity	microsiemens per centimetre	Quarterly	Grab sample
Copper	milligrams per litre	Yearly	Grab sample
Ethyl benzene	milligrams per litre	Yearly	Grab sample
Fluoride	milligrams per litre	Yearly	Grab sample
Lead	milligrams per litre	Yearly	Grab sample
Magnesium	milligrams per litre	Quarterly	Grab sample
Manganese	milligrams per litre	Yearly	Grab sample

Mercury	milligrams per litre	Yearly	Grab sample
Nitrogen Oxides	milligrams per litre	Yearly	Grab sample
Organochlorine pesticides	milligrams per litre	Yearly	Grab sample
Organophosphate pesticides	milligrams per litre	Yearly	Grab sample
pH	pH	Quarterly	Grab sample
Phosphate	milligrams per litre	Yearly	Grab sample
Phosphorus (total)	milligrams per litre	Quarterly	Grab sample
Potassium	milligrams per litre	Quarterly	Grab sample
Salinity	milligrams per litre	Quarterly	Grab sample
Sodium	milligrams per litre	Quarterly	Grab sample
Sulfate	milligrams per litre	Quarterly	Grab sample
Toluene	milligrams per litre	Yearly	Grab sample
Total chromium	milligrams per litre	Yearly	Grab sample
Total dissolved solids	milligrams per litre	Quarterly	Grab sample
Total organic carbon	milligrams per litre	Yearly	Grab sample
Total petroleum hydrocarbons	milligrams per litre	Yearly	Grab sample
Total Phenolics	milligrams per litre	Yearly	Grab sample
Xylene	milligrams per litre	Yearly	Grab sample
Zinc	milligrams per litre	Yearly	Grab sample

M2.4 For the purpose of the table above “Special Frequency 1” means monitoring is to be conducted six monthly for monitoring points 15-17 and monthly for monitoring points 14, 18 and 19.

M2.5 For the purpose of the table above “Special Method 1” means in accordance with Benchmark Technique 16 of the EPA’s “Environmental Guidelines: Solid Waste Landfills 1996”.

Note: The EPA must be notified within 24 hours if the subsurface landfill gas monitoring required by condition M2.1 indicates a methane gas concentration greater than 1.25% (v/v).

M3 Testing methods - concentration limits

M3.1 Monitoring for the concentration of a pollutant emitted to the air required to be conducted by this licence must be done in accordance with:
a) any methodology which is required by or under the Act to be used for the testing of the concentration of the pollutant; or
b) if no such requirement is imposed by or under the Act, any methodology which a condition of this licence requires to be used for that testing; or
c) if no such requirement is imposed by or under the Act or by a condition of this licence, any methodology approved in writing by the EPA for the purposes of that testing prior to the testing taking place.

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

Note: The *Protection of the Environment Operations (Clean Air) Regulation 2010* requires testing for certain purposes to be conducted in accordance with test methods contained in the publication "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW".

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.

M6 Other monitoring and recording conditions

M6.1 The licensee must monitor noise, expressed as LA10 (15 minute), at the premises and in accordance with the methods and protocols for the Noise Attenuation Study as detailed in Section 5.1 of the document titled Hawkesbury City Council Waste Management Facility Environmental Monitoring Program Annual Report dated August 1999 and compiled by Australian Water Technologies, report number 1999/0344.

M6.2 The licensee must conduct landfill surface gas monitoring and gas accumulation monitoring in accordance with benchmark techniques 17 and 18 of the Environmental Guidelines: Solid Waste Landfills 1996 except surface gas monitoring and gas accumulation monitoring is to be carried out quarterly.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,
3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:

a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not

satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

8 Special Conditions

E1 Water balance to be conducted

E1.1 The licensee must conduct a water balance for cells 1-5 in accordance with Section 2.3 of the EPA's Solid Waste Landfill Guidelines 2016 and submit a report detailing the findings to the EPA by 30 March 2018

E2 Groundwater trend analysis to be conducted

E2.1 The licensee must undertake a groundwater trend analysis assessing existing all groundwater data collected at the premises since 2006 and submit a report detailing the findings to the EPA by 30 March 2018

Environment Protection Licence

Licence - 5293

Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 5293

flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

Environment Protection Licence

Licence - 5293

TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non - putrescible), special waste or hazardous waste

Ms Nadia Kanhoush

Environment Protection Authority

(By Delegation)

Date of this edition: 07-August-2000

Environment Protection Licence

Licence - 5293

End Notes

1	Licence varied by notice 1019603, issued on 23-Dec-2003, which came into effect on 17-Jan-2004.
2	Licence varied by notice 1034127, issued on 30-Jan-2004, which came into effect on 24-Feb-2004.
3	Licence varied by notice 1076944, issued on 21-Dec-2007, which came into effect on 21-Dec-2007.
4	Licence varied by Change to schedule 1, issued on 08-May-2008, which came into effect on 08-May-2008.
5	Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>
6	Licence varied by notice 1092988, issued on 12-Dec-2008, which came into effect on 12-Dec-2008.
7	Licence varied by notice 1097153, issued on 04-Feb-2009, which came into effect on 04-Feb-2009.
8	Licence varied by notice 1105486, issued on 25-Aug-2009, which came into effect on 25-Aug-2009.
9	Licence varied by Correction to EPA Regional data record., issued on 24-Jun-2010, which came into effect on 24-Jun-2010.
10	Licence varied by correction to DECCW Region data record, issued on 07-Jul-2010, which came into effect on 07-Jul-2010.
11	Licence varied by notice 1507580 issued on 22-Aug-2012
12	Licence varied by notice 1512429 issued on 07-Jun-2013
13	Licence varied by notice 1541518 issued on 30-Jun-2017
14	Licence varied by notice 1558905 issued on 22-Nov-2017

Hawkesbury City Waste Management Facility

Landfill Environment Management Plan (LEMP)

Hawkesbury City Council

PPK
Environment & Infrastructure

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A Partnership between PPK E&I Pty Ltd and
Parsons Brinckerhoff International (Australia) Pty Ltd
Parsons Brinckerhoff Companies

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Contents

List of Tables

List of Figures

Appendices

1. Introduction

This LEMP sets out existing and proposed operating and management procedures for the Hawkesbury City Waste Management Facility as well as construction and design details. It provides details of all related consents, monitoring requirements and external controls on the facility. The landfill and its management and monitoring procedures are engineered for full solid waste.

This LEMP is the definitive site reference document for all site personnel, regulatory authorities and the facilities Monitoring Committee. The LEMP is to be regularly updated to cater for subsequent episodes of detailed design related to later landfill stages, changes to regulatory or design criteria, Environment Protection Authority (EPA) licensing conditions and technology changes.

1.1 LEMP Format

This LEMP is designed to address the construction, operational, monitoring and reporting requirements of the waste depot in accordance with the EPA license and legislation, Hawkesbury City Council (HCC) requirements and EPA Environmental Guidelines: Solid Waste Landfills.

The NSW EPA Guidelines for Solid Waste Landfills details Environmental Issues and Goals which must be addressed in the site LEMP. These are:

- Water Pollution
  - prevent pollution by leachate;
  - detecting water pollution; and
  - remediating water pollution.
- Air Pollution
  - preventing landfill gas emissions;
  - detecting landfill gas emissions; and
  - remediating landfill gas emissions.
- Land Management and Conservation
  - assuring quality of design, construction and operation;
  - assuring quality of incoming waste;
  - recording waste received;
  - minimising landfill space used;

- maximisation of recycling; and
- remediating landfill after closure.

- Hazards and Loss Amenity
  - preventing unauthorised entry;
  - preventing degradation of local amenity;
  - preventing noise pollution;
  - fire-fighting capacity; and
  - staffing and training.

This LEMP is divided into phases with each phase addressing these requirements through design, construction, operations and monitoring.

1.1.1 Distribution

One copy of the LEMP is kept at the offices of HCC located at 366 George Street Windsor. Numbered copies of the LEMP shall be distributed and retained as per the Distribution List.

A master version of the register of LEMP copy numbers and holders located at the front of the LEMP shall be maintained up to date by HCC or their delegate, and revised as required at each amended issue.

1.1.2 Plan Review and Update

HCC is responsible for the regular update of the LEMP, which shall be undertaken at no less than annual intervals. Update amendments will cater for changes in design and procedures, in accordance with changes in accepted best operational practice, regulations or agreed changes to design and construction dictated by site conditions.

Major revisions will require update by way of re-issue of the Management Plan. A re-issue may also be required following a large number of minor amendments.

Minor revisions will be catered for by issue of amended Plan sections, pages or diagrams to registered holders. The Plan is set out in ring binder format to facilitate such updates. Each amended section, page or diagram will include an insertion instruction stating where it should be placed in the Plan and if appropriate, what section/page/diagram is being replaced. Outdated and replaced sections, pages and diagrams will be retained in a second binder so that Plan holders will be able to review these outdated sections upon request.

1.2 Operational Responsibilities

The landfill gatehouse is operated by Hawkesbury City Council (HCC).

The daily operation of the landfill is the responsibility of a contractor, under the direction of the HCC. It is the Council's responsibility to ensure that the construction and operation of the landfill is in accordance with the plans and specifications prepared for the project, as well as the operating permits and environmental controls. Tip face operations, access maintenance and recycling services are operated by a contractor to HCC.

HCC will also be responsible for all post-closure maintenance including surface water control, leachate collection and disposal and gas control.

1.2.1 Operation Policy

The Council considers the current landfilling operations in Area 2 of the Hawkesbury City Waste Management Facility to be state of the art. This implies that the landfill embodies all of the key landfill engineering and management features required by the NSW EPA Environmental Management Guidelines for Solid Waste Landfills.

The Hawkesbury City Waste Management Facility is to be operated at all times in accordance with the conditions attached to its licence requirements.

1.3 Community Involvement

1.3.1 Policy

HCC seeks to operate the Hawkesbury City Waste Management Facility in a manner which will ensure the facility is a good neighbour.

The right of the public to approach the Council in the event of unexpected problems or nuisance from the landfill operation is maintained. The Council will facilitate this through the Monitoring Committee and through its established formal complaints procedure.

1.3.2 Complaints Procedures

All employees are trained to immediately report any complaints from clients, site visitors, neighbouring property owners or the surrounding community to the site gatehouse. All complaints received are actioned by site personnel as follows:

- all pollution related complaints are recorded to Councils database and referred to the EPA Pollution Hotline (135555);
- all complaints received at the plant regarding site operations (staff behaviour, charges, facilities) are recorded on the gatehouse database;

- all refusals (not enough money, unacceptable waste etc) are recorded on the database.

1.3.3 Visitors and Guests

All visitors (excluding authorised local residents) are recorded on the gatehouse database. All site visits will be supervised by a representative of the Contractor or HCC staff. Where practical, visitors will be conveyed around the site in a vehicle. Visitors will be supplied with the appropriate safety equipment (eg. hard hats, safety vest) as required.

1.4 Site Description

1.4.1 Description

The Hawkesbury City Waste Management Facility is located within the Windsor District. The site is bounded by Blacktown Road, and the Driftway and property owned by the University of Western Sydney – Hawkesbury. The location of the site in relation to Windsor and surrounding districts is indicated on Figure 1.

The site is broadly divided into two areas:

Area 1 - previous landfill (now complete and owned by HCC)

Area 2 – current landfill (since August 1995)

The current landfill operation (Area 2) encompasses an area of 8 ha within one property which is Lot 192 DP729625, The Driftway, South Windsor. The gatehouse and site amenities are located on an adjacent property (Lot 194 DP823986).

The title plan and landfill areas described above are shown in Figure 2.

1.4.2 Ownership

University of Western Sydney – Hawkesbury is the owner of the property described as Lot 192 DP729625. Hawkesbury City Council is the owner of Lot 194 DP823986.

1.4.3 Principle Features

The principle features of the site comprise:

- entrance gatehouse;
- maintenance area;
- recycling area which includes LPG gas bottles, agricultural drums, kerbside collected items, batteries and waste oil;

- bulk recyclable items which includes timber, greenwaste, tyres, bricks and concrete, metal and soil;
- operational cell(s);
- stormwater drainage system and sedimentation basin;
- soil stockpile areas;
- site access roads;
- contractors site shed;
- vehicle wash bay; and
- storage shed.

1.4.4 Access

Access to the site is via The Driftway, South Windsor. The Driftway is a two-lane undivided local road.

1.5 Management Structure

The landfill operates as a service to HCC residents, Council and University waste vehicles.

The landfill management structure is designed to provide a high degree of accountability in terms of both day to day operations and consents granted in respect of landfill operations.

HCC has conferred the responsibility for all aspects of landfill operation to an authorised onsite contractor. HCC operates the landfill gatehouse and oversees the engineering and environmental compliance aspects of the landfill. It is HCC's ultimate responsibility to ensure that the construction and operation of the landfill is in accordance with the plans and specifications prepared for the project, as well as the operating permits and environmental controls. One of HCC's responsibilities is the effective implementation of the EPA licence to ensure that no defined hazardous wastes are deposited in the landfill.

Engineering responsibility lies with HCC who give final approval for all construction and design aspects on site. HCC may, from time to time, transfer responsibility for approval of fill placement or other aspects of the works to other designated staff or to specialist consultants.

1.6 Environmental Monitoring Committee

HCC has established an Environmental Monitoring Committee with the objectives and characteristics described below:

- act in a communication role between HCC, government regulatory authorities and residents on a number of aspects relating to the landfill operation, and as an on-ongoing or referral body so that any concerns regarding the landfill activities can be promptly directed to HCCC for comment and action;
- bring issues to the attention of landfill management at the committee's meetings; and
- quarterly review of the monitoring reports, and review and report on this LEMP to determine its adequacy in resolving problems and assess its effectiveness in monitoring and managing the landfill.

1.6.1 Composition

The Committee is comprised of representatives from HCC, EPA, UWS – Hawkesbury, monitoring consultant and local residents.

The committee meets on a quarterly basis and reviews the monitoring reports, complaints register and general operations.

1.7 Landfill Licensing Requirements

The existing Hawkesbury City Waste Management Facility is licensed under Section 48 of the Protection of the Environment Operations Act 1997 (licence number 005293).

Design, construction, operation, monitoring, reporting and remediation conditions are detailed in the licence or referenced as a condition of the EPA Guidelines Solid Waste Landfills (refer EPA Licence Appendix 1-1).

This LEMP refers to the associated licence condition with listing required actions.

1.8 Landfill Design

The depot layout is shown in Figure 2. The former landfill (Area 1) was designed, constructed and operated to previous council engineering standards and requirements which were significantly less rigorous than those now applied for the current landfill (Area 2).

The current landfill Area 2 has been designed to operate in accordance with the licence conditions and the EPA Guidelines Solid Waste Landfills (Appendix 1-2).

The design details for Area 2 are provided in Appendix 1-3 of the LEMP and comprise:

a) Area 2 landfill master plan drawings showing the proposed cell development sequence and typical construction details.

b) Leachate system plan.

c) Stormwater construction design.

Section 2 Landfill Construction

Contents

2. Landfill Construction

The following section details the requirements and actions involved in the construction of the landfill to satisfy the environmental goals of EPA Guidelines and licence.

2.1 Site Security

Objective: The site must be secure to control entry to premises [1,2,3]

Task	Frequency	Responsibility
"The licensee must take all practical steps to control entry to premises" (condition O26)	Ongoing	HCC
"The licensee must adequately maintain security around the Premises" (condition O27)	Ongoing	HCC
"The licensee must install/maintain lockable security gates at each vehicle access and departure location" (condition O28)	Ongoing	HCC
"The licensee must ensure that the security gates are locked at all times at which the landfill is unattended" (condition O29)	Ongoing	HCC

Electronic lockable entrance gates are present onsite, with a lockable gate in the recycling area to control traffic flow and entry to the tip face.

Signs are erected to direct traffic flow and identify wastes to be received and those not permitted.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

2.2 Recycling Area

Objective: To reduce waste to landfill and increase recycling[1,2,3]

Task	Frequency	Responsibility
"The holder of this licence must ensure that all users of the facility are aware of which materials can be recycled at the facility. Supervision of wastes being deposited must be undertaken and users encouraged to separate waste types to maximise recycling. Recycling facilities must be readily accessible to the public, clearly marked and be able to accept the following materials for recycling as a minimum requirement: ▪ *Class –clear, brown and green;* ▪ *Paper and cardboard;* ▪ *PET plastic;* ▪ *Aluminium and steel cans;* ▪ *Bricks, tiles and concrete;* ▪ *Reusable timber, firewood and garden waste." (condition L7)*	Construction	HCC
"The licensee must display a notice as to which materials can be recycled at the Premises Supervision of wastes being deposited must be undertaken and users encouraged to separate waste types to maximise recycling"(condition O42)	Ongoing	Contractor

Hawkesbury City Waste Management Facility provides facilities for patrons to recycle materials (refer Section 3.6). These are easily accessible and clearly marked.

Two separate recycling areas are present, for domestic recyclables and for bulk recyclables.

Staff supervision is available to assist users in separating their waste.

2.3 Site Preparation

Objective: To minimise sedimentation and dust generation during the preparation of site for cell operations[3]

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

2.3.1 Clearing

Task	Frequency	Responsibility
Stockpiles of waste must not cause hazard[3]	Construction	HCC

All areas subject to development, including general excavations, proposed landfill cells and stockpile areas or other nominated areas shall be cleared of unnecessary fences, rubbish, trees, brush, plants or any vegetative growth to ground level prior to topsoil stripping. All such materials resulting from clearing shall be stockpiled for later landfill disposal or composting to augment and improve the quality of supplies of topsoil scheduled for the landfill rehabilitation process.

All materials excavated and/or cleared onsite shall be stockpiled. These stockpiles must not allow sediment runoff off site. Long term storage should include the use of ground cover to stabilise the stockpiles.

2.3.2 Stripping

Task	Frequency	Responsibility
Stripping must minimise mixing of organic soil with fill[2]	Construction	HCC
Clearing of topsoil must minimise sedimentation[2]	Construction	HCC

Stripping operations will remove all topsoil, roots to expose soil containing insignificant amounts of organic matter.

The process must minimise the mixing of organic soil with structural fill material.

Stripping operations will be programmed in a carefully controlled, systematic manner to ensure HCC and EPA requirements are complied with and sediment generation is minimised. The time between stripping of topsoil and construction works commencing shall be minimised to prevent erosion.

2.3.3 Stockpiled Material

Task	Frequency	Responsibility
Stockpiled materials must minimise runoff and sedimentation[2]	Construction	HCC

Excavated materials shall be stockpiled in the designated stockpile platform areas shown on the Landfill Masterplan drawings (Appendix 1-3).

All stockpile areas shall be appropriately bunded and stormwater runoff shall be collected and directed to sedimentation basins as described in Section 2.8.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Excavated materials shall be classified into Material Type (Section 2.3.5) and each material type separately stockpiled.

To avoid water logging and softening, all stockpiled materials will be placed in such a way to avoid the ingress or ponding of water and shall be sealed to shed excess water.

Wherever practical, structural fill material will not be subject to prolonged stockpiling.

Surplus excavated/stockpiled materials shall be progressively removed from the Waste Depot as required, in accordance with HCC direction.

2.3.4 Protection of Temporary Batters and Slopes

Task	Frequency	Responsibility
Batters and slopes must be protected from erosion[2]	Construction	Contractor/HCC

Areas of prepared clay liner shall not be grassed as they are required to remain visible and accessible (for detection of defects). Exposed liner will generally be covered within a 3-6 month period. If it becomes evident that erosion of the prepared liner is occurring in a particular area, the appropriate mitigating measures shall be adopted to prevent such erosion. Measures may include but are not restricted to diversion of runoff, or applying an artificial membrane to protect the liner areas.

Sidewall areas and areas of the floor of the excavation which are unlined, and which are to remain un-worked for periods of 2-6 months shall be considered for grassing (normally hydroseeding within the active area of the landfill). Where cut faces or exposed areas are unlikely to be worked by subsequent cell construction works then grassing may not be necessary. Faces, which are likely to remain visible for extended periods shall be appropriately grassed as necessary. Requirements in this regard will change with time, location of filling and the detailed planning for the landfill. Any amendments will require agreement from HCC.

2.3.5 Material Types

Task	Frequency	Responsibility
Excavated materials must not be mixed[2]	Construction	HCC

Mixing of materials reduces their reuse options.

Definitions

Site materials have been classified to enable ready description and contractor instruction. The types of materials, which will be encountered during cell excavations and used in the worked cell construction are defined below. In general these materials comprise surface soils, underlain by interbedded clays, sand and silts. Note that changes to this system may be warranted if material types change significantly during the course of cell excavations.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Type 1 – Material

These materials comprise various coloured clays and silty clays which will be mostly used as controlled liner and capping materials.

Type 2 – Materials

These materials comprise fine to coarse grained sands, which may be suitable for drainage or general backfill material in non-critical areas. It should be noted that there are special requirements for leachate drainage filter materials (Refer Appendix 2-2).

Type 3 – Materials

These materials comprise various coloured silts and clayey silts unsuitable for permanent liner construction. If suitable, they may be primarily used in combination with Type 1 materials as daily or intermediate waste cover material.

Unsuitable Materials

A proportion of the materials on site will be:

- unsuitable for liner construction;
- unsuitable for overlaying with structural fill;
- unsuitable for use as daily or intermediate cover or temporary roading.

Surplus Excavated Materials

"Unsuitable materials" are expected to include two predominant material types:

- softened or excessively wet sand, silt or clay;
- organic soils.

Softened, wet or organic materials shall be excavated to a depth determined by HCC in all areas where liner or other structural fill is to be placed. These materials will be used within the landfill. They shall be placed in a designated area within the stockpile platform for conditioning during dry weather and subsequent placement as daily cover or landscaping fill as appropriate.

Unsuitable materials of an organic nature shall be separately stockpiled for mixing with topsoil and later used as growth medium, thereby maximising the usefulness of these soils.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

2.4 Access and Roads

Objective: Provide safe access for patrons, and minimise dust and sedimentation[3]

Task	Frequency	Responsibility
On-site roads must allow safe access and minimise environmental impact[3]	Construction	HCC
Roads & access must be maintained to council's satisfaction[2,3]	Ongoing	Contractor

To ensure safety of all staff and visitors to the facility, roads and accesses must be maintained for clear passage and safe operations.

General

With the exception of the main access road, the design and subsequent construction of site access roads shall comply with the following particular requirements:

- all runoff shall be directed into the stormwater control system, either directly or indirectly;
- batter slopes shall be selected in conjunction with road width and status, fill compaction standards and subsoil drainage, so that any failure during or after development of cells does not significantly impact on haul road availability or stormwater and silt control;
- the minimum road width for two lane traffic shall be 10m inclusive of windows with a profile for safe and efficient operation of all equipment. Windows shall be formed at the sides of all roads and ramps where they are elevated more that 3m above the surrounding terrain and shall be not less thank 1m high;
- the road shall be maintained passable with minimal rutting, no potholes over 100mm depth and to a rural road standard which is acceptable for passage of highway truck and trailer traffic;
- the road surface shall comprise imported hard durable metal regularly maintained to provide adequate surface traction;
- the road shall not exhibit weave at any point under the passage of fully laden earthmoving plant or traffic;
- all roads shall be adequately watered and maintained to prevent the generation of dust. Water for dust suppression will be obtained from the sedimentation dam on site or from the water hydrant.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Materials for Permanent Roads

Course sub-base material shall be a well graded aggregate, free of all deleterious material. When tested in accordance with AS1289.3-6.2, the sub-basecourse aggregate grading shall fall within the envelope described below:

Test Sieve	Percentage by Weight Passing Aperture Size
75mm	100%
19mm	40-65%
5.75mm	22-40%
600µm	10-25%
75µm	3-10%

For permanent road sections, the sub-basecourse aggregate shall have a soaked CBR value of not less than 30% when tested in accordance with AS1289.6.1.1. Alternatively, if the weight of material passing a 10mm sieve is 25% or less, the aggregate shall have a crushing resistance of not less than 100kN when tested in accordance with AS1141, Section 21. The fraction of sub-basecourse aggregate passing a 425 micron sieve shall have a plasticity index not greater than 8 when tested in accordance with AS1289.3.1.1,3.1.2,3.3.1.

Sub-basecourse aggregate shall be placed in layers of equal thickness, each layer being not more than 150 mm in thickness. Sub-basecourse aggregate shall be placed by tailing out from trucks to form layers of uniform thickness which, when compacted, shall be true to the grades or levels required. Surface procedures shall be carried out in a manner calculated to minimise segregation and the use of graders shall be restricted to essential shaping and final trimming.

Compaction shall continue until there is no perceptible weaving or deflection under the passage of the roller to the approval of HCC and the whole surface is a homogeneous mass of aggregate locked in a matrix of fines. Rubber type finish rolling is not required on sub-base.

To assist compaction, water may be added as a fine mist spray. Particular care shall be taken to avoid excess water reaching the subgrade surface.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

2.5 Gas Control System

Objective: Prevent air pollution by landfill gas emissions[1,2,3]

Task	Frequency	Responsibility
"The licensee must either: *implement by 1 April 2000 a gas monitoring program designed to demonstrate that landfill gas is not migrating from the Premises; or* *by 1 April 2000, provide the EPA a justification that a gas monitoring program is not necessary at the premises and receive the relevant written approval from the EPA exempting a requirement for a gas monitoring program at the premises.* *The gas monitoring program should meet the environmental goals detailed in Appendix A of the EPA report entitled 'Environmental Guidelines: Solid Waste Landfills (1996)' for Benchmark Techniques 16 and 17" (condition P1.3)*	Construction	HCC

Gas monitoring locations have been installed onsite (Refer Figure 4). A preliminary gas monitoring assessment completed in 2000 indicated acceptable levels of landfill gas emissions; thereby not warranting the implementation of a gas control system to be implemented. This is to be reassessed upon site closure where a landfill gas management system may be installed in the Area 2 landfill development which will control LFG following site closure, until it no longer poses a hazard. The collection of LFG will also assist in the revegetation of the site. Concept details for the gas management system are presented on the Landfill Masterplan drawings in Appendix 1-3 (refer Section 5.1.1.3).

The gas management system will consist of a series of gas extraction wells, linked by collection header pipes. Each well will be strategically located to distribute the applied vacuum equally throughout the landfill, but may be subject to review depending on system performance.

The landfill gas shall be incinerated in an enclosed flare or used for power generation if this is considered to be a viable option.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

2.6 Liner Construction

Objective: Prevent water pollution by leachate[2,3]

Task	Frequency	Responsibility
Liner construction must prevent pollution[2]	Construction	HCC
Liner construction must conform with NSW EPA Guidelines for Solid Waste Landfills[2]	Construction	HCC

Liner construction must meet the following performance criteria as per NSW EPA Solid Waste Landfill Guidelines.

Key Performance Criteria

The key performance criteria for the excavation to base grade (floor and side walls) and construction of the liner system are:

- provision of a continuous liner comprising a minimum thickness of 900mm of compacted approved clay fill to form a liner whose insitu permeability is less than 1×10^{-9}m/s.
- provision of a continuous liner 900mm thick meeting the liner permeability criterion over any natural ground suspected of not meeting the same permeability criterion;
- avoidance of cracking or runnelling of the clay liner by adopting suitable liner protection methods;
- ensuring adequate short term sidewall and base grade ground stability (minimum short term factor of safety = 1.3 for fills, 1.2 for slopes cut into natural ground);
- ensuring long term liner, sidewall and base grade ground stability (minimum long term factor of safety = 1.5) including allowance for refuse fill surcharging;
- achieving an acceptable factor of safety grater than 1.0 for the sliding stability of intermediate and completed landfill cover for seismic loadings;
- ensuring the natural clays used in liner construction are resistant to chemical attack by leachate.

The liner will be constructed in accordance with the specifications of the Liner Construction Specification (Appendix 2-1) and the design guidelines shown on the construction and Landfill Masterplan Drawings (Appendix 1-3).

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

2.7 Final Cover Construction

Objective: Final capping construction to provide a barrier to water, control gas emissions and prevent safety and environmental hazard[1,2,3]

Task	Frequency	Responsibility
"The licensee must ensure that the landfill cells are effectively capped progressively during operations when the level of waste reaches final height as described in the LEMP" (condition O24)	Completion of cell	Contractor
"The landfill must have a final capping in accordance with Benchmark Technique number 28 of the Landfill Guidelines" (condition O25)	Completion of cell	Contractor

Once the fill is brought above grade the final capping on the outside slope is constructed above the top surface of the refuse cell and is cambered in order to screen the filling operations behind. Drainage is away from the outside slope, at a gentle surface slope to limit soil erosion until a vegetative cover can be established. This slope also allows water to drain off the capped refuse cell.

Objectives

The objectives of final construction are to provide a final sealing layer to the landfill which:

- supports the intended vegetation layer (which acts as a long term aesthetic and stabilising medium);
- is resistant to cracking and water ingress;
- is of sufficient thickness and of sufficiently low permeability to act effectively as a gas barrier (this relates to both internal gas containment and minimisation of air ingress during landfill gas extraction);
- is dimensionally and physically stable long term, even under cyclic saturation and drying at the design slope.

Cracking resistance and permeability are both key performance factors which are interdependent. That is a low permeability material, which shrinks excessively and cracks to a significant depth following placement results in an overall cap of higher permeability which is less effective in terms of infiltration resistance and gas control.

Final capping must be constructed in accordance with Benchmark 28 of the NSW EPA Solids Waste Landfill Guidelines:

- commence capping the completed filling areas within 30 days of completion of landfilling in that area;
- final capping should comprise:

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

  - seal-bearing surface (properly designed and engineered layer of material);
  - gas drainage layer (minimum thickness of 30 cm. The calcium carbonate later must not exceed 10% by weight to prevent encrustation);
  - sealing layer (clay layer at least 50 cm thick and permeability less than $K=10^{-8}ms^{-1}$);
  - infiltration drainage layer (permeability of not less than $K=10^{-5}ms^{-1}$ and not less than 30cm thick); and
  - revegetation layer (not less than 100cm, consisting of plants that will not root beyond revegetation layer);
- seal-bearing surface should leave a gradient of greater than 5% to drainage points; and
- sealing layer exposed for greater than seven days must be covered by a flexible membrane liner protection layer.

2.8 Stormwater and Silt Control

Objective: Prevent offsite sedimentation and contamination of surface water run-on[1,2,3]

Task	Frequency	Responsibility
"Stormwater sedimentation basins must be operated and maintained so as to collect and impounds without discharge to surface waters external to the Premises all surface water runoff on the Premises from or generated by a rainfall event of not less than of 1 in 5 year over a 24 hour period" (condition L4)	Construction	HCC
"Stormwater run-on must be diverted away from any irrigation areas" (condition O14)	Construction & ongoing	HCC
"Surface water run-off from disturbed areas not subject to waste disposal or leachate disposal must be directed away from the leachate collection and storage facilities and must be subject to separate water quality treatment controls" (condition O15)	Construction & ongoing	contractor
"The landfill surface must be contoured to prevent the run-on of surface waters onto areas where waste has been landfilled except during storm events of not less than a 1:10 year recurrence interval of 24 hours duration" (condition O16)	Construction & remediation of cells	Contractor
All surface water that has been collected from cleared or non-vegetated surfaces should be treated in accordance with the NSW EPA Stormwater Manual[2]	Construction & ongoing	HCC

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

System Overview

Controls for stormwater, sediment and erosion are implemented to minimise both on site and off site impacts. A comprehensive system, is installed to remove runoff in a controlled manner to minimise erosion and silt entrainment. Two circuits are identified:

- a clean water circuit comprising all stormwater runoff from undisturbed and disturbed ground not contacting waste material;
- a contaminated water circuit comprising stormwater runoff directly from the landfill face.

Clean Water Circuit

The clean water circuit discharges into sedimentation basin/dam (refer Masterplan and Cell 1 Construction drawings in Appendix 1-3). The main elements of the clean water circuit are as follows:

- stormwater from the catchment within the perimeter of the open cells is drained to pump wells in the cell base stormwater channel and pumped to the sedimentation dam;
- stormwater from the grassed stockpile area (for clay liner material) is shed off the grassed surfaces as surface water runoff;
- stormwater runoff from capped cells is intercepted by surface catch drains on the final landfill capping. These drain to the stormwater pump system, draining to the sedimentation basin. When an adequate vegetation cover has been established on the landfill capping, surface water will be allowed to discharge offsite by natural runoff;
- stormwater held in the sedimentation dam is used for dust suppression and irrigated along the 250m revegetation area along The Driftway or landfill cell 1 and 2.

Contaminated Water Circuit

Some (clean) stormwater storage for large storm events is provided in the operational cells in the area separated from the waste disposal areas by a clay bund wall.

Surface runoff from the waste disposal area is allowed into the stormwater storage area provided that the waste material is adequately capped with daily or intermediate cover material. Any water coming into direct contact with waste material is regarded as leachate, subject to appropriate disposal.

Contaminated water will be contained within the bund containment structure at the operating face. Excess leachate will be pumped from the leachate sump and irrigated either over the open face or ontop of the revegetated old cells.

An ongoing maintenance scheme will ensure that the above systems are functioning to design specifications during all phases of the landfill development.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

General Objectives

The site stormwater and sediment and erosion control system will be maintained and constructed in accordance with the following design objectives:

- the separation of runoff such that all stormwater which has contacted refuse is effectively controlled and is not able to mix with stormwater from earthworks and rehabilitated areas, but rather is collected and treated as leachate;
- the control of runoff from the site during construction so as to avoid erosion from earthworks areas and the detention and settling of that runoff to reduce the level of sediment in the discharges;
- the provision of permanent drainage for the completed and rehabilitated landfill areas, with sediment control until all landfill areas are fully grassed.

During the development phase of the site, stormwater and sediment and erosion control systems will comprise of a network of silt barriers, drainage channels, bund walls, moveable pump-out facilities and a comprehensive leachate capture system as shown on the Landfill Masterplan drawings (Appendix 1-3).

Design Criteria

The criteria for design of the stormwater and sediment and erosion control system components will be in accordance with the following:

1. Sediment and erosion control facilities to be designed to the requirements of HCC.
2. All stormwater system components, including sedimentation basins, pipework, pump-out facilities, surface drains and bunding are to be designed for the critical 1 in 5 year storm event and to convey the critical 1 in 5 year ARI flow in a non erosive manner.

2.9 Landscaping and Restoration

Objective: To remediate the former landfill area for future beneficial use[1,2,3]

Task	Frequency	Responsibility
"The licensee must provide to the EPA a works program by 30 June 2000 detailing the implementation of the rehabilitation plan titled 'South Windsor Waste Depot Area 1 (Eastern Section) Rehabilitation Plan September 1996' prepared by Morse McVey and Associates" (condition P1.4)	30 June 2000	HCC
"Unless otherwise notified in writing by the EPA within 30 days of the submission of the works program described in Condition P1.4 of this licence, the licensee must immediately commence those works detailed in the works	Due 30 July 2000	HCC

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

program" (Condition P1.5)		
Replanting of landfilled area[2,3]	Post closure	HCC
Maintenance of rehabilitated areas[2,3]	Post closure	HCC

The objectives of re-vegetating the landfill surface are to:

- minimise erosion of the final cap;
- provide an aesthetically pleasing final landfill appearance;
- provide a final surface suitable for recreational use in the long term.

The final planting of the landfill comprises predominantly topsoiling and grassing with tree and shrubs planting in selected areas. Regular maintenance of rehabilitated areas shall be undertaken along with irrigation as necessary. In areas where difficulty is encountered in establishing grass cover, a suitable medium such as a straw or artificial mulch mat shall be used to improve grass take.

2.10 Leachate Collection System

Objective: Prevent water pollution by leachate[1,2,3]

Task	Frequency	Responsibility
"The leachate barrier and collection system for Area 2 of the Premises must be constructed in accordance with Section 2.6, Section 2.10 and Appendix 2.1 of the draft LEMP" (condition O3)	Construction	Contractor
"A leachate collection system must be installed on any surfaces within the Premises to be used for the emplacement of waste" (condition O4)	Construction of cells	Contractor
"The licensee must have in place a leachate management system that contains any leachate generated from the waste disposed of at the Premises" (condition O6)	Construction	HCC
"Drainage from areas not subject to waste disposal must be directed away from the areas at which waste is being disposed" (condition O8)	Construction	Contractor
"A leachate barrier system must be installed on any surface to be used for the direct impoundment of leachate" (condition O21)	Construction of cells	Contractor
The leachate collection system must be implemented in accordance with NSW EPA Guidelines for Solid Waste Landfills[2]	Construction	HCC

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Leachate must be managed to meet the following requirements:

- collect all waters (leachate) generated from or contacting with waste or the active tipping area; and
- leachate must be either disposed of or treated at a Premises approved by the EPA, be irrigated back into the landfill cell, or used for dust suppression within landfill cells.

2.10.1 Construction Methods

A leachate drainage and collection system is constructed in each cell and comprises a blanket filter drain and excavated leachate drains below base grade in accordance with the details on the Landfill Masterplan and Cell Construction drawings (Appendix 1-3).

All requirements for leachate collection drains and drainage blanket filter materials are outlined in the filter materials specification (Appendix 2-2).

The drains will be constructed to maintain a specified hydraulic grade to the collection header pipework which in turn will direct leachate to a temporary and then permanent collection sump from where leachate will be pumped for disposal by spraying or land application over completed areas of the landfill or injection back into the landfill. The leachate collection network shall be designed to minimise pressure build-up on the clay base liner and within completed cells.

The grades established on the top of the base liner shall be adhered to, to ensure positive drainage of any leachate to the system of lateral and central collector drains and headers, which lead to the main collector sumps. Gradients on the sidewalls of 1V:3H provide positive drainage on the side slopes.

The temporary and permanent leachate collector sumps shall be fitted with a filtered, inclined rise pipe through which any ponded leachate will be removed and treated. Landfill cell construction shall be managed to allow the construction of prepared base areas and leachate collector drains in advance of landfilling. The cell sequencing and all relevant leachate collection system details are shown on the programme and Cell 1 construction drawings (Appendix 1-3).

Leachate currently drains from Area 1 (Cell 1 and 2) into a collection sump below the top of the clay base liner, and pumped up the riser main. The leachate sump located in cell 3 is the final riser for all of the six cells in the concept plan. The riser main connects to a PVC pipe where leachate is reinjected or spray irrigated into Cell 3.

2.10.2 Quality Control

Quality control of the leachate drainage system shall be implemented by HCC (or HCC's nominated consultant) and shall include:

- inspection and checking of levels of all final base grade surfaces for uniformity of grade to ensure that there are no hollows;

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

- inspection of all leachate sump and pipe drainage works;
- QA checking and QC testing of leachate drainage filter materials to ensure compliance with material specification (Appendix 2-2) requirements.
- inspection of all leachate collection system components to assess compliance with the design on the Masterplan and Cell 1 Construction drawings.

2.10.3 Record Keeping

Monitoring of leachate shall be continued and will be intensified as necessary. Daily rainfall is recorded by the weather station at the landfill site, to provide background data for assessment of leachate volumes.

Leachate quantities removed from the site will be measured on a volume basis as the leachate is either irrigated or tankered from the site. In addition, the date and time of all leachate extractions shall be recorded.

2.10.4 Gas Control System

A landfill gas management system may be installed in the Area 2 landfill development following site closure, which will control LFG emissions, until they no longer pose a hazard. The collection of LFG will also assist in the revegetation of the site. Concept details for the landfill gas management system are presented on the Landfill Masterplan drawings in Appendix 1-3.

The landfill gas management system will consist of a series of gas extraction wells, linked by collection header pipes. Each well will be strategically located to distribute the applied vacuum equally throughout the landfill, but may be subject to review depending on system performance.

The landfill gas shall be incinerated in an enclosed flare, or used for power generation if this is considered to be a viable option.

Footnotes:
[1] or *Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Section 3 Landfill Operations

Contents

3. Landfill Operations

The following section details the requirements and actions involved in the operation of the landfill to satisfy the environmental goals of the EPA Guidelines.

3.1 General Requirements

Task	Frequency	Responsibility
"All activities carried out at the Premises must be carried out in a competent manner. In this condition, activities includes: *a) processing, handling, movement and storage of materials and substances; and* *b) the treatment, storage and disposal of wastes (including solid and liquid wastes)" (Condition O1)*	Ongoing	HCC & Contractor
"The licensee must ensure that all staff are aware of the manner in which the Premises is to be managed in order to comply with the conditions of its licence and that appropriate staff are available who can competently carry out all duties to meet the requirements of this licence" (Condition O37)	Ongoing	HCC & contractor
"The hours of operation for waste receipt and compaction must be in accordance with Hawkesbury City Council Development Consent" (Condition O41)	Daily	HCC & contractor
"A copy of this licence must be kept at the premises" (Condition G1.1)	Ongoing	HCC

"The licence must be produced to any authorised officer of the EPA who asks to see it" (Condition G1.2)	Ongoing	HCC
"The licence must be available for inspection by any employee or agent of the licensee working at the premises" (Condition G1.3)	Ongoing	HCC

All vehicles entering the landfill to deposit waste are required to:

- obey all current transportation laws, road and traffic laws and by-laws in force in the Sydney region for bulk haul vehicles; and
- deliver covered and secured loads which contain material within vehicle.

Hours of operation are generally 8am to 4.30pm. Landfill staff are in attendance at the gatehouse at all times during operating hours. The landfill is open to the public seven days a week excluding public holidays.

3.2 Machinery Maintenance

Objective: Prevent environmental impacts associated with equipment and system failure[1,3]

Task	Frequency	Responsibility
"All plant and equipment installed or used in or on the Premises: *a) must be maintained in a proper and efficient condition; and* *b) must be operated in a proper and efficient manner* *In this condition, 'plant and equipment' includes drainage systems, infrastructure, pollution control equipment and fuel burning equipment""(Condition O2)*	As required	HCC & contractor

A plant and equipment register is maintained onsite to update and record the working condition of equipment.

The machinery onsite includes:

- landfill compactor;
- bulldozers;
- hydraulic excavator;
- motorgrader;
- water trucks;

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

- other (towable sheepsfoot rollers and harrowing discs are used for compaction and conditioning of earth fill and liner materials respectively; portable lighting units, pick-up truck(4 wheel drive), emergency pumping equipment).

3.3 Traffic Control

Objective: Ensure safe and efficient vehicle movements onsite[3]

Task	Frequency	Responsibility
Traffic flow must be controlled to ensure safe and efficient movement through the facility[3]	Ongoing	HCC & contractor

Signs erected at the entrance to the landfill displays the following information:

- name of facility;
- operating hours;
- restricted materials;
- penalties for unlawful dumping;
- restrictions on access;
- a sign displaying the speed limit.

Traffic is first routed to the gatehouse and then proceeds to the bulk recycling area or active landfill area as directed.

Traffic control and directional signs have been erected on-site where needed, to facilitate uniform traffic flow. Additional signs shall be emplaced if an obvious need is identified (eg direction along temporary internal roads to the filling face). When vehicles reach the working area, verbal instructions and signs shall be used to direct vehicles to their unloading locations.

Landfill vehicle movements shall be recorded at the gatehouse. A register of daily vehicle movement numbers shall be maintained and must be made available to authorised persons on request.

All vehicles must adhere to the landfill policies, covering both speed and general safety aspects. The complaints procedures outlined in Section 1.3.2 also applies to traffic related incidents and will enable any concerns of local residents to be effectively dealt with by HCC. HCC has the authority to deny access to any user of the facility.

The gatehouse operator will have the authority to monitor load security and reject any non-conforming vehicles and loads and notify the EPA. Any complains regarding litter loss on open road areas will be investigation by HCC, and landfill access will be denied to persistent offenders.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.4 Leachate Management

Objective: Prevent water pollution by leachate[1,2,3]

Task	Frequency	Responsibility
"The leachate collection system must be operated in accordance with Section 3.4 of the LEMP" (Condition O5)	Daily	Contractor
"All waters coming into contact with waste (including waste stockpiles) or the active tipping area must be treated as leachate" (Condition O7)	Ongoing	Contractor
"Leachate collected by the subsurface leachate collection system must either be disposed of or treated at a Premises approved by the EPA to accept such waste; be irrigated on the irrigation area within the landfill cell or used for dust suppression within landfill cells" (Condition O9)	Ongoing	Contractor
"Leachate collected by the subsurface leachate collection system must not be discharged to waters or stormwater" (Condition O10)	Ongoing	Contractor
Disposal of collected leachate by spraying or land application over completed areas of the landfill or injection back into the landfill[2,3]	Ongoing	HCC
Inspect and maintain leachate pumps[3]	Monthly	Irrigation contractor
"Wherever leachate is discharged from the Premises the licensee must report the event to the EPA as soon as practicable after it becomes known to the licensee or to one if the licensee's employees or agents" (Condition R7.1)	As required	Contractor
"The event must be reported to the EPA by submitting a written report" (Condition R7.2)		
"The report must include the following information:		
a) the volume of the leachate discharged and over what time period the discharge occurred;		
b) the weather conditions at the time of the discharge, specifying the intensity of the rainfall event if it was raining;		
c) the most recent leachate monitoring results;		
d) an explanation as to why the discharge occurred;		
e) the location(s) of the discharge;		
f) a plan of action to prevent a similar discharge in the future; and		

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Task	Frequency	Responsibility
g) was the discharge permitted by this licence" (Condition R7.3)		
"This condition applies even if the harm caused or likely to be caused to the environment is expressly permitted by this licence" (Condition R7.4)		

3.4.1 General

The overall objective of the leachate management strategy shall ensure:

- that minimal leachate pollution from the landfill to adjacent ground and surface water resources takes place;
- that potential for leachate generation is minimised;
- that any leachate generated within the leachate collection system is monitored, controlled and disposed of in an environmentally responsible manner.

The landfill will not accept radioactive waste, liquid waste, asbestos waste of any type, pesticides, herbicides, contaminated soil, hospital or medical contaminated wastes or toxic wastes unless specific EPA approval is given. This policy is aimed at minimising the overall potential for leachate generation.

Perimeter drainage control and diversion bunds have been adopted to prevent surface run on from adding to the leachate quantity.

3.4.2 Leachate Collection

Leachate generated in the landfill will percolate down through the "windows" left in the daily/intermediate cover layers, until it reaches the top of the landfill liner base.

The leachate will then flow through the granular filter (sand) blanket drainage layer and will be collected via a grid of collector drains incorporated in the bottom of the liner. These drains are filled with gravel filter wrapped in synthetic fabric and lead to a collection sump.

3.4.3 Monitoring of Leachate Level in Sump

The level of leachate in the sump is regularly monitored by a mechanical float switch which activates the pump. This system is a check that there is no head build-up of leachate above the top of the clay base liner. It is critical that the level of leachate does not rise above the top of the clay base liner. No measurements of levels is undertaken, automatic float switch and regular monthly maintenance of these float switches is adopted.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.4.4 Leachate Treatment and Disposal

In order to maintain the leachate level in the collection sump below the top of the clay base liner, the leachate will be pumped up the riser pipe into a pipe to be discharged over the open landfill area or re-injected into the operating cell.

Whilst it is anticipated that recirculation of leachate through the refuse cells will be adequate in the short term, the volume of leachate generated will increase with placement of future waste and development of new cells. Monthly monitoring should consider the quality and quantity of leachate with consideration of disposal of the leachate off site eg to a licensed liquid waste landfill or sewerage treatment plant. In the long term consideration should be given to the viability of an on-site leachate treatment plant.

3.5 Data Collection

Objective: Maintain accurate record of site events and waste flows[1,2,3]

Task	Frequency	Responsibility
"The licensee must complete and supply to the EPA an Annual Return in the approved form comprising: *a) a statement of Compliance; and* *b) a Monitoring and Complaints Summary" (Condition R1.1)*	Annual	HCC
"In accordance with clause 25 of the POEO (Waste) Regulation, the licensee must install an approved weighbridge at the premises by 30 September 2000" (Condition P1.7)	30 Sept. 2000	HCC
"The licensee must maintain a daily log and record the following data of fires at the site: *a) time and date that a fire was deliberately or accidentally started;* *b) the time and date that the fire was either burnt out or extinguished;* *c) the location of fire (ie. clean timber stockpile putrescible garbage cell, etc);* *d) prevailing weather conditions;* *e) any complaints of smoke nuisance from the public or local residence; and* *f) observations made in regard to smoke direction and dispersion" (Condition R6)*	As required	Contractor

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Task	Frequency	Responsibility
"The licensee must keep a legible record of all complaints received by the licensee or by any employee or agent of the licensee, in relation to pollution from or on the premises"(Condition M4.1) *"The record must include details of the following:* *a) the date and time of the complaint;* *b) the method by which the complaint was lodged;* *c) any personal details of the complainant that were provided by the complainant or, if no such details were provided, a note to that effect;* *d) the nature of the complaint; and* *e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant" (Condition M4.2)* *"The record of each complaint must be kept for at least 3 years after the complaint was received" (Condition M4.3)* *"The records must be produced to any officer of the EPA who asks to see them" (Condition M4.4)*	As required	HCC
"The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises o by the vehicle or mobile plant, unless otherwise specified in the licence" (Condition M5.1) *"The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint" (Condition M5.2)*	Ongoing	Contractor
"A weather station must be operated and maintained at the Premises to monitor and record daily rainfall" (Condition O42)	Daily	HCC
Gatehouse database is to record the following: ▪ incoming load details; ▪ outgoing load details; ▪ daily rainfall levels; ▪ daily leachate levels; ▪ refusal and complaint incidents; and ▪ fire incidents [2,3]	Ongoing	HCC
Reports detailing the following: ▪ Materials salvaged; ▪ Service records; and ▪ Costs of recycling services As per the contract[2,3]	Monthly	Contractor

EPA has issued special consideration for the facility with regard to the installation of a weighbridge. With the impending change to operations with the inclusion of an onsite 'Pre-treatment Facility', the weighbridge requirements are projected to change. It is permitted that this requirement be held until the installation of the new technology.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Database

All loads entering and leaving the facility are recorded in a database at the gatehouse. Information recorded includes:

- type of vehicle;
- type of waste;
- amount of waste; and
- cost and receipting.

Material movements out of the facility also record the destination.

All pollution related complaints are referred to the EPA Pollution Line (135555). All complaints received at the plant regarding site operations (staff behaviour, charges, facilities) are recorded on the gatehouse database.

All refusals (not enough money, unacceptable waste etc) are recorded on the database.

All fires onsite are reported to the gatehouse for recording on the database.

3.6 Waste Acceptance and Screening

Objective: Assure quality of incoming wastes[1,2,3]

Task	Frequency	Responsibility
"Only waste, including putrescible waste, that is assessed as inert waste or solid waste following the technical assessment procedure outline in Technical Appendix 1 of the Waste Guidelines or that specified as inert waste or solids waste in Schedule 1 of the Protection of the Environment Operations Act 1997 may be disposed of at that Premises" (Condition L1.2)	Ongoing	Contractor
"The following types of waste must not be disposed of at the Premises: *1 Liquid Waste; or* *2 Asbestos waste of any type; or* *3 Contaminated soil" (Condition L1.3)*	Ongoing	Contractor
"The licensee must not cause, permit or allow any waste generated outside the Premises to be received at the Premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the Premises to be disposal of at the Premises, except as expressly permitted by the licence" (Condition L3)	Ongoing	Contractor

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Task	Frequency	Responsibility
"The licensee must not dispose of any tyre in the landfill at the Premises unless: *a) the tyre has a diameter of 1.2 metres or more; or* *b) the tyre has been shredded (as defined in condition L6.3 of this licence) or had its walls removed; or* *c) the tyre was delivered to the Premises as part of a domestic load (as defined in condition L6.3 of this licence)" (Condition L6.1)*	Ongoing	Contractor
"In condition L6.1: *a) tyres are taken to be shredded only if the tyres are in pieces measuring no more than 250mm in any direction; and* *b) domestic load means a load containing no more than 5 tyres having a diameter less than 1.2 metres" (Condition L6.3)*	Ongoing	Contractor
"The licensee must have in place and implemented procedures to screen and remove any waste not permitted by this licence to be disposed of at Premises" (Condition O20)	Ongoing	contractor
"The holder of this licence must ensure that all users of the facility are aware of which materials can be recycled at the facility. Supervision of wastes being deposited must be undertaken and users encouraged to separate waste types to maximise recycling. Recycling facilities must be readily accessible to the public, clearly marked and be able to accept the following materials for recycling as a minimum requirement: *a) glass – clear, brown and green;* *b) paper and cardboard;* *c) PET plastic;* *d) Aluminium and steel cans;* *e) Bricks, tiles, concrete;* *f) Reusable timber, firewood and garden waste" (Condition L7)*	Ongoing	Contractor
"The Licensee must display a notice as to which materials can be recycled at the Premises. Supervision of wastes being disposed of must be undertaken and users encouraged to separate waste types to maximise recycling" (Condition O44)	Ongoing	contractor
Recyclable materials received must be: • Inspected for contamination • Sorted and stockpiled • Periodically processed or transferred offsite for reuse/resale • Recorded and reported on volumes[2]	Ongoing	Contractor

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

HCC complies with all consent conditions and licence requirements for waste handling and acceptance.

HCC will not accept the following wastes unless specific EPA approval is given:

- radioactive waste;
- liquid waste;
- asbestos waste of any type;
- pesticides and herbicides;
- contaminated soil;
- hospital or medically contaminated waste; and
- toxic waste.

The materials accepted onsite and either reprocessed or recycled are:

- putrescible waste;
- paper and cardboard;
- aluminium and steel cans;
- PET plastics;
- batteries;
- tyres;
- empty agricultural chemical drums ('Drum Muster');
- green waste;
- metal (white goods & black goods);
- bulk wood (furniture);
- waste oil;
- soil; and
- bricks, tiles and concrete.

Only putrescible waste is disposed of in the landfill cell. The remaining accepted wastes are transferred to recyclers or processed onsite for landscaping (green waste, bulk wood and building waste) or for sale.

Treatment of recyclables is in accordance with HCC Recycling Specifications (see Appendix 3-1).

The landfill licence permits the acceptance of appropriate 'Industrial Wastes' however HCC policy is not to accept these materials.

HCC has a number of opportunities to screen unacceptable wastes from the landfill.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

a) council municipal collections are screened during the run to identify any non-conforming wastes;

b) private refuse collection companies usually inform clients of acceptable waste as part of contract, and inspect bins upon collection;

c) all onsite staff are trained to identify unacceptable wastes;

d) signs are posted at the entry and all drop-off points stating the accepted wastes;

e) each incoming load of waste is visually inspected by the gatehouse attendant and the driver questioned as to the contents;

f) bulldozer and compactor operators are responsible for routine inspection of waste;

g) contractor tip face operator supervises the unloading of all wastes;

h) gatehouse and tip face staff have two-way communication system so any 'special wastes' (eg. carcasses) may receive immediate burial; and any non conforming patrons may be identified and tracked for appropriate control.

Any non-conforming wastes are removed from the site at the expense of the person delivering the waste to the landfill. Any company or person depositing refuse that does not conform to site acceptance policy on a repeated basis, will be refused tipping rights unless compliance can be provided.

A record of non-conformances is kept in the gatehouse database.

3.7 Waste Handling and Operating Procedures

Objective: Ensure optimum performance of the landfill[1,2,3]
Minimise exposure of wastes[1,3]

Task	Frequency	Responsibility
"The licensee must ensure that the amount of landfill void space used per tonne of waste disposed of at the Premises is minimised" (Condition O21)	Daily	Contractor
"The licensee must ensure that effective compaction of all landfilled waste is achieved" (Condition O22)[3]	Daily	Contractor
"The licensee must ensure that the achieved compaction rate of landfilled waste (excluding cover material) is stated in the annual report for the Premises submitted to the EPA" (Condition O23)	Annual	Contractor
"Cover materials must be VENM or other material approved by the EPA" (Condition O33)	Daily	Contractor

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Task	Frequency	Responsibility
"Cover material must be applied to a minimum depth of 15 centimetres over all exposed landfilled area prior to ceasing operations at the end of each day" (Condition O33.1)	Daily	Contractor
"Where the surface of any landfilled waste at the Premises is to exposed for more than 90 days cover material must be applied to a depth of 30 centimetres over that surface" (Condition O33.3)	As required	Contractor
"Where wastes are received at the Premises for purposes of reuse, reprocessing, recovery, recycling or transfer to another Premises, then such wastes are not required to be covered on a daily basis provided that: *a) such wastes are stored and managed so as not to cause or be likely to cause any off-site environmental effects;* *b) such wastes are stored in a clearly defined area of the Premises away from the tipping face; and* *c) the licence holder accepts full responsibility for such wastes while they are kept on the Premises" (Condition O33.4)*	Ongoing	Contractor
"The maximum amount of unprocessed wood and unprocessed vegetation to be stockpiled at the Premises must be limited to 400 cubic metres (m^3)" (condition O45)	Ongoing	Contractor
"Tyres may be stockpiled at the Premises if: *a) the total quantity stockpiled at the Premises does not exceed 50 tonnes; and* *b) the stockpiles are located in a clearly defined area away from the tipping face; and* *c) the stockpiles are stored and managed so as not to cause or likely to cause off-site environmental effects (such as the spread of disease by vermin); and* *d) the licensee accepts full responsibility for the tyres while stockpiled at the Premises; and* *e) all practical measures are taken to prevent any tyres from catching fire""(Condition L6.2)*	Ongoing	Contractor
When special wastes identified at the gatehouse, the tipface operator must be notified immediately to ensure immediate burial and cover	As required	HCC gatehouse

3.7.1 General Waste Handling

Generally, refuse shall be placed in a cellular fashion incorporating daily and intermediate cover, in accordance with accepted sanitary landfill practice.

Each daily filling operation shall begin with cutting of "windows" nominally 20m square through the previous layer of daily or intermediate cover. Windows shall be of

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

sufficient size to provide effective connection between cells and may be varied in size according to soil operating conditions and cell arrangements.

Both upslope and downslope refuse placement operations shall be employed, although upslope operation is given preference due to improved waste compaction at the tow of the fill slope. The target minimum refuse density is 850kg/m^3, with a density of 1000kg/m^3 achieved most of the time.

For the first 1.8m above the liner zone and leachate drains, refuse shall be selected so as to ensure continuity of drainage and to avoid damage to the liner and drains from angular material in such refuse. Materials of significant permeability such as fine demolition rubble shall be placed within 2m of leachate drains when available.

The working surface of each refuse cell shall be minimised in order to reduce the exposed refuse surface and optimise the quantity of daily and intermediate cover required. The width of the working face is such as to allow room for the manoeuvring of the expected traffic volumes at the working face. The thickness of each refuse cell shall be between 2.5 and 4.5 metres and the working face shall be operated with a nominal slope of 5 horizontal to 1 vertical, but will be finished at a slope of 3 horizontal to 1 vertical prior to placing the daily cover.

The refuse placement, compaction and cover procedures outlined above are expected to minimise the incidence of fires in the deposited refuse at the landfill. In the event of a fire developing in the refuse at the landfill, refer section 4.13.2 Fire Contingency Plan.

3.7.2 Special Waste Disposal Procedures

Wastes requiring special treatment are identified during the acceptance procedure. Any such wastes are handled in accordance with EPA and Council guidelines.

Wastes not requiring special treatment are to be handled in the same manner as other waste as set out in Section 3.7.1.

Special procedures are outlined to deal with non-hazardous special wastes. In general, these wastes will be placed in designated areas and surveyed areas within cells and then immediately buried. Where possible, wastes deemed objectionable due to, for instance, odour, will be deposited into nominated disposal areas and covered immediately with a minimum of 150mm of approved cover material, in accordance with licence Condition O33.

3.7.3 Temporary Roading

On-site access roads shall be constructed with all weather surfaces between the site entrance and the working face. All main access roads shall remain sealed and regularly maintained by the HCC/contractor.

All site working areas are maintained to enable safe and efficient operation during wet weather.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.7.4 Cover Material

The function of intermediate cover layers is to provided an effective sealing layer over the waste materials in areas where working landfill cells is not expected for a period of more than 30 days. This layer ensures that rainfall infiltration into (temporarily) completed cell areas is minimised, hence reducing leachate generation.

Intermediate cover shall comprise suitable soil fill materials capable of being compacted to a low permeability (typically less than $1x10^{-6}$m/s). Intermediate cover shall be at least 300mm thick and shall be compacted in a minimum of 2 layers.

3.7.5 Compaction

Daily compaction of waste is required to minimise leachate generation.

3.8 Landfill Gas Management

Objective: Prevent air pollution by landfill gas[1,2,3]

Task	Frequency	Responsibility
Landfill Gas shall be managed to prevent any safety, environmental and nuisance effects[2,3]	Daily	Contractor

General

Landfill gas is a by product of anaerobic decomposition of organic waste in a sanitary landfill. Landfill gas is composed of approximately 58% methane, 42% carbon dioxide and trace amounts of hydrogen sulfide and some minor organic compounds. The landfill generation rate is dependent upon the moisture content, composition and age of the refuse as well as the temperature and pH of the landfill. The concern over landfill gas relates to the potential migration from the landfill, which may lead to nuisance odours, vegetation stress, leachate break outs and safety hazards (eg explosions). A landfill gas monitoring program is necessary to ensure that such migration problems are detected and controlled through a gas recovery system (see Section 4.4).

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.9 Nuisance Control

Objective: Prevent degradation of local amenity[1,2,3]

Task	Frequency	Responsibility
"The licensee must minimise the amount of waste and mud that is tracked from vehicles leaving the Premises" (Condition O32)	Ongoing	Contractor
Vehicle wash bay separator must be cleaned and maintained[3]	Weekly	Contractor

A vehicle wash bay is present onsite for use by all patrons to wash off dirt from vehicles before leaving the site. This facility is fitted with a bund and oil separator pit. Water from the system is discharged to a rehabilitated grassed area whilst sediment is collected and spread on the landscaped areas of the site.

3.9.1 Litter

Task	Frequency	Responsibility
"The licensee must ensure that local amenity is not degraded by litter from the Premises" (Condition O30)	Ongoing	Contractor
"The licensee must minimise the amount of waste and litter escaping from the premises" (Condition O31)	Ongoing	Contractor
Maintenance of litter screens (if used)[3]	Weekly	Contractor
Educate patrons to cover loads[3]	Ongoing	HCC

Generally, the problem of airborne litter will be minimised by the progressive use of cover over the active fill areas as described in Section 3.7 and by the provision of earth berms around the area being landfilled. The size of the working face will be restricted to the minimum practical, which is dependent on traffic flow.

Additionally, a portable litter screen may be used downwind of the working face to contain loose paper and other windblown refuse which might otherwise escape from the working face before daily cover is applied. The operations supervisor would be responsible for the correct placement of the portable screens to ensure they are located correctly relative to wind direction and working areas. Litter will be cleaned from the screens on a weekly basis and collected by hand prior to relocation.

Minor quantities of litter which escape and blow around the site are to be recovered by litter "pickers" who will patrol the landfill workface areas and boundaries recovering such materials as required.

HCC will continue the community education programme to advise users of the waste depot to adequately cover and secure loads, as well as ensuring that all waste,

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

especially light weight plastic or paper, has been removed from vehicles prior to leaving.

3.9.2 Dust Control

Task	Frequency	Responsibility
"The licensee must minimise the amount of dust emitted from the Premises" (Condition O34)	Ongoing	Contractor
"Without limiting the above condition, the following measures must be followed:	Ongoing	Contractor
a) sealed or gravel roads must be constructed and maintained from the public roadway to the gatehouse/waste reception section of the landfill.		
b) Dust suppression methods must be used as frequently as necessary for any unsealed or unvegetated areas at the landfill including the use of water sprays and water carts.		
c) A water cart must be always available on the site for the purposes of dust suppression" (Condition O35)		

Dust generation is controlled onsite by the use of stormwater for dust suppression on exposed soils (Cell 1).

Air Pollution and Dust

A wheel wash facility is provided onsite if required.

Minimising dust deposition is achieved by the following:

- reduction of the total surface area exposed by stripping;
- weekly sweeping of hard surface roads;
- encouragement and maintenance of grass cover on stockpiles;
- maintenance of dust suppression by water spray on active roadways;
- planting of heavy cover of shrubbery to act as a wind break and filter dust in all constructed and proposed acoustic and landscape bunds;
- positioning of a two to three metre high fabric perimeter fence to form a wind break and dust filter and litter patrols.

Potential dust nuisance during dry weather is controlled by regular wetting down of unsealed access and manoeuvring areas, as required. A water truck is maintained permanently on the site for this purpose as well as for fire control.

The main access road and manoeuvring areas are sealed. Access roads shall be wetted down by the water truck on a needs basis to maintain minimum potential for dust generation. A washbay is provided for all vehicles prior to leaving the landfill site and the washbay facility is cleaned regularly and checked by HCC/contractor.

ootnotes:
NSW EPA licence requirement
NSW EPA Guidelines for Solids Waste Landfill –Benchmark
HCC requirement

3.9.3 Odour

Task	Frequency	Responsibility
Ensure good compaction over correct working face gradients to ensure water ingress is minimised[2]	Ongoing	Contractor
Ensure the immediate deposition of waste upon delivery. Highly odorous wastes such a dead animals shall be buried and covered immediately[2,3]	Ongoing	Contractor
If offensive odours are being generated, either of the following shall be implemented: a) provision of improved drainage to minimise the occurrence of standing water; b) spreading of hydrated lime over newly deposited or saturated waste, prior to covering; c) use of deodorisers; d) increasing cover thickness or using more impermeable intermediate cover material[3]	As required	Contractor
Ensure adequate cover is applied to the waste on daily basis[2,3]	Daily	Contractor

3.9.4 Noise

Task	Frequency	Responsibility
"The level of noise emitted from the premises must not exceed an LA10 sound pressure level of 50dBA when measured or calculated for any pint within one metre of the boundary of the nearest affected residence or other noise sensitive areas in the vicinity of the Premises, using the 'Fast' response on the sound level meter" (Condition L5.1)	Ongoing	Contractor
"In the case of any noise which is tonal or impulsive in character, the level of continuous noise LA10,T from the Premises at any pint within six metres of any residence or other noise sensitive areas in the vicinity of the Premises, is obtained by adding 5dBA to the measured level" (Condition L5.2)	Ongoing	Contractor
Use of appropriate and well maintained machinery manufactured to minimise noise generation[3]	Ongoing	Contractor
Incorporation of acoustic barrier along the southern boundary of the site[3]	Construction	Contractor
Organise storage stockpiles to provide acoustic shielding[3]	Ongoing	Contractor

The landfill's design, construction and operating procedures incorporate measures specifically aimed at mitigating excessive noise impacts from the operation and ensuring compliance with licence conditions and requirements.

Any additional works required beyond working hours (5pm and 7am) shall reduce noise. Vehicles shall not use engine brakes.

Perimeter planting around the site will reduce noise levels offsite.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Staged construction and development works will minimise noise generation.

Noise levels from landfill construction and operation are monitored quarterly as described in Section 4. Monitoring results are forwarded to the EPA on a annual basis. If noise levels are detected in excess of the established acceptance limits, the offending activity is modified or stopped according to the response procedures set out in Section 4.

3.9.5 Vermin and Pest Control

Task	Frequency	Responsibility
"The licensee must take all reasonable steps to minimise pests, vermin and noxious weeds at the Premises" (Condition O36)	Ongoing	Contractor
Daily cover of waste material to prevent vermin[2,3]	Daily	Contractor

3.9.6 Vermin, Insect and Bird Control

Vermin

The normal operation of the sanitary landfill, which includes placement of 150mm of compacted daily cover at the end of each day prevents vermin from developing a presence at the site, by eliminating the food source. Site personnel are trained to observe and identify the first signs of vermin presence. Any vermin problems at the landfill will be eliminated by site personnel and if necessary a local exterminating firm will be contracted to provide an additional exterminating service, as required.

Pest Control

Provision of adequate cover material with good compaction is essential to the control of flies and other insects. The provision of graded perimeter drains and smooth finished surfaces is undertaken to eliminate stagnant water, which might encourage insect breeding. Highly odorous wastes entering the site are immediately covered to minimise insect attraction.

Minor pest problems will be dealt with by site personnel. Care would be exercised in the use of pesticides and operator informed of the nature of materials they are handling, instructed in its use and would be provided with the appropriate equipment and clothing.

Bird Control

Potential bird problems will be controlled by making the landfill facility less attractive for feeding, roosting and resting. It is the policy of HCC to implement control methods to ensure that birds do not become a nuisance or a hazard.

Primary Control Practices

These are operated as part of the overall site management strategy:

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

- covering waste regularly and promptly;
- operating with a small uncovered tipface;
- special handling of organic waste;
- proper compaction of the waste;
- completed landfill areas seeded to provide 25-30cm vegetation cover.

Secondary Control Practices

These will be implemented if a problem arises:

- distress tapes;
- avitrol poisoning;
- propane cannons;
- racket bombs;
- blank .22 calibre shells;
- wire grid system;
- mobile net cover.

Weeds

Currently weeds are managed on rehabilitation areas with standard herbicides, however operational cells and temporary spoil stockpiles are not weed controlled as they act to stabilise these areas and are expected to be only temporarily exposed.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.10 Silt Control

Objective: Minimise erosion and sedimentation during operations[1,2,3]

Task	Frequency	Responsibility
"The residual capacity of sedimentation basins must not be reduced by more than 5 percent from their original design capacity in accordance with Section 2.8 of the LEMP" (Condition O13)	Ongoing	Contractor
Temporary diversion ditches and berms shall be constructed during operation in excavated areas[3]	As required	Contractor
Sediment control fences and traps shall be used in conjunction with the stormwater/sediment basin[2,3]	As required	Contractor
Areas of soil exposed for more than 30 days should be stabilised to prevent erosion[2]	As required	Contractor
Establishment of vegetation on exposed areas which are intended to remain un-worked for a period of 2 to 6 months[2,3]	As required	Contractor

These measures will be implemented as necessary during the landfill operation. Control structures and temporary measures will be maintained until complete grass cover has been established over the site area. Sediment collected from the sediment traps and basins is dried and re-used as daily cover.

3.11 Stormwater Management

Objective: Minimise erosion and sedimentation during operations[1,2,3]

Task	Frequency	Responsibility
Monitor and maintain sedimentation dam levels to prevent overflow[3]	Daily	HCC

Stormwater levels are recorded daily. Water from the sedimentation dam is spray irrigated by a pump system to the revegetated section along the Driftway or to Cell 1 and 2, during operating hours only.

Refer Section 2.8 for design details.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.12 Site Security

Task	Frequency	Responsibility
"The licensee must take all practicable steps to control entry to Premises" (Condition O26)	Ongoing	HCC

The premises is secured with electronic locking gates across the site access road. Access is to the site gained only via the gatehouse. Here all loads and identification are checked (only HCC residents are accepted).

Electronic entry gates and boom gates prevent unauthorised access to the facility after operating hours. Authorised staff are issued with electronic passes which must be scanned to gain entry after hours.

Inferred video surveillance records all traffic movements into and out of the site and is regularly monitored for anomalies.

3.12.1 Fire Prevention

Task	Frequency	Responsibility
"The licensee must have in place and implement fire prevention measures to minimise the risk of fire occurring at the Premises" (Condition O17)	Ongoing	Contractor
"There must be no incineration or burning of any waste at the Premises"(Condition O18)	Ongoing	Contractor
"The licensee must have adequate fire prevention measures in place, and ensure that Premises personnel are able to access fire-fighting equipment and are able to manage fire outbreaks at any part of the Premises" (Condition O19)	Ongoing	Contractor

The following safety measures are undertaken to reduce the risk of fires onsite:

- open burning of wastes at the facility is not permitted;
- a water taker is kept onsite and may be used in emergency fires;
- in the event of a fire, the local fire station should be contacted;
- onsite leachate and stormwater may be used to suppress a fire;
- portable extinguishers are fitted to the landfill compactors to deal with any minor fires that might accidentally start around the work face; and
- a fire buffer is maintained around the perimeter of the site.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

3.13 Occupational Health and Safety

Task	Frequency	Responsibility
First Aid officer to be onsite each day[3]	Daily	Contractor
Personal Protective Equipment is to be worn at all times[3]	Ongoing	HCC & contractor
Medical examinations are to conducted for all employees[3]	Pre-employment and annual	HCC & contractor

Occupational Health and Safety Policy

HCC and contractor will take all reasonable steps to safeguard the health and safety of all employees, and any person within the facility. HCC will also protect all property from damage where possible. HCC aims to provide and maintain standards and practices which offer the highest practicable degree of protection based on current knowledge.

Responsibilities

HCC and contractor are responsible for implementing, maintaining and monitoring the OHS policy and procedures outlined herein and ensuring they are adhered to on site.

All staff are responsible for following the OHS policies and procedures for their work area. They shall take action to minimise or avoid hazard if which they are aware of and to advise their supervisor or safety representative of the existence of such hazards. They will, at all times, make proper use of appropriate safeguards, safety devices and personal protective equipment provided by their employer.

Employee Safety Training Programme

All site staff will be trained regularly in OH&S by HCC and the contractor with particular reference to safety procedures. This training will include familiarisation with the location and use of first aid and fire fighting equipment. Routine training sessions will be carried out at a maximum interval of 12 months, but any new staff will receive safety training as part of their induction procedure within 2 days of commencing employment at the site.

Standard Safety Equipment and Procedures

All operations personnel will be equipped with safety clothing including gloves, hard hats, safety shoes and goggles which they will be required to wear at all appropriate times. Personnel will be trained in proper landfill management and operating procedures.

Other key safety controls are:

- all site roads will have maximum speeds posted (15kph in the landfill areas);
- no smoking will be allowed beyond designated places.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

As a minimum, safety equipment to be maintained on-site will include:

- fire extinguishers for each piece of equipment.

First aid kits

- A St Johns First Aid kit is currently kept in the gatehouse and contractors site shed.

In addition to fire extinguishers, on-site fire protection facilities will consist of earth stockpiles near the working face, fire breaks and water retention (sedimentation) basins.

First Aid

General

First Aid is the emergency treatment of illness and injury to stabilise a patient before they are evacuated by an ambulance or moved by other means to a medical facility.

The contractor responsible for the landfill activity shall have at least one person per shift is to be appointment the first aid officer and shall render first aid to staff when required. The first aid officer is to have a current First Aid Certificate. All staff should be instructed in basic first aid skills, which include CPR and be prepared to assist as directed by the first aid attendant.

First Aid Room

The First Aid Rooms are located at the gatehouse and the contractors site shed. These shall be equipped with a first aid kit.

This kit is to be portable.

The first aid attendant is to maintain the kits and ensure all supplies have not expired their useful life.

The first aid kit is to be white with the following markings painted on them.

a) A Red Cross.

b) The words "FIRST AID"

The container should be dust and moisture proof and not be locked.

NB Small first aid kits will be placed in designated vehicles.

Personal Protective Equipment

General

Personal Protective Equipment (PPE) is only to be considered for use when all other methods of removing or reducing hazards have been exhausted. There are areas

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

identified at the landfill that require the use of PPE. Employees working in these areas and visitors must comply with the PPE requirements for the areas.

Training

Before any PPE is issued the wearer is to be trained in its use, maintenance and performance capabilities (including any restrictions on its use).

Maintenance

Each employee issued with PPE is to maintain that equipment to the standard described by the manufacturer. Items which become unserviceable are to be repaired or replaced immediately. Maintenance checks are to be completed by all contractor or the site supervisor each month. This is to include all items on issue and held in store. Unserviceable items or items which have passed their effective life are to be replaced.

Wearing

It is the responsibility of the employee to ensure they are wearing the correct PPE before they start work in a hazardous area. It is the responsibility of the contractor or the site supervisor to ensure that all staff are correctly wearing their PPE issued for that work area. Staff are to store their issued PPE in the site shed or gatehouse. PPE is not to be taken off the premises without the approval of the HCC or the contractor.

Manual Handling

There will be occasions when staff will be required to manually handle furniture and waste. These are the times when staff are at most risk of injury. To reduce the possibility of injury the following points are to be observed when lifting or carrying waste items.

a) Check weight or check lift first, if in doubt get help or use Mechanical Handling Equipment (MHE).

b) Remove rings.

c) Wear gloves.

d) When lifting as part of a team appoint a team leader. The team leader is to control the lift by giving the following instructions:

   1) "Prepare to lift" and when everyone is in place and taking the strain instruct "lift".

   2) Once the item is lifted the team leader is to indicate the direction of the movement and when to stop.

   3) When it is time to lower the team leader is to say "prepare to lower". Once everybody is settled, instruct the team "lower".

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

e) Before lifting an object check the object for:

1) Loose items.

2) Sharp items.

3) Sharp edges.

Confined Spaces Procedures

Any enclosed area that contains unacceptable levels of atmospheric hazards can be defined as a confined space. A confined space is:

- a space which has restricted means of entry and/or exit;
- a space not intended as a regular place of work;
- a space which may have adequate ventilation and/or a toxic or oxygen deficient atmosphere.

Confined spaces may contain physical as well as chemical hazards. Their size and shape may contribute to the hazard by restricting ventilation, worker mobility or rescue efforts. Confined space entries should be authorised only when there is no other practical way in which the work can be performed from the outside.

The general requirements and procedures for confined space safety are:

1. All potential confined spaces at the landfill must be identified, listed and labelled with warning signs where practicable.

2. Door openings to confined spaces must be secured.

3. Contractor safety must be integrated into the program. All contractors must comply with the confined space entry procedures at the landfill.

4. All personnel at the landfill must be properly trained in confined space techniques before they enter a confined space. Training is to be on-going with regular reviews. Training is to meet all requirements of AS2865.

5. The approval of HCC must be received in writing once an evaluation of each confined space's actual or potential conditions has been carried out and before any employee enters a confined space on site.

6. Where possible all identified potential hazards should be eliminated prior to entry. Where this is not practicable, control of any safety or health hazards should be undertaken via air monitoring, purging, ventilation, lock out and tagging, observation, support and communication measures.

7. All persons entering a confined space must wear the appropriate personal protective equipment including retrieval devices, where appropriate.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Medical Examinations

General

All operations and management staff will undergo pre-employment medical examinations in accordance with the contractors requirements to ensure they are of satisfactory standard of health to work at the landfill.

Pre-Employment Medical Checks

Pre-employment medical checks for all operations and management staff will cover the following items, as a minimum:

a) blood sugar levels

b) blood pressure

c) weight

d) lung function

e) chest x-ray

f) hearing test

g) eyesight test

h) heartbeat (heart murmur)

i) reflexes

j) blood screen test

k) urine screen test

Current tetanus vaccination protection will be required as a condition of employment.

The following items will also be checked at the pre-employment medical, with the applicants permission:

l) Hepatitis A

m) Hepatitis B

n) HIV

In addition to the tetanus protection requirement, application will be urged to have the following vaccinations:

o) Hepatitis A

p) Hepatitis B

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

q) Typhoid

Annual Medical Checks

All staff will be required to undergo an annual medical check for the following items:

r) blood sugar levels

s) blood pressure

t) weight

u) lung function

v) chest x-ray

w) hearing test

x) eyesight test

y) blood screen test

z) urine screen test

or as required by their employer.

3.14 Contractors Safety Guide

Contractors Safety Manual Guide Part 1 and Small Contractors Safety Manual Guide Part 2:

All contractors at HCC premises shall share the responsibility for preventing accidents. Before any work is commenced it is important to realise how serious safe working procedures are and to include safety as par of the planning process.

They shall at all times obey councils safety rules and follow the standard operating procedures. Contractors are required to acknowledge receipt of the mandatory induction guide (manual) before commencing work.

3.15 Facility Maintenance Programme

Task	Frequency	Responsibility
Plant and equipment must be inspected for faults and repairs made as appropriate[3]	Monthly	HCC

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Fixed Installations/Plant

It is the responsibility of all staff to ensure that plant and installations in their work area are well maintained and serviceable. Any faults or signs of wear are to be reported immediately. The contractor is responsible for ensuring all facilities are maintained to their manufacturer/design requirements. Items of major importance are the leachate collection system, the stormwater pumps and pipework fittings.

In addition to their manufacturer requirements, the above items should have a non-technical inspection once a month. It is the contractor's responsibility to check the facilities.

Mechanical Plant

In terms of operating the landfill on a daily basis the most critical plant item is the landfill compactor. Should this suffer a breakdown there will be a standby machine available, which will be maintained in an operative state. In addition the bulldozer on site can be called on to perform compaction of refuse in the short term (24 hours).

All other items of operating plant are not critical in terms of time and can be serviced with down time not affecting the environmental security of the operation.

In addition, all breakage's or failures that require un-scheduled maintenance will be split into one of two levels of priority.

Level One failure may affect the safe operation of the landfill, so it can be repaired as soon as is convenient eg excavator breakdown.

Level Two failure may affect the safe operation of the landfill. Level Two damage/failures require immediate repair and may require the equipment to be placed off line for a period of time. If this affects the operation of the landfill, a temporary replacement is to be supplied until the defective machinery is repaired.

All vehicles will have a maintenance record compiled by the contractor and held in log books in the company office to enable analysis of equipment's performance and maintenance scheduling.

The log books will be divided in sheets, into four areas. These areas are:

a) Title Area - This area contains the driver's name, vehicle fleet number and start, end and total kilometres or hours of operation.

b) Checklist Area – This area contains a service check list. The driver must initial each entry.

c) Faults Area – The fault area is a space for the driver to enter any faults he identifies with the vehicle at the start up or during operation of the vehicle.

d) Damage Diagram Area – This area contains four diagrams of the vehicle (viewed from the front, rear, and both sides) and a space for notes. Any damage is noted in this area.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Ground Maintenance and Landscaping

Grassed surfaces on intermediate and final cover will be maintained as part of the landfill operating programs by mowing. Landscaped perimeter areas and bunds shall be maintained by HCC. These areas shall be maintained in a neat and tidy state with pruning and replanting in accordance with the landscape plan. Litter collection from these areas will be undertaken on a regular basis by the contractor or as directed by HCC.

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Section 4 - Monitoring and Contingency Plan

Contents

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Footnotes:
[1] NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4. Monitoring and Contingency Plan

4.1 Compliance Management Systems

General

Details of the monitoring systems are set out in Sections 4.2 – 4.8 while protocols currently applicable to environmental measurement/sampling are set out in Appendices 4-1 and 4-2.

The landfill monitoring programs include groundwater, surface water, leachate, noise, dust and landfill gas. Legal requirements, assurance tasks, verification tasks and corrective actions for each monitoring program shall be incorporated into the daily landfill operation and documented.

Baseline environmental data was provided by commencing monitoring landfilling activities in August 1996. Monitoring data is currently obtained on a routine basis throughout the operation and will be implemented during the after care period of the landfills life cycle. Data other than baseline shall be compared with baseline data, as described below in order to define any change in conditions which may occur as a result of landfilling operations. Should this evaluation process indicate that any significant landfilling related impacts are occurring, then the appropriate regulatory authorities will be notified and the response procedures set out in Sections 4.2 to 4.13, implemented.

Data Evaluation and Response

There will be three levels of review and evaluation of monitoring data:

Level 1: Routine comparison of results with baseline data

Level 2: Detailed evaluation of extraordinary results by a specialist

Level 3: Independent scrutiny by the EPA

If a response is required as a result of any level of evaluation, the action to be taken is described in general terms below and in more specific terms in Sections 4.2 to 4.8.

Level 1

Preliminary review of all monitoring data collected will be carried out by HCC or by an independent and technically qualified environmental scientist appointed by HCC.

The nominated review person shall be responsible for reviewing and identifying any environmental monitoring data which are high relative to baseline data. To assist with this review, 'high' results are defined as results which exceed the standard values

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

which have been derived from previous data collection. In general, the standard value will be equal to the mean value plus three standard deviations for each parameter measured.

If no result exceeds the standard value, then routine monitoring shall continue.

If any result exceeds the standard value, then the cause shall be investigated. If no obvious transient effect or influence can be identified, then sample re-analysis shall be conducted at the laboratory and if a high value is maintained then further field sampling shall be undertaken. Advice shall be sought from the environmental specialist and if the source can reasonably be assigned to filling operations, then HCC shall notify the relevant authority eg EPA.

There are two exceptions to this rule:

Standard response – if any of the monitoring results for conductivity and turbidity in the sedimentation basins, exceed their standards, then normal response actions shall be taken including re-sampling.

Prior advice – if the exceedance relates to parameters which are not indicative of contamination by refuse, and specialist advice has been obtained relating to a previous similar exceedance, then it would be sufficient to take the action recommended by the specialist environmental consultant on that previous occasion.

Level 2

It is HCC's responsibility to obtain a review by the environmental specialist of any high result flagged at Level 1. It is intended that the standards will have been set at values which ensure specialist adviser involvement approximately annually, given a normal data distribution and no exceptional incidents.

To conduct the Level 2 review, the specialist adviser will compare the monitoring data with background information including the ANZECC and Dutch Intervention guidelines (Appendix 4-3) and any other relevant regulatory guidelines. The specialist adviser will advise whether to immediately commence the response procedure (Sections 4.3 to 4.13) or a variation of that procedure.

A second set of response standards will be provided if any of these higher standards are exceeded and a contingency plan shall be implemented immediately. This procedure includes notification to the EPA, and initiation of appropriate investigation and mitigatory actions as specified in Sections 4.3 to 4.13.

The EPA will be consulted as appropriate to determine whether the baseline data for each part of the site may be considered to include a limited amount of data gathered after start-up.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Level 3

The third level of evaluation of the data will be provided by the EPA. If as a result of their independent reviews, it is the opinion of both parties that there is evidence of impacts from the landfill operation, then site specific response procedures shall be designed to mitigate further impacts.

4.1.1 Compliance Management Systems Reviews

Monitoring procedures and standards which are defined in EPA Licence conditions may be revised only on the basis of written advice from the EPA.

In-house management will be reviewed regularly and any improvements affecting this Monitoring and Contingency Plan component of the LEMP will be subsequently issued as an amendment to the LEMP.

4.2 Groundwater Monitoring

Objective: Detect groundwater pollution.

4.2.1 Monitoring Network

A groundwater monitoring network comprising combined monitoring and sampling wells are distributed around the periphery of the site in areas which are not disturbed by landfill workings. Figure 3 provides a location plan of all groundwater monitoring bores. Figures 3 shall be updated in the event that further bores are constructed.

Each well installation comprises a piezometer screen set within an identified groundwater zone. There are generally one or two wells at each monitoring station. The piezometers are isolated from overlying clays and by the emplacement of bore annulus bentonite seals.

Data loggers have been installed in three selected wells to monitor groundwater level fluctuations on a continuous basis.

Construction logs have been prepared for each well. These logs identify drilling method, materials used, depth of well and geological strata. Each well was constructed generally in accordance with details shown in Figure 5.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.2.2 Groundwater Quality Monitoring

Task	Frequency	Responsibility
Sample groundwater quality parameters in Appendix 4-1 following Monitoring Procedures Manual (Appendix 4-2)[3]	Quarterly	Contractor
Sample groundwater quality in accordance with NSW EPA Solids Waste Landfill Guidelines[2,3]	Quarterly	Contractor
Report to EPA findings of monitoring[3]	Quarterly	HCC/ Contractor
"Samples taken pursuant to a requirement in this licence to monitor the volume, mass or concentration of pollutants must be analysed and reported in accordance with the laboratory accreditation requirements set out in section 2.1.3 of the Load Calculation Protocol..." (Condition M2.1)	Quarterly	Contactor
"The licensee must maintain following monitoring points for the purpose and at the location specified for each monitoring point (as shown in Figure 1 of the Monitoring Program Report..." (Condition M2.2.1) (refer Appendix 4-1 and Figure 3)	Quarterly	Contractor
"The licensee must maintain all monitoring bores in a manner that ensures that all samples taken fro the bores are representative of the groundwater" (Condition M2.2.2)	Quarterly	Contractor
"The licensee must monitor the groundwater at the monitoring bore locations specified in Condition M.2.1 for the analytes, and at the frequency, detailed in the Monitoring Program Report" (Condition M2.2.3) (refer Appendix 4-1 and Figure 3)	Quarterly	Contactor
"The licensee must take a minimum of 8 quarterly groundwater samples in accordance with conditions M2.2.1, M2.2.2 and M2.2.3 over a period of 24 months from the date of this licence and establish for each parameter the range of concentrations/units indicative of uncontaminated groundwater at the Premises" (Condition M2.2.4)	Quarterly until December 2001	Contactor
"Within 27 months from the date when the licence is issued the licensee must submit in writing to the EPA the results of complying with Condition M2.2.4" (Condition M2.2.5)	March 2002	HCC
"Within 27 months from the date when the licence is issued the licensee must submit in writing to the EPA and seek approval for the following: *a) a list of parameters and sampling frequencies to be used as the basis for an ongoing Groundwater Monitoring Program; and* *b) a list of concentrations/units for the parameters to be the basis for comparison to the ongoing Groundwater Monitoring Program, to act as triggers for the need to undertake a Groundwater Assessment Program" (Condition M2.2.6)*		

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

A monitoring programme was initiated in June 1995 aimed at gathering baseline information prior to construction of Cell 1 in Area 2 and the commencement of waste emplacement. The initial programme involved the collection and analysis of groundwater samples at monthly intervals.

All sampling protocols are defined in the Environmental Monitoring Procedures Manual (Appendix 4-2). All site sampling procedures shall be conducted at all times in accordance with the defined protocols which shall be amended and updated to incorporate the most appropriate sampling technologies.

The parameters monitored at the site are sufficiently comprehensive to reveal any changes in groundwater chemical conditions that might derive from the effects or activities within the landfill. The range of parameters to be monitored is the responsibility of HCC and is determined by the EPA licence conditions. HCC shall also ensure that the testing laboratory is competent to perform the specified analyses required. The current monitoring schedule is provided in Appendix 4-1 and will be regularly updated.

Quarterly sampling and analysis of specified analytes will be conducted. Original laboratory test results will be retained in a permanent file and maintained by HCC and specialist environmental consultant for ease of interpretation.

Compliance monitoring data and laboratory analytical results shall be forwarded to the EPA.

4.2.3 Groundwater Quality Evaluation and Response Procedure

The response procedures for groundwater quality monitoring are as follows:

Laboratory test data will be evaluated with reference to baseline data trends by the contracted consultant. This data shall also be compared by HCC, where appropriate, to nominated guideline data (ANZECC) on receipt of results from the testing laboratory. If standard values are not exceeded then no action shall be taken.

According to NSW EPA Solid Waste Landfill Guidelines, "if any standard values are exceeded, the affected groundwater monitoring bores should be re-sampled as soon as possible. If the anomaly is verified in re-sampling, the EPA should be notified immediately by phone and in writing within 14 days of verification of the increase in the groundwater indicator contaminants".

If Dutch Intervention criteria are not exceeded, the specialist consultant will review the existing monitoring record for any other indication of groundwater quality impacts. If in the opinion of the specialist consultant, there is evidence of landfill related impacts, an appropriate investigation and remedial works programme will be implemented in conjunction with the previous response action.

The EPA generally carries out independent reviews of monitoring data. If in their opinion, there is evidence of groundwater contamination by leachate, an investigation programme will be implemented, and remedial works carried out as required.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Should there be any groundwater contamination detected, HCC's response will be documented as part of the annual report submitted to the EPA.

The following details will be outlined in that notification:

(i) the nature of the contaminant;

(ii) the cause of the contamination event;

(iii) remedial actions taken; and

(iv) measures taken to prevent further contamination events

4.3 Surface Water Monitoring

Objective: Detect surface water pollution.

4.3.1 Monitoring Network

Surface water quality is monitored at the nominated locations as shown in Figure 3.

Water sampling at the nominated locations shall be conducted in accordance with strict and established protocols as defined in the Environmental Monitoring Procedures Manual (Appendix 4-2).

Current management of run-off from hardstand, bare areas and other material stockpiles prevents the overflow from dams and storages except in extreme conditions.

4.3.2 Monitoring and Maintenance Requirements

Task	Frequency	Responsibility
Inspection of the stormwater and sediment and erosion control system[3]	Quarterly	HCC
Monitor water volume in sediment basin[3]	Monthly	HCC/Contactor
Sample surface water quality parameters in Appendix 4-1 following Monitoring Procedures Manual (Appendix 4-2)[1,2,3]	Quarterly	Contractor
Report to EPA findings of monitoring[1]	Quarterly	HCC
"The licensee must maintain the following monitoring points for the purposes and at the locations specified for each monitoring point as shown in Figure 1 of the Monitoring Program Report..." (Condition M2.3.1) (Refer Appendix 4-1 and Figure 3)	Quarterly	Contractor
"The licensee must monitor the surface water at the	Quarterly	Contractor

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

monitoring bore locations specified in Condition M.2.3.1 for the analytes, and at the frequency, detailed in the Monitoring Program Report" (Condition M2.3.2) (refer Appendix 4-1 and Figure 3)		
"The licensee must take a minimum of 8 quarterly groundwater samples in accordance with conditions M2.3.1 and M2.3.2 over a period of 24 months from the date of this licence and establish for each parameter the range of concentrations/units indicative of uncontaminated surface water at the Premises" (Condition M2.3.3)	Quarterly until December 2001	Contractor
"Within 27 months from the date when the licence is issued the licensee must submit in writing to the EPA the results of complying with Condition M2.2.4" (Condition M2.3.3)	March 2002	HCC
"Within 27 months from the date when the licence is issued the licensee must submit in writing to the EPA and seek approval for the following: *c) a list of parameters and sampling frequencies to be used as the basis for an ongoing Surface Water Monitoring Program; and* *d) a list of concentrations/units for the parameters to be the basis for comparison to the ongoing Surface Water Monitoring Program, to act as triggers for the need to undertake a Surface Water Assessment Program" (Condition M2.2.6)*		

Inspections will be undertaken quarterly and following heavy rainfall events, and maintenance conducted as required.

Where maintenance of components is required, HCC will initiate a program of repair immediately. This may include:

- repairs to stormwater pump-out facilities;
- repair of bare areas and areas of surface erosion on earth bunds;
- repair of areas of persistent erosion along inverts of surface catch drains by providing protection in the form of localised rip rap or other artificial means;
- repair of cracking and seepage in sedimentation basins by providing and additional impermeable lining to the basin floor and side faces, as required;
- de-silting of the sedimentation basin where capacities have been reduced by more than 5%;
- de-silting of any component of the stormwater drainage system should a blockage or flow impedance be observed.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Upon completion of landfill operations and thereafter HCC or contractor shall continue to inspect and maintain the stormwater drainage system so that the whole system is functioning to design specifications.

Water volume stored in the sedimentation basin will be monitored monthly in accordance with Environmental Monitoring Requirements (Appendix 4-1).

4.4 Landfill Gas Monitoring

Objective: Detect air pollution from landfill gas.

4.4.1 Monitoring Network

Landfill Gas Monitoring boreholes are located throughout the site see Figure 4.

Subsurface Gas Monitoring

At eight locations across the former landfill cells, small diameter monitoring wells were installed to a depth below the capping material to the capping/waste interface to assess the concentration of gases below the capping material. Also, at seven locations around the perimeter of the landfilled areas, monitoring wells were installed to a maximum depth of 0.5 metres below ground level to assess the migration of gases, if any, from the landfill site. In addition, six monitoring wells are used to assess the migration of gases through the landfill capping. Figure 4 shows the location of gas monitoring wells.

All gas monitoring wells are constructed from small diameter perforated tubing, which were installed within approximately 15mm diameter holes and backfilled with graded sand to 5cm below ground level. The remainder of the hole was backfilled with bentonite to preclude any surface water infiltration. Measurements are taken of the accumulated gas within the tubing at each location with the use of a portable landfill gas analyser, calibrated to detect methane, carbon dioxide and oxygen.

Surface Gas Monitoring

A portable landfill gas analyser is used to monitor the atmosphere within five centimetres of the ground level in areas where intermediate cover or final capping has been placed over waste. The atmosphere is monitored for methane, carbon dioxide and oxygen gas on a 25 point grid across the landfill site. The atmosphere within depressions, fissures or failures in the capping/cover away from the nominated sampling grid is also tested.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.4.2 Monitoring Frequency

Task	Frequency	Responsibility
Sample landfill gas parameters in Appendix 4-1 following Monitoring Procedures Manual (Appendix 4-2)[3]	Yearly	HCC/Contractor
Report to EPA findings of monitoring[3]	Annually	HCC

If concentrations of landfill gas are detected in excess of nominated values, the monitoring frequency will immediately be increased and contingency measures determined, as discussed in Section 4.11.

4.4.3 Landfill Gas Evaluation & Response

Assessment of the monitoring data will be conducted by the environmental consultant initially, HCC and the EPA. If set criteria is exceeded, monitoring frequency will be increased.

4.5 Leachate Monitoring

Objective: Detect water pollution from leachate[1,2,3]
Provide water quality baseline information[3]
Track landfill processes as biodegradation occurs[3]

4.5.1 Leachate Monitoring Network

Leachate sampling is conducted from the operational leachate riser main.

4.5.2 Leachate Monitoring Frequency

Task	Frequency	Responsibility
Sample leachate quality against parameters in Appendix 4-1 following Monitoring Procedures Manual for surface water sampling (Appendix 4-2)[2,3]	Quarterly	Contractor
Report to EPA findings of monitoring[2,3]	Quarterly	HCC
Maintain checks on leachate pump system[3]	Monthly	Contractor
"The licensee must maintain the following monitoring point for the purpose and at the location specified for the monitoring point..." (Condition M2.4.1) (Refer Appendix 4-1 and Figure 3)	Quarterly	Contractor
"The licensee must monitor the surface at the locations given in M2.4.1 at the frequency and using the method specified below for each parameter..." (Condition M2.4.2)	Quarterly	Contractor

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

(Refer Appendix 4-1 and Figure 3)

4.6 Noise Monitoring

Objective: Detect noise pollution for remedial action.

4.6.1 Noise Monitoring Network

Noise levels will be monitored at the location shown in Figure 3.

Noise Attenuation Survey

To exclude external noise such as traffic noise, aeroplane noise and bird noise, an additional noise assessment was carried out inside the Waste Management Facility. This additional assessment was undertaken at selected distances from specific noise sources within the depot. The major noise sources were identified on observations and noise measurements during previous monitoring events.

The major noise sources within the depot are associated with the scrap metal handling, mulching, crushing and waste compaction at the tip face. Noise attenuation surveys are therefore undertaken at selected distances from each of these activities. A calculation is then performed (noise attenuation due to distance) to estimate noise levels at N1 and N2, which are directly attributable to activities undertaken within the waste facility.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.6.2 Noise Monitoring Frequency

Task	Frequency	Responsibility
Measure noise levels against parameters in Appendix 4-1 following Monitoring Procedures Manual (Appendix 4-2)[2,3]	Quarterly	Contractor
Report to EPA findings of monitoring[1,2,3]	Quarterly	HCC/Contractor
"Noise generated from the Premises expressed as LA10 (15 minutes) must be measured in accordance the methods and protocol for the Noise Attenuation study as detailed in the Monitoring Program Report" (Condition M2.5) (Refer Section 4.6.1, Appendix 4-1 and Figure 3)	Quarterly	Contractor

4.6.3 Noise Response Procedures

The mean corrected noise level shall be calculated on an energy basis from the measurements and no single corrected measured level shall exceed the permitted mean level by more than 5dBA.

Noise monitoring evaluation and response procedures are:

LA_{10} of noise emanating from the operations shall be compared to the background noise level of LA_{90} by the specialist environmental consultant and HCC immediately after monitoring has been completed.

If LA_{10} noise levels exceed LA_{90}, by 5dBA, HCC will immediately undertake a review of monitoring records and operating procedures to determine the cause of the elevated noise levels. Appropriate measures shall be implemented to ensure that further elevated noise levels do not occur.

If noise levels exceed 50dBA, HCC will be required to immediately locate the activity causing the noise, and modify or terminate the activity as required. HCC will inform the EPA of the exceedance event, and implement action to prevent any future exceedance.

4.7 Dust Monitoring

Objective: Prevent degradation of local amenity[2]

4.7.1 Dust Monitoring Network

Dust is collected at the nominated locations on Figure 3.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.7.2 Dust Monitoring Frequency

Task	Frequency	Responsibility
Dust deposition rates against standard in Appendix 4-1 following Monitoring Procedures Manual (Appendix 4-2)[2,3]	Monthly	Contractor
Report to EPA findings of monitoring[1,2,3]	Quarterly	HCC
"The licensee must maintain the following monitoring points for the purpose at the locations listed below and shown in the amended location figure attached to the correspondence dated 19 November 1999 and referred to as P2015/55 Pt15..." (Condition M2.6.1) (Refer Appendix 4-1 and Figure 3)	Monthly	Contractor
"The licensee must collect dust samples at the monitoring points given in M2.6.1 and monitor using the protocols and methodologies detailed in the Monitoring Program Report" (Condition M2.6.2) (Refer Appendix 4-1 and Figure 3)	Monthly	Contractor

4.7.3 Dust Response Procedure

The total deposited mass of dust emanating from the operation shall be compared to the baseline data.

If Total Deposited Mass exceeds the baseline levels at a specific gauge, HCC/Contractor will be responsible for reviewing monitoring records and operating procedures to determine the cause of the elevated dust levels, and for implementing appropriate measures to ensure that further elevated levels do not occur.

Dust complaints are recorded on the complaints register and are forwarded to the contractor to implement remediation and the EPA Pollution Hotline.

4.8 Odour Monitoring

Objective: Prevent offsite odours[2,3]

4.8.1 Odour Monitoring Program

Task	Frequency	Responsibility
Monitor detectable odours downwind of the landfill boundary[2,3]	Daily	Contractor

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

A suitably trained, non-smoking nominee of the contractor shall check for the presence of detectable odours at the downwind boundary of the site before 9:00am on each working day. If odours are detected, the main odour source(s) shall be identified and the upwind boundary checked for any odours from off-site sources.

Observations including current wind speed and direction, odour strength and character shall be recorded.

4.8.2 Odour Response Procedure

HCC shall assess the contractors methods of controlling odours and implement additional or alternate management methods to control odours.

These methods may include active gas collection and combustion from completed cells and odour controls on active cells (such as passive gas collection or covering with a 300mm thick layer of compost). Consideration may also need to be given to excluding any particularly odorous waste from the site.

4.9 Groundwater Contingency Plan

As set out in Section 4.2.3 further investigation will be implemented if the monitoring criteria are exceeded. These investigations would need to be tailored to suit the specifics of any particular problem.

The first issue to be addressed under such a contingency plan is to confirm the presence or otherwise, of contamination. If contamination were confirmed then a program of further well drilling would need to be developed (possibly including groundwater abstraction if soil permeability were such that this was practical).

It is a requirement of the NSW EPA Solid Waste Landfill Guidelines that within 28 days of EPA notification of the exceedance, a Groundwater Assessment Plan is required, which identifies the specific contaminants and extent of the pollution to the groundwater. This should include list of proposed analytes for evaluation and a monitoring program.

Other contingency measures might need to be considered depending on the depth, severity, extent and rate of movement of any contamination and could include:

- installation of groundwater recovery wells
- installation of grout curtains or cut-off trenches
- construction of interceptor trenches

A Groundwater Remediation Plan would need to be developed in accordance with NSW EPA Solid Waste Landfill Guidelines.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.10 Surface Water Contingency Plan

Surface water monitoring and response procedures, which incorporate contingency measures for non-compliance either in forms of sedimentation dam or truck waste water discharges, are set out in Section 4.3.

In the event of sedimentation dam failure and where discharges are likely (such as would be the case if sedimentation dam breached during a major storm event), an emergency diversion will be created by using mechanical equipment to excavate a secondary flow path back into the active cell area where storage will generally be available below grade.

Given the substantial dam volume available in the sedimentation dam, such contingency provisions are expected to be adequate for most storm events, where a 'contain and treat' approach will be adopted in the case of any accidental spillages or contamination events (eg. leachate spillage on site during tanker loading).

In the event of a sedimentation dam failure the following steps will be undertaken:

a) Closure of inlet to sedimentation dam

b) Construction of a new temporary dam in a buffer area adjacent to sedimentation dam

c) Re-direct in-flows to an alternative temporary dam

d) Pump out sufficient sedimentation dam water to temporary dam to enable restoration of dam failure

e) Recommission sedimentation dam

f) Decommission temporary dam including reinstating temporary water and inlet flows.

Should the suspended solids threshold not be achieved as per EPA criteria, retention time of the surface water in the dam will be increased by prevention of re-irrigation. As the sedimentation dam is designed with excess capacity, retention times can be increased significantly without reducing the factor of safety in the event of a storm.

In the event that the threshold be exceeded on a continuous basis, extension of wetland planting in the dams themselves and the channels may be necessary.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.11 Landfill Gas Contingency Plan

Contingency planning for landfill gas must take account of the particular factors of potential risk to life or property which can occur in the case of uncontrolled gas accumulations.

Where either regular or random monitoring procedures as described in Section 4.4 indicate exceedance of criteria, then specific contingency measures will need to be established in conjunction with the EPA and specialist advisers. Generally, if criteria appear to be exceeded in any test, the test shall immediately be repeated, with further testing at a maximum of 1 week intervals until the level of hazard is established. In addition a borehole probing programme shall be implemented around any permanent probe where exceedance is confirmed, so as to define the extent of the affected area and assist in determining appropriate contingency / mitigation measures.

Random monitoring will also be undertaken in low areas (such as culverts) and site buildings. Where the concentration of methane exceeds 0.5% of the L.E.L. or CO2 is found in excess of 0.5% by volume then immediate notification should be given to HCC and investigation undertaken. Where any methane level exceeding 20% of the L.E.L. or CO2 level exceeding 0.5% by volume are detected in any buildings, then these buildings should be evacuated and should remain evacuated until gas control measures are implemented to reduce the gas concentration below 5% L.E.L.

Gas monitoring shall also be undertaken in the area of landfill cap and spot checks will need to be undertaken to ensure gas is not collecting in low areas or drains and culverts and as a general check on cap integrity. If gas levels greater than 1% are detected in cracks or fissures in the cap, then remedial work shall be implemented.

4.12 Leachate Spillage Contingency Plan

Leachate spillages could conceivably originate from:

- surface break-out of leachate
- leachate spills while loading
- a vehicle accident

Contingency measures for each of these scenarios are described below:

4.12.1 Surface Break-out Leachate

The potential for leachate break-out on the landfill face is remote. However, in the event of such break-out the impacts will be minimised by:

Footnotes:
[1] *or Italics* NSW EPA licence requirement
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[3] HCC requirement

- leachate extraction during landfill life ensuring a well drained fill mass with no build-up of leachate level, thus reducing the potential for leachate seepage gradients to develop;
- incorporation of a daily windowing procedure to ensure adequate internal drainage to the collector sumps;
- sloping completed daily and intermediate cover layers away from the landfill edge and back towards the centre of the landfill.

In the unlikely event of surface break-out of leachate, the area concerned is to be isolated, the leachate collected and removed, and the break-out area excavated and re-compacted to eliminate the problem. Provision would need to be made for drainage reversal back into the free draining landfill mass in any such areas.

4.12.2 Leachate Spills while Loading

If the need arises to transport leachate offsite to an authorised disposal point, there is a slight risk of leachate spillage during loading from valve leakage or a burst hose when pumping from a collector sump into a truck.

Each leachate riser will have a concrete spill pad at the head of the upstand, incorporating a means of draining any leachate spilled on the pad from the collection truck back into the refuse cells. The drain inlet will be covered to ensure that excess rainwater does not flow into the refuse cell. The head of the riser will have gas tight fittings to ensure that gas does not escape.

4.12.3 Spills Due to Vehicle Accidents

Spills of leachate could potentially occur as a result of an incident involving a truck / trailer unit either en-route to the treatment plant, or at the loading facility.

Resultant environmental risks are mainly limited to those locations where a direct spill to Rickabys Tributary could occur, or other watercourses or populated areas en-route. Critical locations include bridges. The effects of a spill on surface water resources would depend on the quantities released, but could potentially be severe.

HCC would seek advice from the EPA and the NSW Fire Brigade on the appropriate clean-up and disposal procedures.

HCC is to ensure the liquid waste transporter is a licensed transporter and has prepared a contingency and emergency plan to deal with such accidents.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

4.13 General Contingency Plans

4.13.1 Earthquakes

Although a significant seismic event is extremely rare in this area, the following steps will be taken should any part of the landfill be effected by earthquake:

a) assess the extent of damage, if any

b) cease operations in the area

c) prevent any damage, if any, increasing because of environmental inputs eg. cut off stormwater (via bunding) to a slope failure

d) prevent contaminant escape from damaged area, if any

e) mitigate environmental effect of contaminants that escape due to the earthquake

f) relocate waste, if required

g) repair damage, as appropriate

4.13.2 Fire Contingency Plan

In a properly operated landfill, the chance of fire is minimal. On site fire protection facilities will consist of earth stockpiles near the working face, fire breaks and a water storage dam. The daily cell construction which utilises 150mm of compacted cover spread over the work face should act as an effective fire wall. There is a slight chance that when opening windows in the daily cover to facilitate the movement of leachate and landfill gas, spreading of an underground fire could occur.

If a fire was to develop in the landfill, the first procedure would be to apply additional thickness of heavily compacted cover. This should be sufficient to prevent oxygen from reaching the burning area and the fire will die out. If this does not prove sufficient to extinguish the fire, the affected area will be dug out systematically and the exhumed material thoroughly wetted until the fire is put out. After the fire is extinguished, the refuse cells will be rebuilt.

Water from on site sources such as the sedimentation dam will provide an immediate water supply. Access to the fire hydrants will be maintained from the landfill access road at all times.

A water tanker which will also be used for dust suppression will be positioned on site to allow delivery of the water from the hydrants to a fire, should it develop. The tanker will be maintained in efficient working order.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Equipment, storage and structural fires will be handled by appropriate fire extinguishers which will be available at all times and will be checked periodically. A 2kg capacity fire extinguisher will be supplied with each landfill machine. Site personnel will be instructed in the most efficient fire fighting procedures.

4.13.3 Hazardous Wastes

All waste that enters the site is subject to screening and acceptance procedures, as set out in Section 3.6 and Section 3.7. Both the site entrance / gatehouse keeper operator and machine operators / spotter at the working face are trained in the identification of hazardous wastes and typical containers.

In the event that any prohibited materials are identified on board a delivery vehicle, the priority will be to refuse the material to be off loaded at the landfill. The material will be removed from the site by the transporter for appropriate disposal.

In the event that any prohibited materials are discovered at the working face, immediate steps will be taken to isolate that material. The material must not be handled by any person until the material has been identified by a suitably qualified person and instruction given as to the appropriate means of handling it.

Upon discovery and temporary storage, EPA will be notified within one working day, as appropriate. Also, the generator and transporter of the waste will be notified and advised if they are required to remove the waste for final disposal.

4.13.4 Medical Emergency Contingency Plan

In the event of an on-site medical emergency the following steps should be taken.

1. Identify the exact type of medical emergency.
2. Ensure that all personnel are safe and secure the emergency site.
3. Administer first aid and treatment as appropriate.
4. Call an ambulance by dialling 000.
5. Notify other emergency services as required (eg. NSW Fire Service, Police, HAZMAT etc.).
6. Notify HCC.
7. Clean up the scene of the emergency following Occupational Safety and Health regulations.

Footnotes:
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[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

5.0 Post Closure Management

Contents

5. Post Closure Management

Objectives

The objectives of site restoration and after care are to:

- ensure the final landfill surface remains in a stable, vegetated condition capable of supporting passive recreation;
- minimise long term infiltration into the landfill and hence leachate generation;
- minimise gas migration through provision of a low permeability compacted earth cap and continued gas extraction and disposal, for the duration of the post closure period.

5.1 Restoration Program

The landfill surface will be progressively restored as areas reach final level. This is to ensure that surface erosion is minimised and that planting is significantly established over the bulk of the landfill surface by the time filling is complete.

In this way restoration becomes an integral part of the landfilling operation and experience gained during the completion of the initial cells can be applied to forward plan the restoration of subsequent cell areas.

5.1.1 Factors Affecting Restoration

5.1.1.1 Settlement

A key aim of landfill cell construction will be to ensure that even settlement occurs. Regular visual inspections (6 monthly intervals) of the completed site will indicate the presence of localised settlement, which may pond rainfall. Settlement markers are an effective method of monitoring these movements.

Settlement is a progressive process, which commences immediately following placement of waste. Experience has shown that the bulk of the settlement occurs in the first 5 years following refuse placement and is generally complete (ie the landfill becomes relatively stable dimensionally) after 10 years.

At South Windsor Waste Depot total settlement of 10-15% of the waste thickness is expected. In most cases the expected residual settlement following landfill completion is likely to be less than 5% (and probably less than 3%) of the refuse thickness, given the proposed cell sequencing (refer Masterplan drawings) and expected filling rate. Thus residual settlement is not expected to exceed 0.5 – 1.0m in any given areas. As part of the regular operation, settlement monitoring will be undertaken during landfill operations with the results to be used to predict settlement for the later, deeper cells. Settlement monitoring will consist of survey control from

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[3] HCC requirement

the landfill perimeter to settlement monuments set in concrete on intermediate and/or final cover surfaces, as appropriate.

The capping layer as designed can cope with such settlement, as will the surface drainage system, provided the settlement is relatively even. Operations will need to take account the need for even settlement when considering the final capping programme in any areas of deep landfilling where a significant time interval occurs in the filling operation between the areas.

Generally, differential effects due to uneven settlement are dealt with by adding additional topsoil locally, re-grading and re-grassing as necessary. If differential settlement is too extensive then the affected areas of cap will need to be stripped of topsoil, re–graded using additional cover material and then re-topsoiled and restored as necessary.

5.1.1.2 Leachate

The objective will be to minimise long term leachate generation by providing a dense low permeability soil cap and by maintaining the cap in a stable, vegetated, crack free condition. The final landform will provide maximum runoff from the site and reduce leachate generation. The performance of the leachate system will be monitored.

5.1.1.3 Gas

Following the completion of the detailed landfill gas investigation at site closure and implementation of the control systems recommended, on-going monitoring of the landfill gas system will be undertaken. Although the details of this will be dependent on the long term solution adopted and developed during the system design.

The primary function of the Landfill Gas Management System is to control odorous emissions from the landfill by collecting the gas generated in the landfill, transporting it to the flare station, and incinerating it. The system will consist of gas extraction wells, a gas collection header pipe system and ultimately the gas will be incinerated in an on-site blower/flare station. Consideration will be given to use of the gas for power generation.

Wells

Landfill gas will be initially collected by a gas extraction well. Each well will be strategically located to distribute the vacuum equally throughout the landfill via a ring main. The zone of influence (ZOI) defines an approximate areas from which gas is extracted around each well without inducing excessive air intrusion into the landfill.

The primary operating criterion for the system is to extract landfill gas with less than 5% oxygen by volume. Excess air intrusion through the cover may result in landfill fires. The ZOI of a well is assumed to extend to the base of the landfill forming a cylinder. Excessive overlap of individual well ZOI's would cause the wells to draw air into the landfill.

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[3] HCC requirement

Regular detection for the presence of methane near the surface and adjacent to the site to assess the effectiveness of the gas collection system will be undertaken.

5.2 Cap Construction

The landfill cap is to be constructed to provide a permanent sealing layer over the landfill that will:

- Not erode significantly or become unstable even in the very long term.
- Prevent gas migration and/or oxygen ingress under gas well vacuum.
- Support vegetation in accordance with the planting plan, without excessive cracking or root penetration.

5.2.1 Cap Thickness and Compaction Standards

The landfill cap will be constructed of compacted low permeability clay with a minimum thickness of 600mm over the underlying layer of intermediate cover (nominal 500mm thickness).

In areas where shrub and tree planting is proposed, cap thickness is to be increased. Final cap thickness will be determined by trial plots in the Cell 1 area, but will be a minimum of 600mm in thickness.

All final cover material will be compacted to at least 98% of standard optimum dry density (AS12895.1.1, 5.4.1) as measured according to the QC testing programme implemented at South Windsor Waste Depot, with a target permeability of 1×10^{-9} m/s or less. The final controls on cover material placement will be developed during the cell 1 trials and be consistent with soil compaction criteria applied elsewhere in the works, and in particular, those applied to liner construction.

Laboratory testing has shown that this permeability can be readily achieved for the material types expected for use as final cover. However, key factors in cap performance will be the dimensional stability and cracking resistance of the cap material once placed.

The requirement to minimise cracking has implications for landfill operation in that achieving even settlement helps to minimise cap cracking and hence cap maintenance requirements. The final cover layer (cap) shall not be placed over the intermediate cover layer until expected residual settlement is less than 5% of the waste thickness.

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[1] *or Italics* NSW EPA licence requirement
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[3] HCC requirement

5.2.2 Cap Protection

Completed areas of final cap shall be adequately protected by rubber tyre rolling to seal the surface against erosion prior to placing the grammar drainage layer and vegetation layer.

Following application of the vegetation layer and mulch mat the surface shall be protected against cracking and desiccation by applying spray irrigation until grass growth is fully established.

The cap will be effectively maintained by re-applying topsoil and/or mulch mat in areas where soil loss occurs until fully established growth is achieved.

5.2.3 Cap Drainage

Cap drainage will be established by contouring the final cover to form drainage swales (refer Masterplan drawings). All cap drainage shall be carefully monitored and drainage swales maintained to mitigate the effects of:

- Uneven settlement (requiring adjustment of swale gradient/surface).
- Localised erosion (due to uneven grass strike for example).
- Cracking (due to settlement or desiccation).

In areas of drainage swale construction, final cap thickness may be increased depending on location to mitigate the effects of settlement induced cracking. In areas where experience shows drainage swales may be prone to erosion or de-vegetation, appropriate additional protection measures shall be implemented (eg. riprap, matting or close turfing).

5.2.4 Gas Control

Gas control measures shall be implemented progressively as the landfill is completed with the objectives of:

- Controlling gas hazard and odour problems by minimising passive venting of gas through the cap.
- Controlling gas penetration of cap soils and hence mitigating adverse effects on vegetation.
- Recovering energy from gas utilisation as appropriate.

Where appropriate gas wells shall be installed prior to the landfill reaching final level usually following placement of the final intermediate cover layer. The wellheads are finally completed after reaching final grade. Gas well header pipes and collectors shall be laid in trenches excavated in the intermediate cover layer beneath the clay capping layer.

Footnotes:
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[3] HCC requirement

Currently, the well-head design includes monitoring ports to allow measurement of vacuum, which is indicative of withdrawal rate and landfill gas composition. Additionally, each well contains a valve to allow adjustment of the gas withdrawal rate. Concept details for the gas extraction system are presented in the landfill Masterplan Drawings (Appendix 1-3).

Gas Collection Header Pipe

Once the gas has been extracted into the wells it will pass through the gas collection header pipe. The header pipe will be sized to optimise gas velocity and minimise pressure drop during both concurrent and countercurrent flows. Concurrent flow occurs when the gas and condensate are both moving in the same direction: concurrent flow occurs when they are moving in opposite directions. Low velocities are maintained to reduce turbulent flow in the header network. The gas collection header pipe will transport the gas to the blower/flare station.

Blower/Flare Station (Future Development)

The blower/flare station would be located for ease of maintenance, accessibility and proximity to electrical supply. Care shall be taken to ensure that the flare stack is positioned away from trees, buildings, electrical utility poles and lines, and any other overhead obstacles.

The blower will draw a vacuum on the gas collection header pipe thus creating the driving force for both gas extraction from the landfill and gas transport to the flare. The landfill gas would then be incinerated in the enclosed flare.

Condensate Management

During gas extraction, the gas cools significantly. This cooling process produces condensate which will be collected at strategic low points. The gas collection header pipe is sloped to prevent accumulation of liquid, and subsequent blockage of gas flow, in the header pipe. Condensate drip legs are located at low points to provide a vacuum seal between the leachate collection system, and the landfill gas system to be discharged to the leachate collection system.

This landfill gas management system makes provision for the collection, transport and disposal of landfill gas, and the associated condensate. If implemented correctly, this system will reduce the odorous emissions from the landfill and protect the area surrounding the landfill from sub-surface migration.

Gas pressures within the landfill will be controlled by abstraction and venting through the gas collection system. This will ensure a slight negative pressure exists in the landfill which will minimise the tendency for gas penetration of the cap material and forced oxygen displacement, which could result in plant die-off.

Given the expected low permeability of the cap materials, gas penetration is likely to be minimal. However, any "hotspots" showing evidence of gas penetration will need to be sub-excavated, gas control measures implemented and a fresh layer of cover, growth medium and vegetation applied.

Footnotes:
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[3] HCC requirement

5.3 Planting

5.3.1 Soil

Soil will be checked once a year to determine its depth, fertility, texture and condition by a soil scientist. Additional soil, fertiliser and compost will be applied if deemed necessary following this inspection.

5.3.2 Vegetation Management and Replacement

Phase 1

Perimeter planting will be a two stage process. Fast growing native tree species planted along the southern boundary, the eastern and northern boundaries will have been established in the initial stages to provide screening. Indigenous climax species will be inter-planted amongst establishing colonising species one or two years later.

Phase 2

Once all the planting surrounding the landfill has been completed, the vegetation (trees, shrubs) will be checked by the landscape architect periodically but not exceeding annually, to ascertain the general condition of the plants, to identify those plants which are thriving and to replace those plants which may have died or are not prospering. These shall be replaced with either the same variety of plant, or one which has proved itself more suited to the conditions.

All planted areas will need to be checked by HCC for evasive weed species every six months and weeds removed before becoming established.

Following the inspections, surface depressions will be filled, reseeded and mulched. Insufficiently vegetated areas will be lightly tilled, reseeded and mulched to re-establish vegetative growth. Dense vegetative cover will also be maintained along the side slopes of drainage ditches. These measures will prevent erosion damage to the cover and sedimentation of the waterways. The establishment of deep-rooted vegetation (such as trees and bushes) will be prevented by removal. Any pests endangering the integrity of the cover will be controlled with traps or insecticide.

5.3.3 Irrigation and Drainage

The irrigation and drainage of planted areas will be checked weekly throughout the summer period. This will involve checking the system for damage and to ensure adequate watering of all planted areas.

During the winter months monitoring will need to focus on the drainage of planted areas to ensure that ponding is not occurring. Remedial drainage works will be required in any areas which are consistently being waterlogged.

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[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

5.4 Post Closure Management Plan

Objectives

To provide a framework of maintenance, monitoring and reporting activities which will ensure proper engineering and environmental performance of the facility following the completion of landfilling and closing off of the final cover layer.

To ensure that all parties have a measure of certainty as to the final appearance and landscaping of the facility at the outset of the project.

To detail routine ground and landscaping maintenance activities which will ensure that the closed landfill facility will both remain attractive, thereby adding to the amenity value of the surrounding area, and be available as an accessible, well maintained recreational area for the residents of the district.

5.4.1 Management

This plan for post-closure care is based on the landfill operating (ie. receiving refuse), for some 10-15 years.

Thus, at the time of final closure the bulk of the expected landfill settlement and resulting cover maintenance requirements will have been completed for the initial cells in the northern part of the Area 2 landfill. A significant amount of settlement and cover maintenance work will also have been completed in this area.

Similarly, the bulk of the site landscaping and planting will have been established. The bulk of the site will therefore be in a completed, established state, with routine maintenance of planting, drainage, roads and grounds, having been undertaken for many years prior to the final closing off of cells.

Leachate collection will be established in each phase area as the landfill progresses. Landfill gas management system may be implemented as required. Routine operation and maintenance of these facilities will have been proceeding as required.

The overall scenario is thus one of a mature site, with the bulk of the landscaping, final cover and planting well established and self-sustaining. Leachate, gas and monitoring systems for the bulk of the site will be in routine operating mode. In the final area of landfilling, the final cover and gas and leachate collection systems would be recently installed and would need to be subject to a higher level of maintenance immediately following closure. This requirement naturally defines and divides post-closure care into two categories, namely the intensive maintenance of the final cell areas (required for approximately the first 5 years), and the ongoing routine maintenance of the whole landfill site and its environmental control measures.

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[1] *or Italics* NSW EPA licence requirement
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[3] HCC requirement

5.4.1.1 Responsibilities

Monitoring of the site will be undertaken throughout the post closure period. This will primarily consist of continuing monitoring of the site and any remedial action should this be required. Monitoring will continue until the site is considered to be stable and safe by HCC and Government Authorities in accordance with EPA requirements.

During the landfill operation, many of the activities which will need to be continued during the post-closure period will be implemented as part of the routine operational procedures (eg. landfill gas and leachate management). During the operational life of the landfill, these activities would be the responsibility of HCC.

At least one year prior to the final closure of the facility, HCC shall identify a Maintenance Supervisor (MS) for the facility's post-closure period. This Supervisor shall be appropriately qualified. The MS shall be actively involved in post-closure care operations and maintenance of the leachate, gas collection and monitoring systems at the site for at least one year and shall be thoroughly trained in all safety and contingency aspects of the facility's operation.

Should the MS be unable to continue his/her duties for any reason, or should HCC wish to replace the MS for any reason, then HCC must nominate a similar, suitably qualified person meeting the above requirements.

5.4.1.2 Duties of The Maintenance Supervisor

The duties of the Maintenance Supervisor will be as follows:

- to report at regular intervals (to be determined) to HCC prior to landfill closure and to HCC's designated manager responsible for the facility in the post-closure stage, in relation to maintenance and monitoring activities;
- to ensure that routine environmental monitoring is undertaken and that the records and reporting procedures associated with the monitoring are regularly and properly implemented;
- to regularly inspect the site in accordance with a defined programme, covering all permanent structures, environmental monitoring systems and landscaping/planting areas;
- to liaise with the Monitoring Committee and HCC as appropriate in relation to the environmental monitoring programme and to report any anomalous test results or findings promptly to the relevant authorities;
- to implement the programs of routine site care and facility maintenance;
- to record any complaints received from local residents following facility closure and report these immediately to HCC;
- to prepare regular reports and data summaries;
- to arrange and administer all maintenance contracts associated with site maintenance, leachate and gas disposal; and

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[3] HCC requirement

- any other duties which HCC may require from time to time.

5.4.2 End Use

Final usage will be determined closer to the completion date of landfill activities and will be subject to final ownership of the site. However, it is anticipated that the site's end use would be one of passive recreation. If appropriate, local community input will be sought during the life of the facility, to ensure that the final development plan optimises the potential for recreational uses desired by the site owner and local community, provided that the technical and safety considerations associated with the landfill's operation and post-closure care are not compromised.

Possible recreational activities which could be catered for at the site following closure include:

- cycle paths;
- fitness and jogging trails;
- theme gardens/urban forest;
- picnic facilities/adventure play.

5.4.3 Landscaping and Planting

The proposed landscaping and planting plan for the site is shown in Figure 6. It is intended that this landscaping programme will be progressively implemented throughout landfill life and at the point of final closure. Only minimal areas will remain where significant planting needs to be established and maintained with irrigation.

The procedures required to successfully implement the landscaping and planting plan will have been well tried and tested prior to final landfill closure and it is expected that a continuation of these procedures will be able to be applied directly to the areas requiring planting and establishment of grass cover in the final completed cell areas.

5.4.4 Maintenance of Grounds and Approach Roads

Maintenance activities related to maintaining the facility grounds and surrounds will be well established by the time final closure occurs. Generally these activities will be subject to maintenance contracts, although following closure, some activities may be undertaken by the MS.

The following sections summarise regular maintenance activities and requirements, with specific requirements for the final cell areas (which will be in an immediate post-closure state) identified as appropriate. It is expected that the following requirements will be refined as a result of facility operation over its design life and that a matrix of maintenance activities will be developed.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
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[3] HCC requirement

5.4.4.1 Fencing

All fences shall be maintained in good, secure condition, for as long as is required by HCC into the post-closure period. The following inspections shall be undertaken and documented, with appropriate repairs to be undertaken as necessary.

3 Monthly or following significant storms

Inspection of area fences

Annually

Full inspection of site perimeter

5.4.4.2 Planting

All planting shall be maintained, fertilised and watered as necessary to avoid excessive plant die off and any general degradation of the overall planting concept. The following inspections shall be undertaken:-

3-Monthly

Inspection of all main planting areas and irrigation systems. During the summer season (1 December to 1 March), this frequency to be increased to fortnightly. Determination of any weed control or plant replacement requirements.

Annually

Detailed inspection of all plant growth, including assessment of soil gas penetration at key monitoring points to be established in the final cover. Assessment of fertiliser and ongoing irrigation requirements for all areas.

Grassed Areas

All grassed areas shall be mown regularly (at intervals to suit weather conditions and growth rates). Grass mowing shall be of a mulching type and shall be carefully scheduled so as to avoid excessive build up of growth resulting in a degradation of the grass sward. Grass cover shall be inspected on a 3-monthly basis and any requirements for re-seeding of bare areas, fertilising or weed control shall be regularly scheduled so as to maintain a dense, continuous grass cover on the final cap.

Grass growth on the cover of the final cell areas to be closed, shall be subject to weekly monitoring and regular maintenance by way of topsoil replacement and fertiliser applications as necessary, in accordance with the grass establishment procedures developed during the landfill's operating life.

5.4.4.3 Irrigation

All irrigation systems shall be checked at least weekly during their operating periods for leaks or blocked jets. Annual checks of the overall system shall be undertaken, prior to the commencement of irrigation each summer season.

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[1] *or Italics* NSW EPA licence requirement
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[3] HCC requirement

5.4.4.4 Access Road

The access road shall be inspected on an annual basis and remedial works programmed to address any defects which may develop, with particular attention to:

- maintenance of the seal surface on the access road
- maintenance of roadside drains.
- Signage at The Driftway intersection

5.4.5 Landfill and Monitoring System Maintenance

5.4.5.1 Leachate Collection System

Maintenance activities in relation to the leachate collection system shall be summarised in the annual maintenance report.

Table 5-1 - Leachate Collection System – Checking and Maintenance Schedule

Item	Frequency	Responsibility
Riser Levels/ Pumping Efficiency	Routinely when extracting	Operator
Leachate Drain Cleaning	Every 2 years for first 10 years, then5 yearly (or as necessary)	Maintenance Supervisor/ Contractor
Extraction	Routinely during operation	Operator
	Full 6 monthly check	Maintenance Supervisor

5.4.5.2 Gas Collection System

Maintenance activities in relation to the gas collection system shall be summarised in the annual maintenance report.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Table 5-2 - Gas Collection System - Checking and Maintenance Schedule

Item	Frequency	Responsibility
Wellhead	6 monthly	Maintenance Supervisor
Valves and header collection pipes	6 monthly	Maintenance Supervisor
Flare Station	Monthly	Maintenance Supervisor
	Gas well efficiency checks every 3 years, with remedial work as appropriate	Hawkesbury City Council

5.4.5.3 Roads and Crossings

Table 5-3 - Roads and Crossings - Checking and Maintenance Schedule

Item	Check/Maintenance Frequency	Responsible
Drains and culverts	Monthly, or after significant storms during operation, 3 monthly after closure	Maintenance Supervisor
Road Surfaces	Routinely (weekly) during operation, 3 monthly after closure	Maintenance Supervisor
Main Access Road including table drains	3 monthly	Maintenance Supervisor
Signage and The Driftway intersection	3 monthly	Maintenance Supervisor

5.4.5.4 Final Cover Layer

A regular cover inspection and maintenance programme shall be implemented as set out below, with the frequency inspections and maintenance dependent on the "age" of the cover and hence the maturity of the planting on it.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Table 5-4 - Final Cover Layer - Checking and Maintenance Schedule

Item	Frequency	Responsibility
Grass/planting general Condition	Routinely during maintenance and 3 monthly checks	Mowing Contractor Maintenance Supervisor
Gas Penetration/plant die off	6 monthly	Maintenance Supervisor Hawkesbury City Council
Erosion – surface drainage – swale inverts	6 monthly (or after major storm)	Maintenance Supervisor

5.4.5.5 Drains and Sedimentation Ponds

Maintenance activities in relation to the drainage system shall be summarised in the annual maintenance report.

Table 5-5 - Drains and Sedimentation Ponds - Checking and Maintenance Schedule

Item	Check/Maintenance Frequency	Responsible
Surface Drainage Swales	3 monthly	Maintenance Supervisor
Channel Drains	6 monthly	Maintenance Supervisor
Sedimentation Basins and Structures	3 monthly for first 3 years then 6 monthly	Maintenance Supervisor
Main outlet Drain	6 monthly	Maintenance Supervisor
Monitoring Points	3 monthly	Maintenance Supervisor

5.4.6 Monitoring and Reporting

Consent conditions related to all site discharges will be periodically reviewed during the landfill's operating life, and at the time of final closure an extensive database of monitoring data will have been compiled. It is therefore inappropriate to attempt to pre-define long term monitoring frequencies and absolute monitoring parameters at the time of initial consents being granted.

The following sections therefore define the principles of ongoing monitoring which are expected to apply, with the detail of the actual monitoring programs to be agreed with EPA, prior to landfill closure.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

5.4.6.1 Groundwater

Groundwater monitoring provides a key long-term overview of the landfill's performance as a contaminant cell, and hence it is anticipated that groundwater monitoring will run for the full term of the post-closure care period, at a monitoring frequency to be determined as a result of performance and groundwater response during the landfill's operational life.

5.4.6.2 Surface Water

Surface water monitoring relates predominantly to the operational and immediate post-closure periods, where the greatest potential exists for surface water impacts as a result of siltation or leachate-related contamination from the operational and site facility areas. However, while it is envisaged that surface water monitoring frequencies may gradually be able to be reduced following final closure of the landfill and completion of cover rehabilitation, ongoing surface water monitoring will be required in watercourses or at sedimentation basin outlets until the basins are de-commissioned to:

- mitigate against the possibility of localised or undetected leachate break-out from the final cover layer;
- ensure that the cover layer has a stabilised growth layer and that undetected erosion is not occurring;
- provide assurance that any ongoing environmental control measures on the site are not adversely affecting local watercourses.

5.4.6.3 Gas

Gas generation from the landfill will develop progressively following filling. Gas generation rates are expected to peak approximately 10 years after the completion of cell filling and at the time of landfill closure the gas generation rate is expected to be close to peak value. Therefore, for a period of at least 10 years following final closure, significant gas generation can be expected and an appropriate level of gas monitoring, associated with both the gas management system itself and the perimeter, on and off-site monitoring points will need to be provided.

The specifics of this monitoring programme will need to be confirmed prior to landfill closure, based on gas monitoring experience gained at the site during the operational period.

5.4.7 Local Authority Liaison and Reporting Procedures

5.4.7.1 Local Authority Liaison

An appropriate level of ongoing local authority liaison will be required during the post-closure period to supplement the monitoring data and reporting procedures. Responsibility for maintaining ongoing dialogue with the relevant authorities will lie with the Maintenance Supervisor.

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Exact requirements for ongoing liaison will need to be determined closer to landfill closure, with the frequency of contact, requirements for regular meetings etc., likely to be largely determined by the environmental performance of the facility during the operating period.

5.4.7.2 Post Closure Reporting Requirements

Regular reporting of observations, monitoring data, test results and maintenance activities will be required during the post-closure care period. A preliminary format for the frequency and content of this reporting is shown below. Final procedures for reporting will need to be agreed by all parties, prior to landfill closure.

Table 5-6 - Post Closure Reporting Requirements

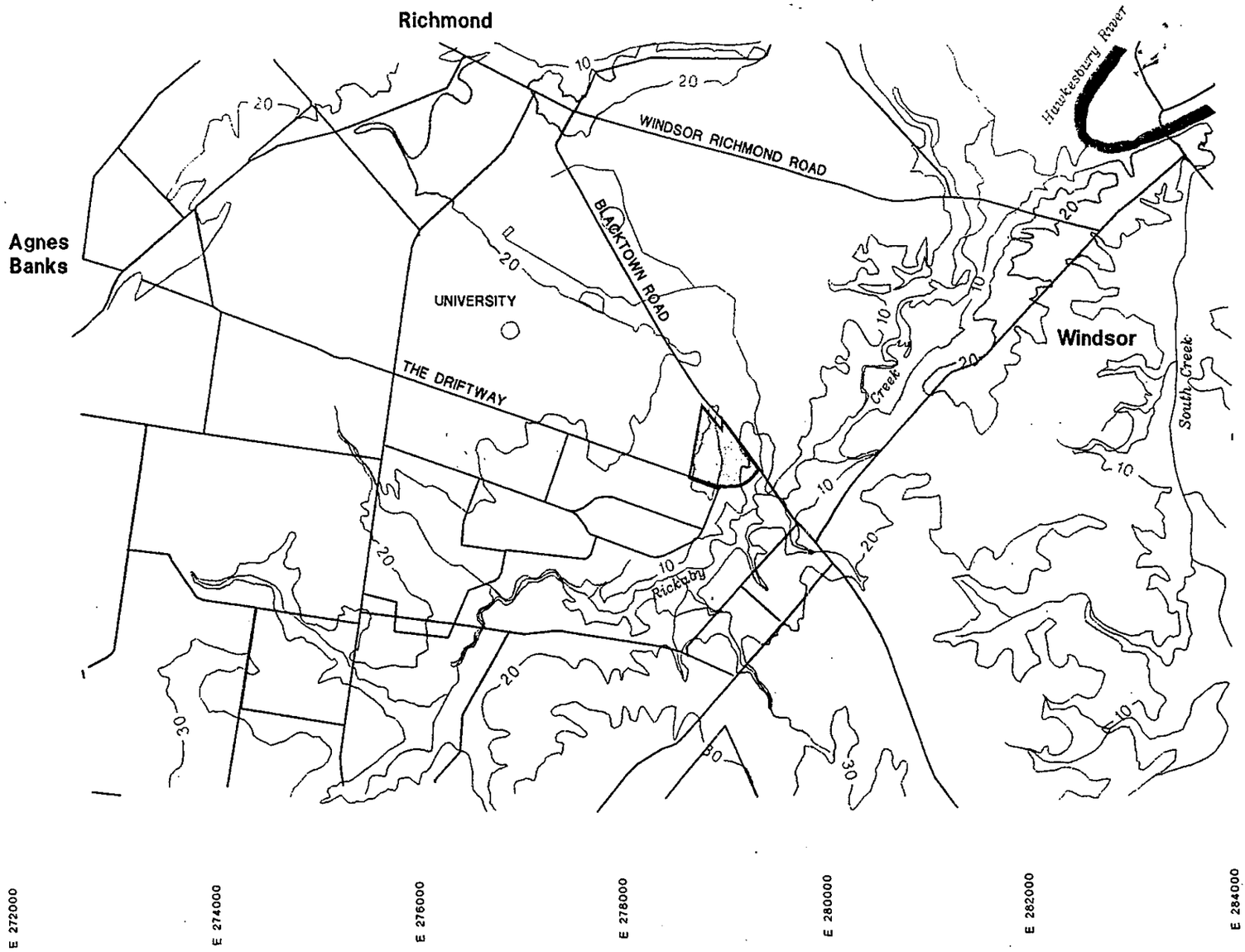
Report Time	Covering	By	Distribution
Quarterly	*Monitoring	Maintenance Supervisor	EPA
	*Inspections		HCC
	*Remedial Works		
Annual	*Summary of quarterly reports	Maintenance Supervisor	HCC
	*Overview of compliance	HCC	EPA
	*Annual Inspections		
	*Scheduled maintenance for following year		
	*Any other issues relevant to site consents		
5 yearly	Review of all maintenance, aftercare and current issues	HCC	HCC

Footnotes:
[1] *or Italics* NSW EPA licence requirement
[2] NSW EPA Guidelines for Solids Waste Landfill –Benchmark
[3] HCC requirement

Figures

RUST PPK
Environment & Infrastructure

Hawkesbury City Council
South Windsor Waste Depot
Landfill Study



LEGEND

- Depot Boundary
- Topographic Contours, contour interval 10m
- Roads
- Creeks
- Townships
- South Windsor Waste Depot

NOTES:

Co-ordinates are in ISG

Depot boundary supplied by Hawkesbury City Council

Cultural data digitised from 1: 25,000 topographic maps

N

0 500 1000 1500 2000 2500 3000 Metres

ORIGINAL SCALE 1 50000

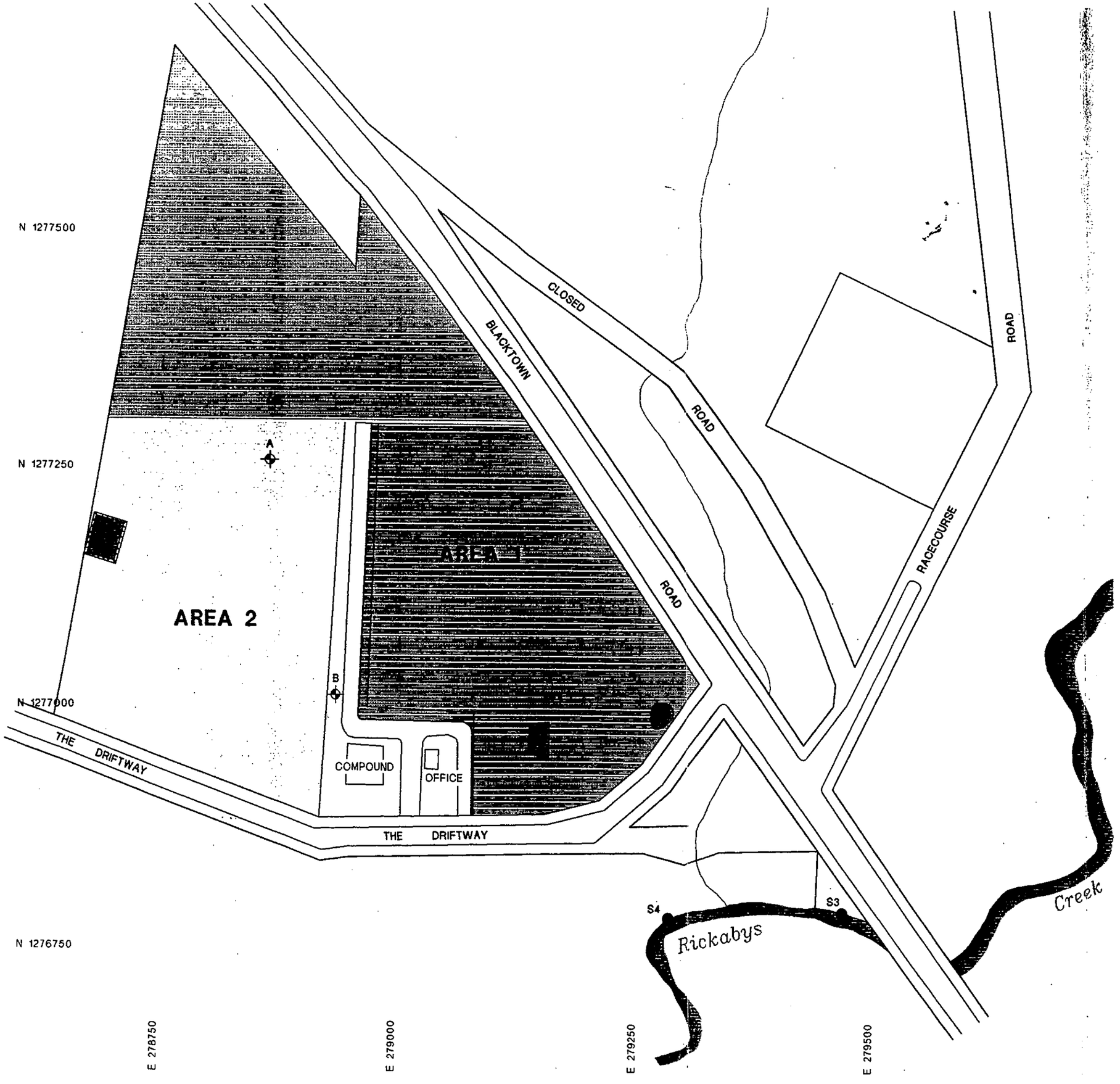
Regional Plan

Figure 1

Project No: 58GU11A Cadfile: 58G11F30 Date: 25/08/95

RUST PPK
Environment & Infrastructure

Hawkesbury City Council
South Windsor Waste Depot
Landfill Study



LEGEND

- Depot Boundary
- Roads
- Creeks
- Area 1
- Area 2
- Dams
- Existing Bores

NOTES:

Co-ordinates are in ISG

Depot boundary and cadastral information supplied by Hawkesbury City Council

N

0 50 100 150 200 250 Metres

ORIGINAL SCALE 1: 4000

Existing Site Layout

Figure 1

Project No: 58G011A Cadfile: 58G11F33 Date: 25/08/95

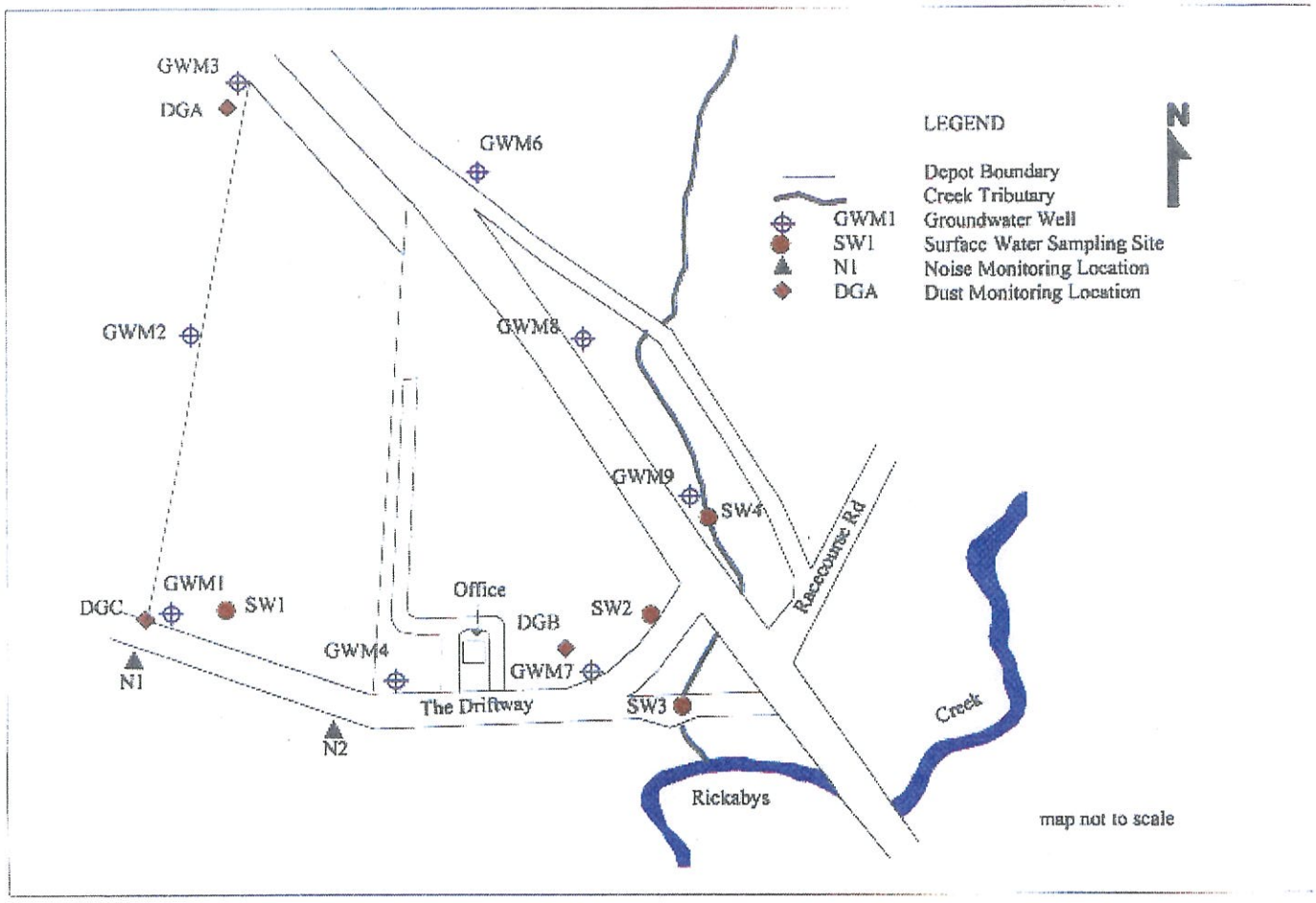


Figure3 Location map showing sampling sites.

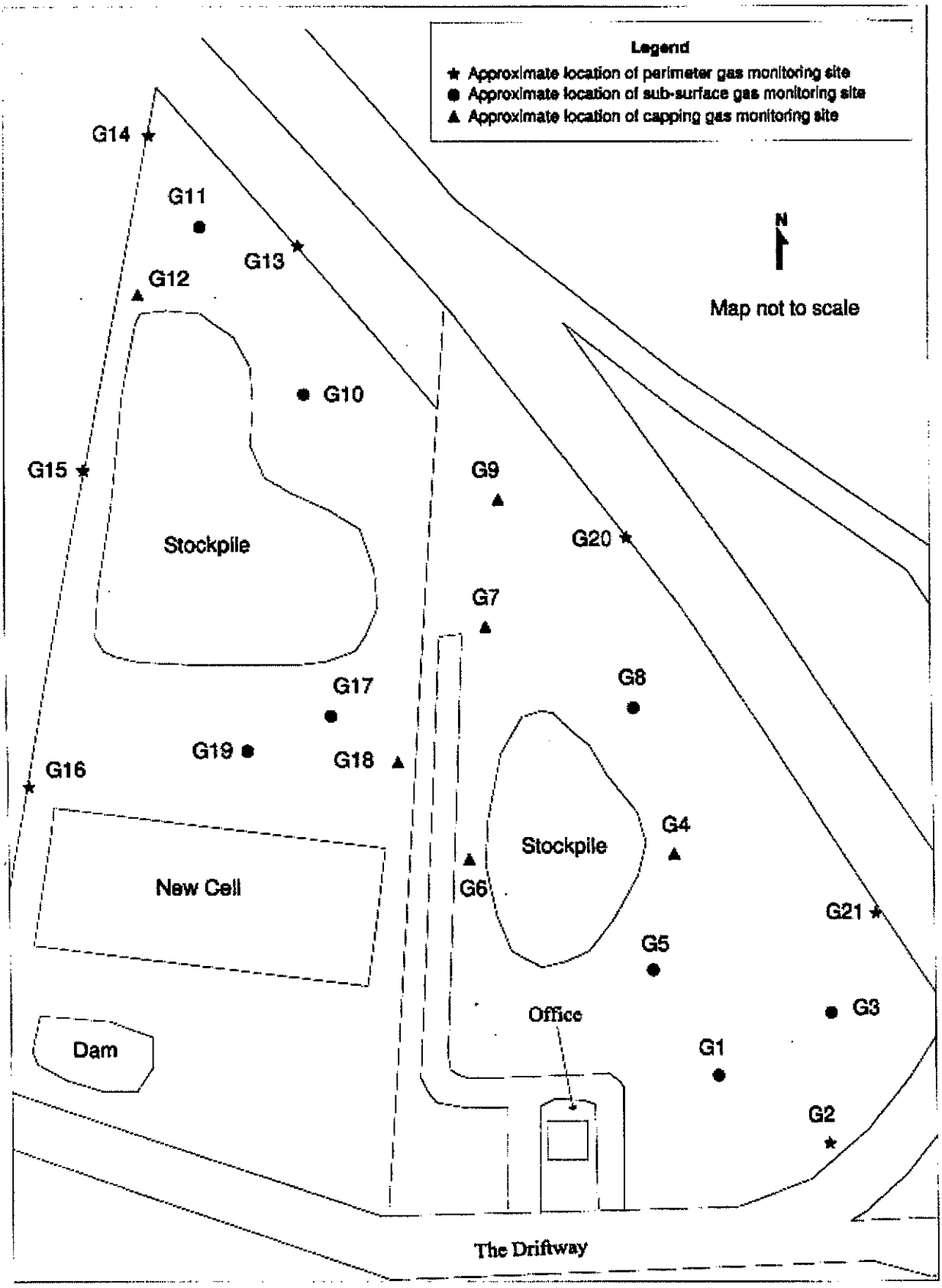
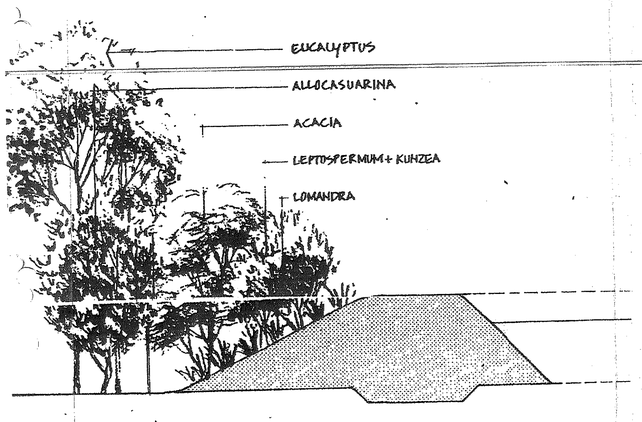
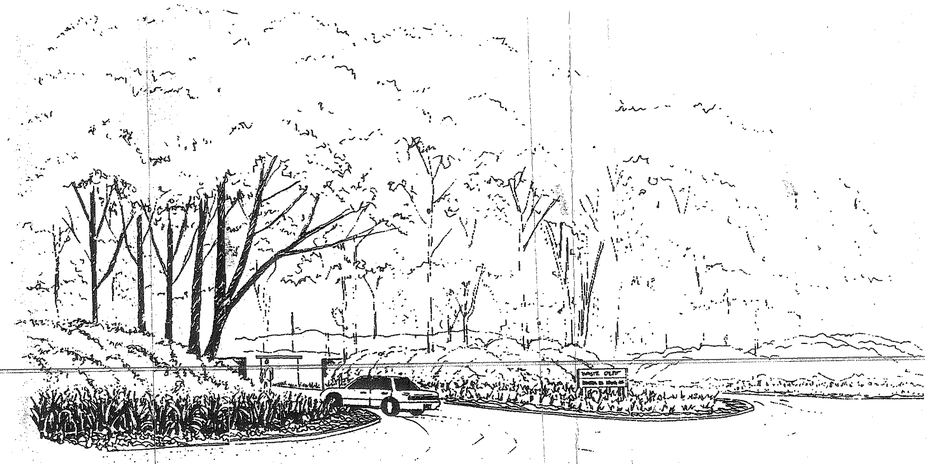


Figure 4 Location of landfill gas monitoring sites



SECTION A-A: TREATMENT TO STAGE 1 EMBANKMENT AND UNIVERSITY LAND
1:100

EXISTING EMBANKMENT: (3M. HGT.)
- NO GRASS COVER EXISTING.
- REQUIRES TRIMMING PRIOR TO HYDROMULCHING



VIEW TOWARDS WASTE DEPOT ENTRY FROM THE DRIFTWAY:
SHOWING PROPOSED LANDSCAPE IMPROVEMENTS.

BLACKTOWN ROAD

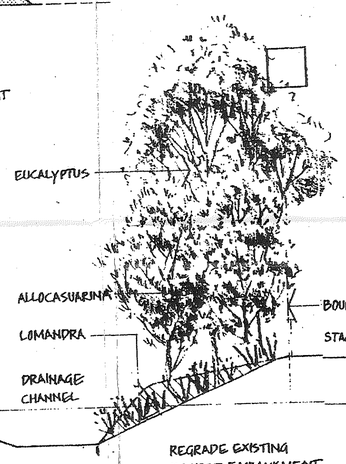
WESTERN SYDNEY

A ▲ ▲ A

STAGE 1 AREA:
FILLING OPERATIONS IN PROGRESS.
(TO BE GRASS SEEDED ON COMPLETION OF FILLING).

EXISTING EMBANKMENT: (3M. HGT.)
- SOME EXISTING GRASS COVER.
- SELECTED AREAS TO BE GRASS SEEDED AND HYDROMULCHED WITH SHRUB SPECIES (TO MAX. 5 METRE HEIGHT) TO PROVIDE VISUAL SCREEN.

LEGEND:
- EXISTING VEGETATION TO BE REMOVE
- EXISTING VEGETATION TO BE RETAINE
- AREA TO BE GRASS SEEDED.
- AREA TO BE HYDROMULCHED + SEEDED :- NATIVE PLANTS (MAX 5M. HGT.) + GRASSES TO EXISTING EMBANKMENTS
- TREE PLANTING :- TUBE STOCK. (WHERE TREATMENT OCCURS ON U.W.S LAND, IT IS RECOMMENDED THAT PLAN COULD BE SUPPLIED BY THE UNIVERSITY INSTALLED BY COUNCIL).
- AREAS TO BE HYDROMULCHED + SEEDED INCLUDING TUBE STOCK. (TO FORM DEN VEGETATION SCREEN).
- ENTRY TREATMENT :- MASS PLANTING OF SHRUBS + GROUND C SOIL IMPROVEMENT AND MULCHING, INCLUDING SCREEN PLANTING ON EMBANKMENT ADJACENT TO COMPO



SECTION B-B: NATURE STRIP TREATMENT
1:100

REGRADE EXISTING ERODED EMBANKMENT

SCREEN PLANTING TO BE ESTABLISHED PRIOR TO COMMENCEMENT OF STAGE 2.

PROPOSED NATIVE PLANTS: (MAJOR SPECIES)

TREES:
- ANGOPHORA SUBVELUTINA
- ALLOCASUARINA LITTORALIS
- EUCALYPTUS PANICULATA
- SYNCARPIA GLOMULIFERA

SMALL TREES + LARGE SHRUBS:
- ACACIA FALCATA
- ACACIA FLORIBUNDA
- KUNZEA AMBIGUA
- LEPTOSPERMUM FLAVESCENS

SMALL SHRUBS + GROUND COVERS:
- KENNEDIA RUBICUNDA
- LOMANDRA LONGIFOLIA

UNIVERSITY OF
FUTURE TREATMENT TO MATCH STAGE 1 AREA LANDSCAPE IMPROVEMENT PROPOSALS

STAGE 2 AREA:
RETAIN EXISTING VEGETATION UNTIL STAGE 2 FILLING OPERATIONS COMMENCE

NATURE STRIP:
REGRADE EXISTING ERODED EMBANKMENT; STABILIZE WITH HYDROSEED VEGETATION. CARRY OUT EROSION CONTROL MEASURES IN LIAISON WITH COUNCIL'S ENGINEERS.

TRACK

COMPLETED FILL AREA:
MINOR EARTHWORKS FOR DRAINAGE AND EROSION RECTIFICATION, TO BE CARRIED OUT BY COUNCIL PRIOR TO GRASS SEEDING.

COMPOUND
OFFICE
DAM
EXISTING GRASSED AREA
THE DRIFTWAY

ENTRY TREATMENT:
REFER LEGEND

TREE PLANTING REQUIRED TO SCREEN VIEWS INTO SITE FROM INTERSECTION

REYNOLDS ROAD

SCALE 1:2000
METRES
0 50 100 150 200

PREPARED BY:
STEVENS WALLMAN ASSOCIATES
LANDSCAPE ARCHITECTS

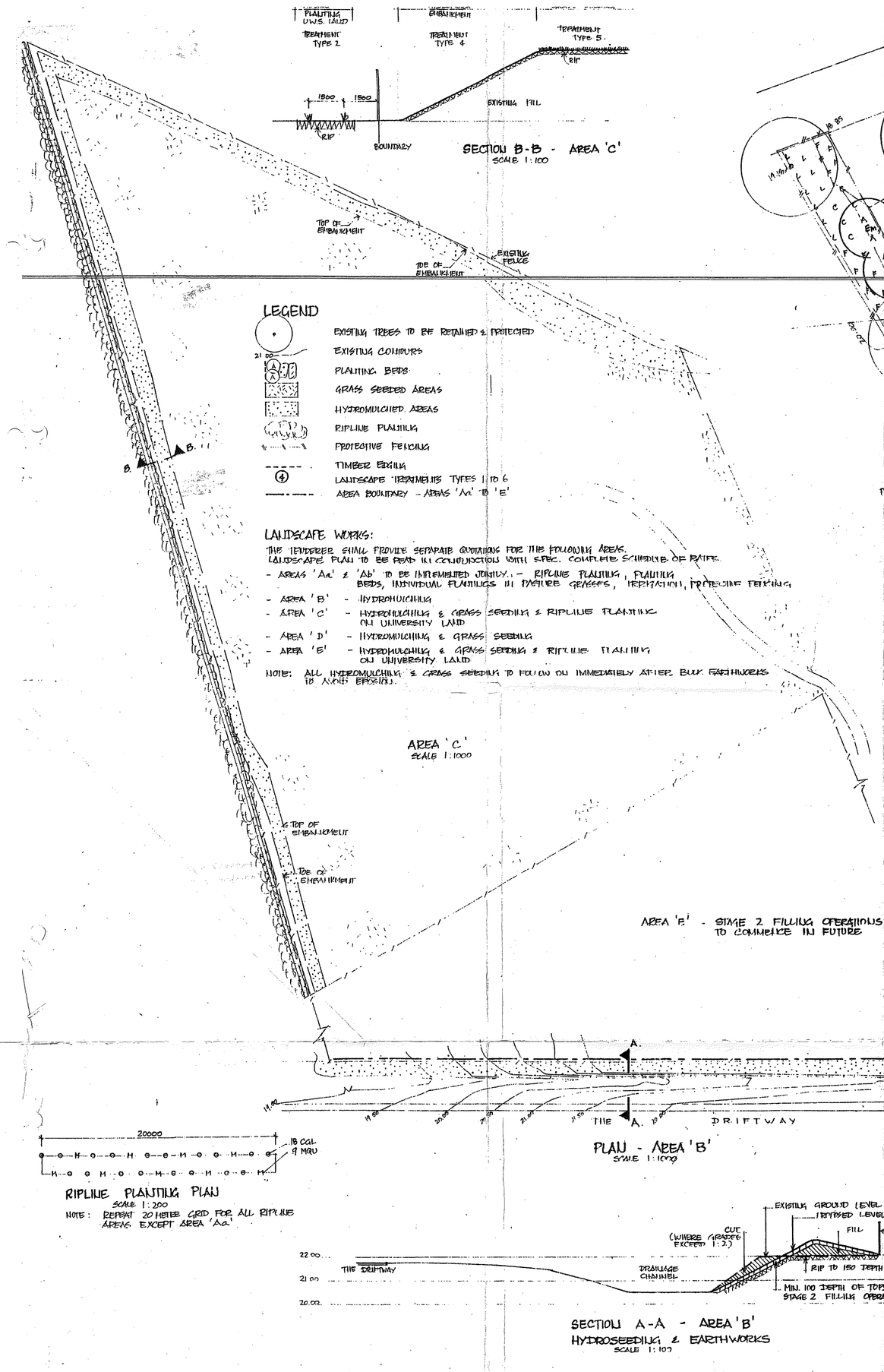
PROJECT: 94:44
SEPTEMBER '94

FOR:
HAWKESBURY COUNCIL

PROPOSED LANDSCAPE IMPROVEMENTS

SOUTH WINDSOR WASTE DEPOT

SECTION B-B - AREA 'C'
SCALE 1:100



LEGEND

- EXISTING TREES TO BE RETAINED & PROTECTED
- EXISTING CONTOURS
- PLANTING BEDS
- GRASS SEEDED AREAS
- HYDROMULCHED AREAS
- RIPLINE PLANTING
- PROTECTIVE FENCING
- TIMBER EDGING
- (4) LANDSCAPE TREATMENTS TYPES 1 TO 6
- AREA BOUNDARY - AREAS 'Aa' TO 'E'

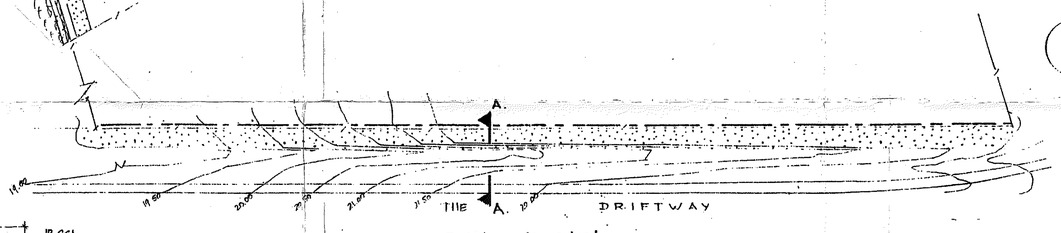
LANDSCAPE WORKS:

THE TENDERER SHALL PROVIDE SEPARATE QUOTATIONS FOR THE FOLLOWING AREAS.
LANDSCAPE PLAN TO BE READ IN CONJUNCTION WITH SPEC. COMPLETE SCHEDULE OF RATES.

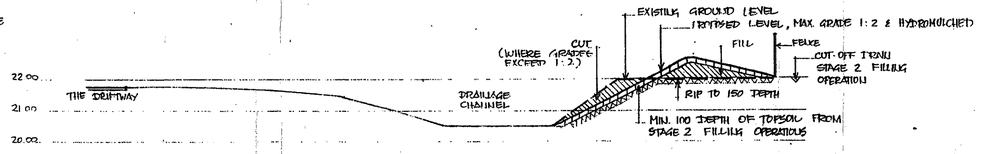
- AREAS 'Aa' & 'Ab' TO BE IMPLEMENTED JOINTLY. - RIPLINE PLANTING, PLANTING BEDS, INDIVIDUAL PLANTINGS IN PASTURE GRASSES, IRRIGATION, PROTECTIVE FENCING.
- AREA 'B' - HYDROMULCHING
- AREA 'C' - HYDROMULCHING & GRASS SEEDING & RIPLINE PLANTING ON UNIVERSITY LAND
- AREA 'D' - HYDROMULCHING & GRASS SEEDING
- AREA 'E' - HYDROMULCHING & GRASS SEEDING & RIPLINE PLANTING ON UNIVERSITY LAND

NOTE: ALL HYDROMULCHING & GRASS SEEDING TO FOLLOW ON IMMEDIATELY AFTER BULK EARTHWORKS IS NOW EFFECTIVE.

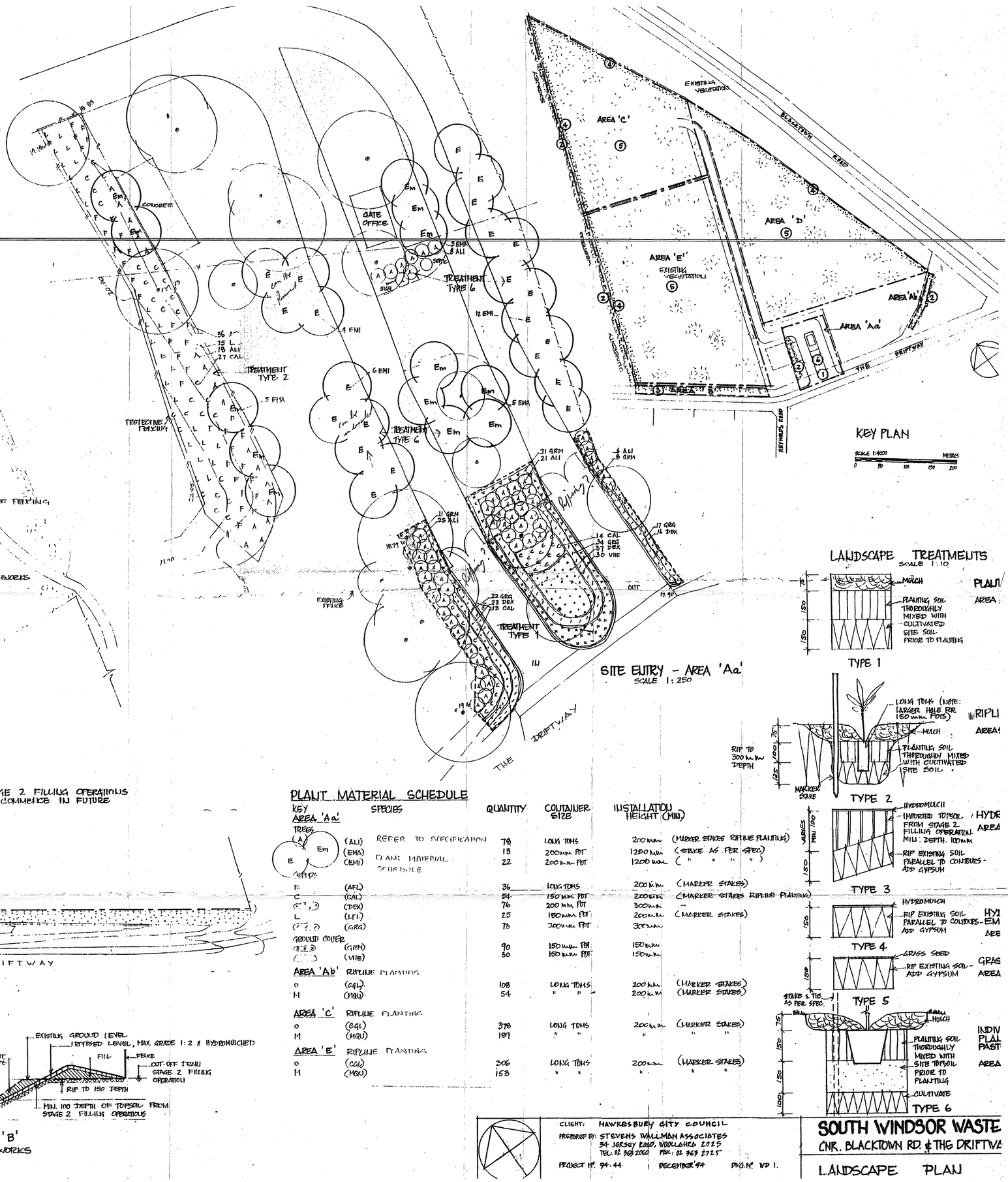
RIPLINE PLANTING PLAN
SCALE 1:200
NOTE: REPEAT 20 METRE GRID FOR ALL RIPLINE AREAS EXCEPT AREA 'Aa'



PLAN - AREA 'B'
SCALE 1:1000



SECTION A-A - AREA 'B'
HYDROSEEDING & EARTHWORKS
SCALE 1:100



KEY PLAN
SCALE 1:4000
METRES 0 50 100 150 200

SITE ENTRY - AREA 'Aa'
SCALE 1:250

PLANT MATERIAL SCHEDULE

KEY	SPECIES	QUANTITY	CONTAINER SIZE	INSTALLATION HEIGHT (MIN)
AREA 'Aa'				
TREES				
(ALI)	REFER TO SPECIFICATION	78	LONG TOMS	200mm (MARKER STAKES RIPLINE PLANTING)
(EMA)	PLANT MATERIAL SCHEDULE	13	200mm POT	1200mm (STAKE AS PER SPEC)
(EMI)		22	200mm POT	1200mm (" " " ")
SHRUBS				
(AFL)		36	LONG TOMS	200mm (MARKER STAKES)
(CAL)		54	150mm POT	200mm (MARKER STAKES RIPLINE PLANTING)
(DEX)		76	200mm POT	300mm -
(LFL)		25	150mm POT	200mm (MARKER STAKES)
(GRA)		73	200mm POT	300mm
GROUND COVER				
(GRN)		90	150mm POT	150mm
(VIN)		30	150mm POT	150mm
AREA 'Ab'	RIPLINE PLANTING			
(CAL)		108	LONG TOMS	200mm (MARKER STAKES)
(MAU)		54	" "	200mm (MARKER STAKES)
AREA 'C'	RIPLINE PLANTING			
(CAL)		378	LONG TOMS	200mm (MARKER STAKES)
(MAU)		189	" "	" " "
AREA 'E'	RIPLINE PLANTING			
(CAL)		306	LONG TOMS	200mm (MARKER STAKES)
(MAU)		153	" "	" " "

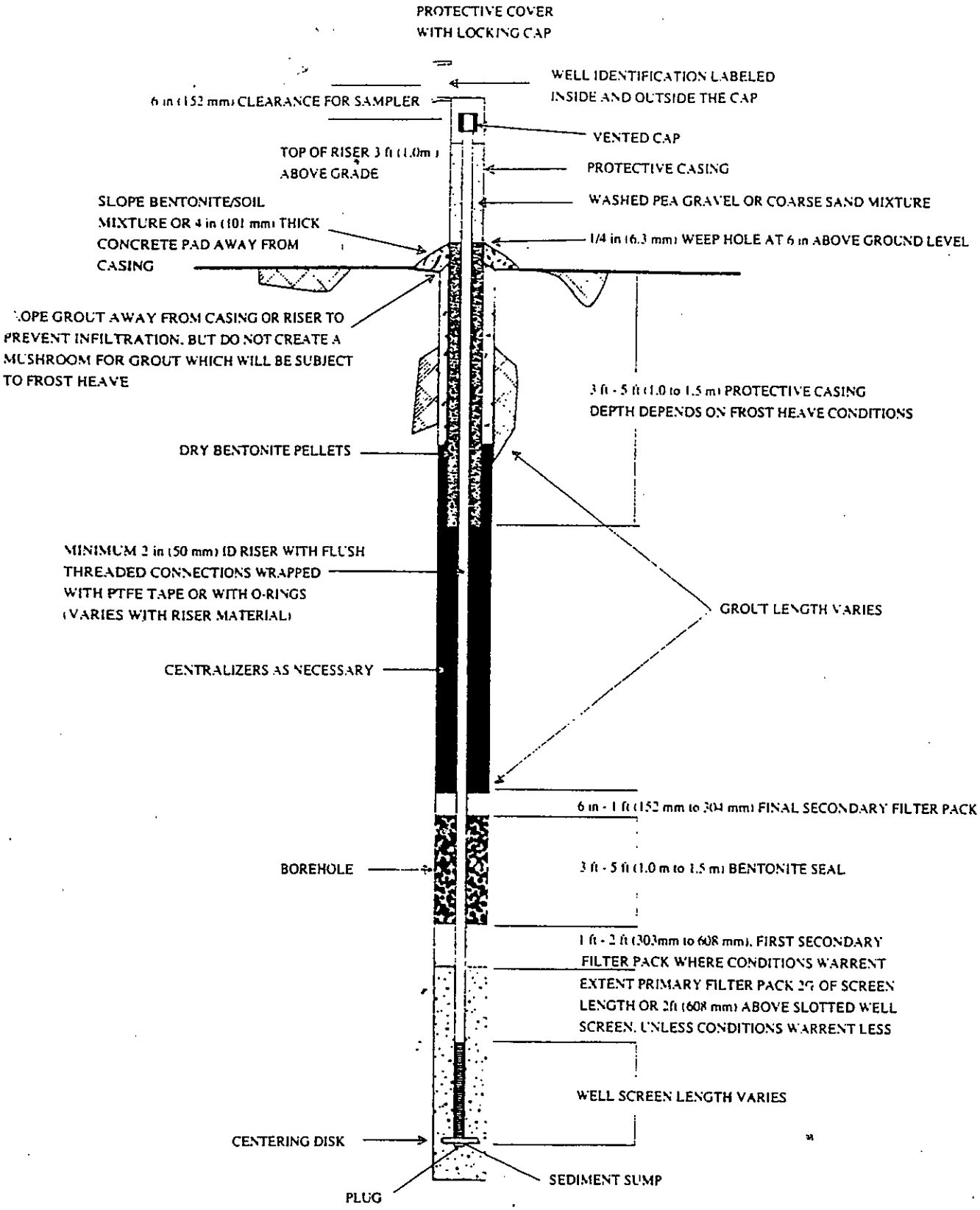
LANDSCAPE TREATMENTS
SCALE 1:10

CLIENT: HAWKESBURY CITY COUNCIL
PREPARED BY: STEVENS WALLMAN ASSOCIATES
34 JERSEY ROAD, WOOLLAHRA 2025
TEL: 02 363 2060 FAX: 02 363 2725
PROJECT No. 94:44 DECEMBER '94 DWG No. SD 1.

SOUTH WINDSOR WASTE
CNR. BLACKTOWN RD. & THE DRIFTWA
LANDSCAPE PLAN

RUST PPK
Environment & Infrastructure

Hawkesbury City Council
South Windsor Waste Depot
Landfill Study



Groundwater Monitoring Bore (typical)

Figure 5

Appendix 1-1

EPA Licence

Environment Protection Authority

Environment Protection Licence

Section 55 Protection of the Environment Operations Act 1997

- Licence number: 5293
- File number: 301492
- Licence Anniversary Date: 28 July
- Review date not later than 01-Jul-2002

Information about this licence

Dictionary

The licence contains a dictionary, which defines terms used in the licence. It is found at the end of the licence.

A4 Information supplied to the EPA

A4.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
(a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998 and
(b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

A4.2 The Hawkesbury City Council South Windsor Waste Depot Draft Managment Plan (Version Syd/087) is not to be taken as part of the documentation in A4.1, other than those parts specifically referenced in this licence.

Note: For the purposes of this licence the abbreviation 'LEMP' is defined as the document titled *Hawkesbury City Council South Windsor Waste Depot Draft Management Plan (Version Syd/087)* submitted to the EPA.

Discharges to air and water and applications to land

P1 Location of monitoring/discharge points and areas

P1.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.

Air

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Description of Location
2	Dust deposition		Dust gauge, as shown as D1 in the amended location figure attached to correspondance dated 19 November 1999 and referred to as P2015/55 Pt 15
3	Dust deposition		Dust gauge, as shown as D2 in the amended location figure attached to correspondance dated 19 November 1999 and referred to as P2015/55 Pt 15
4	Dust deposition		Dust gauge, as shown as D3 in the amended location figure attached to correspondance dated 19 November 1999 and referred to as P2015/55 Pt 15

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

P1.3 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

Water and land

EPA Identification no.	Type of monitoring point	Type of discharge point	Description of location
1	Leachate quality		The leachate collection system via the riser/collection sump described in Section 4.6 of the LEMP and the map series titled "Master Plan - Area 2; Sequence of Operation" in Section 6 of the LEMP

3 Limit conditions

1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must

comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Load limits

L2.1 Not applicable.

L2.2 Not applicable.

L3 Concentration limits

L3.1 Not applicable.

L3.2 Not applicable.

L3.3 Not applicable.

L4 Volume and mass limits

L4.1 Not applicable.

L5 Waste

L5.1 The licensee must not cause, permit or allow any waste generated outside the premises to be received at the premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the premises to be disposed of at the premises, except as expressly permitted by the licence.

L5.2 This condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the premises if it requires an environment protection licence.

L5.3 The licensee must ensure that only the following types of waste are disposed of at the premises:

ype of landfill	Wastes able to be landfilled
Solid Waste Class 1 Landfill	Waste, including putrescible waste, that is assessed as *inert waste* or *solid waste* following the technical assessment procedure outlined in Technical Appendix 1 of the Waste Guidelines or that is specified as *inert waste* or *solid waste* in Schedule 1 of the Protection of the Environment Operations Act 1997.

L5.4 The following types of waste must not be disposed of at the premises:

(a) Asbestos waste of any type; and

(b) Contaminated soil.

Tyres

L5.5 The licensee must not dispose of any tyre at the premises unless:

(a) the tyre has a diameter of 1.2 metres or more; and/or
(b) the tyre has been shredded or had its walls removed; and/or
(c) the tyre was delivered to the premises as part of a domestic load.

For the purposes of this condition:

(a) tyres are taken to be shredded only if the tyres are in pieces measuring no more than 250mm in any direction; and
(b) domestic load means a load containing no more than 5 tyres having a diameter of less than 1.2 metres.

L5.6 Tyres stockpiled on the premises must:
(a) not exceed fifty (50) tonnes of tyres at any one time; and
(b) be located in a clearly defined area away from the tipping face; and
(c) be managed to control vermin; and
(d) be managed to prevent any tyres from catching fire.

Unprocessed wood and vegetation

L5.7 Stockpiling of unprocessed wood and unprocessed vegetation at the premises must not exceed 4000 cubic metres (m^3).

L6 Noise Limits

L6.1 Noise from the premises must not exceed an LA 10 (15 minute) noise emission criterion of 50 dB(A). 5dB(A) must be added if the noise is tonal or impulsive in character.

L6.2 Noise from the premises is to be measured at any point within one metre of the boundary of the nearest residence or other noise sensitive premises to determine compliance with this condition.

L7 Hours of Operation

L7.1 The hours of operation for waste receipt and compaction must be in accordance with Hawkesbury City Council Development Consent.

4 Operating conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.

This includes:

(a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and

(b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O1.2 All operations and activities occurring at the premises must be carried out in a manner that will prevent and minimise fire at the premises.

O1.3 The licensee must take all practicable steps to control entry to the premises.

O1.4 The licensee must operate in accordance with the filling plan detailed in Section 6 of the LEMP.

O1.5 There must be no incineration or burning of any waste at the premises.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
(a) must be maintained in a proper and efficient condition; and
(b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

O4 Waste recycling

O4.1 The licensee must provide facilities for recycling the following materials:

(a) Glass – clear, brown and green;
(b) Paper and cardboard;
(c) PET plastic;
(d) Aluminium and steel cans;
(e) Bricks, tiles, concrete; and
(f) Reusable timber, firewood and garden waste.

O4.2 Recycling facilities at the premises must be clearly marked and be available for access by the public.

O5 Management of surface waters

O5.1 Surface waters must be diverted away from any area where waste is being or has been landfilled.

O5.2 The landfill surface must be contoured to prevent the run-on of surface waters onto areas where waste has been landfilled, except during storm events of not less than a 1 in 10-year recurrence interval of 24-hours duration.

O6 Leachate management

O6.1 A leachate barrier system described in Section 2.7 of the LEMP and leachate collection system described in Section 2.11 of the LEMP must be installed on each surface within the premises to be used for the disposal of waste. This condition does not apply to any surface used for the emplacement of waste before 1 August 1995 as shown as Area 1 on map titled "Existing Site Layout Figure 1.3 " submitted with the LEMP.

O6.2 The leachate barrier system must be installed above the groundwater table.

O6.3 The leachate collection system must be capable of capturing all leachate generated from the waste disposed of at the premises.

O6.4 A leachate barrier system described in Section 2.7 of the LEMP must be installed on each surface within the premises to be used for the storage of leachate.

7 Leachate disposal

O7.1 The leachate collection system must be operated in accordance with Section 3.4 of the LEMP.

O7.2 The licensee must ensure that leachate is disposed of in accordance with Section 3.4.4 of the LEMP.

O8 Completion of landfill cells

O8.1 The licensee must ensure that the landfill cells are capped progressively as described in the LEMP.

O8.2 The licensee must ensure that the final capping of all landfill cells is in accordance with the environmental goals of Appendix A Benchmark Technique Number 28 of the *Environmental Guidelines: Solid Waste Landfills 1996.*

O9 Covering of waste

O9.1 The licensee must operate in accordance with Appendix A Benchmark Technique 33 – Covering of waste, *Environmental Guidelines: Solid Waste Landfills 1996.*

O9.2 Where wastes are received at the premises for purposes of reuse, reprocessing, recovery, recycling or transfer to another premises, then such wastes are not required to be covered on a daily basis provided that:

(a) such wastes are stored and managed so as not to cause or be likely to cause any off-site environmental effects; and
(b) such wastes are stored in a clearly defined area of the premises away from the tipping face

5 Monitoring and recording conditions

1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
(a) in a legible form, or in a form that can readily be reduced to a legible form;
(b) kept for at least 4 years after the monitoring or event to which they relate took place; and
(c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:

(a) the date(s) on which the sample was taken;
(b) the time(s) at which the sample was collected;
(c) the point at which the sample was taken; and
(d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Alkalinity (as calcium carbonate)	mg/L	Quarterly	Grab sample
Aluminium	mg/L	Yearly	Grab sample
Ammonia nitrogen	mg/L	Quarterly	Grab sample
Arsenic	mg/L	Yearly	Grab sample
Barium	mg/L	Yearly	Grab sample
Benzene	mg/L	Yearly	Grab sample
Cadmium	mg/L	Yearly	Grab sample
Calcium	mg/L	Quarterly	Grab sample
Chemical Oxygen Demand	mg/L	Yearly	Grab sample
Chloride	mg/L	Quarterly	Grab sample
Chlorinated volatile compounds	mg/L	Yearly	Grab sample
Cobalt	mg/L	Yearly	Grab sample
Conductivity	uS/cm	Quarterly	Grab sample
Copper	mg/L	Yearly	Grab sample
Dissolved Oxygen	mg/L	Quarterly	Grab sample
Ethylbenzene	mg/L	Yearly	Grab sample
Fluoride	mg/L	Quarterly	Grab sample
Hexavalent chromium	mg/L	Yearly	Grab sample
Lead	mg/L	Yearly	Grab sample
Magnesium	mg/L	Quarterly	Grab sample
Manganese	mg/L	Quarterly	Grab sample
Mercury	mg/L	Yearly	Grab sample
Nitrate	mg/L	Quarterly	Grab sample
Nitrite	mg/L	Quarterly	Grab sample
Organochlorine pesticides	mg/L	Yearly	Grab sample
Organophosphate pesticides	mg/L	Yearly	Grab sample
Phosphate	mg/L	Yearly	Grab sample
Polynuclear aromatic hydrocarbons (PAHs)	mg/L	Yearly	Grab sample
Potassium	mg/L	Quarterly	Grab sample
Sodium	mg/L	Quarterly	Grab sample
Sulfate	mg/L	Quarterly	Grab sample
Toluene	mg/L	Yearly	Grab sample
Total Iron	mg/L	Quarterly	Grab sample
Total Phenolics	mg/L	Quarterly	Grab sample
Total Phosphorus	mg/L	Yearly	Grab sample
Total chromium	mg/L	Yearly	Grab sample
Total petroleum hydrocarbons	mg/L	Yearly	Grab sample
Xylene	mg/L	Yearly	Grab sample
Zinc	mg/L	Yearly	Grab sample
pH	pH	Quarterly	Grab sample
polychlorinated biphenyls	mg/L	Yearly	Grab sample

POINT 2

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	g/m2/month	Monthly	Australian Standard 3580.10.1-1991

POINT 3

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	g/m2/month	Monthly	Australian Standard 3580.10.1-1991

POINT 4

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	g/m2/month	Monthly	Australian Standard 3580.10.1-1991

M3 Testing methods - concentration limits

M3.1 Monitoring for the concentration of a pollutant emitted to the air required to be conducted by this licence must be done in accordance with:

(a) any methodology which is required by or under the Act to be used for the testing of the concentration of the pollutant; or

(b) if no such requirement is imposed by or under the Act, any methodology which a condition of this licence requires to be used for that testing; or

(c) if no such requirement is imposed by or under the Act or by a condition of this licence, any methodology approved in writing by the EPA for the purposes of that testing prior to the testing taking place.

Note: The Clean Air (Plant & Equipment) Regulation 1997 requires testing for certain purposes to be conducted in accordance with test methods contained in the publication "Approved Methods the Sampling and Analysis of Air Pollutants in NSW".

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

4.2 The record must include details of the following:
(a) the date and time of the complaint;
(b) the method by which the complaint was made;
(c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
(d) the nature of the complaint;
(e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
(f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 Conditions M5.1 and M5.2 do not apply until 3 months after:
(a) the date of the issue of this licence or
(b) if this licence is a replacement licence within the meaning of the Protection of the Environment Operations (Savings and Transitional) Regulation 1998, the date on which a copy of the licence was served on the licensee under clause 10 of that regulation.

M6 Requirement to monitor volume or mass

M6.1 Not applicable.

M7 Recording of fires

M7.1 The licensee must record the following data for every fire at the site:

(a) the time and date that the fire started;
(b) the time and date that the fire was either burnt out or extinguished;
(c) the location of the fire (eg. clean timber stockpile, putrescible garbage cell etc.);
(d) prevailing weather conditions; and
(e) observations made in regard to smoke direction and dispersion.

M8 Noise monitoring

M8.1 The licensee must monitor noise, expressed as LA10 (15 minute), at the premises and in accordance with the methods and protocols for the Noise Attenuation Study as detailed in Section 5.1 of the document titled *Hawkesbury City Council Waste Management Facility Environmental Monitoring Program Annual Report* dated August 1999 and compiled by Australian Water Technologies, report number 1999/0344.

M9 Requirement to monitor weather

M9.1 The licensee must monitor daily rainfall at the premises.

6 Reporting conditions

R1 Annual return documents

What documents must an Annual Return contain?

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
(a) a Statement of Compliance; and
(b) a Monitoring and Complaints Summary.
A copy of the form in which the Annual Return must be supplied to the EPA accompanies this licence. Before the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

Period covered by Annual Return

.1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee,
(a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
(b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on
(a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
(b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

Deadline for Annual Return

R1.5 The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

.lotification where actual load can not be calculated

R1.6 Not applicable.

Licensee must retain copy of Annual Return

R1.7 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

Certifying of Statement of Compliance and Signing of Monitoring and Complaints Summary

R1.8 Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
(a) the licence holder; or
(b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

.1.9 A person who has been given written approval to certify a certificate of compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.

R2 Notification of environmental harm

Note: The licensee or its employees must notify the EPA of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.1 Notifications must be made by telephoning the EPA's Pollution Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
(a) where this licence applies to premises, an event has occurred at the premises; or
(b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
(a) the cause, time and duration of the event;
(b) the type, volume and concentration of every pollutant discharged as a result of the event;
(c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; and
(d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
(e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;

(f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event;
(g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

General conditions

G1 Copy of licence kept at the premises

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

Pollution studies and reduction programs

U1 Land rehabilitation

U1.1 The licensee must commence the rehabilitation works program within 30 days of the submission of the works program to the EPA unless otherwise noted in writing from the EPA.

U2 Installation of a weighbridge

.2.1 The licensee must install an approved weighbridge at the premises, by 30 September 2000 and in accordance with clause 25 of the *Protection of the Environment Operations (Waste) Regulation 1996.*

U3 Groundwater monitoring

U3.1 For each location specified below the licensee must monitor (by sampling and obtaining results by analysis) each parameter specified in column one (1). The licensee must use the sampling method and frequency specified in the other columns.

1. Ground water bores as shown as GWM1, GWM2, GWM3, GWM4, GWM6, GWM7, GWM8 and GWM9 on Figure 1 of the document titled *Hawkesbury City Council Waste Management Facility Environmental Monitoring Program Annual Report* dated August 1999 and compiled by Australian Water Technologies.

Parameter	Unit of measure	Frequency	Method
Alkalinity	mg$CaCO_3$/L	Quarterly	Grab sample
Conductivity	uS/cm	Quarterly	Grab sample
pH	pH	Quarterly	Grab sample
Redox potential	mV	Quarterly	Grab sample
Salinity	ppt	Quarterly	Grab sample
Turbidity	NTU	Quarterly	Grab sample
Total dissolved solids	mg/L	Quarterly	Grab sample
Dissolved oxygen	mg/L	Quarterly	Grab sample
Temperature	oC	Quarterly	Grab sample
Water Table Depth	AHD	Quarterly	Grab sample
Chloride	mg/L	Quarterly	Grab sample
Sulfate	mg/L	Quarterly	Grab sample
Ammonia	mg/L	Quarterly	Grab sample
Oxidised nitrogen (nitrate + nitrite)	mg/L	Quarterly	Grab sample
Total Nitrogen	mg/L	Quarterly	Grab sample
Total phosphorus	mg/L	Quarterly	Grab sample
Total sodium	mg/L	Quarterly	Grab sample
Total calcium	mg/L	Quarterly	Grab sample
Total magnesium	mg/L	Quarterly	Grab sample
Total potassium	mg/L	Quarterly	Grab sample
Total organic carbon	mg/L	Quarterly	Grab sample
Biological oxygen demand	mg/L	Quarterly	Grab sample
Total phenolics	mg/L	Quarterly	Grab sample
Total petroleum hydrocarbons	mg/L	Quarterly	Grab sample

U3.2 The monitoring required by condition U3.1 must be undertaken during the period of 1 January 2000 to 1 January 2002.

U3.3 The licensee must submit the groundwater monitoring results to the EPA by 31 March 2002.

U3.4 The licensee must submit the following to the EPA by 31 March 2002:

(a) a list of parameters and sampling frequencies to be used for the proposed ongoing Groundwater Monitoring Program; and

(b) a list of concentrations and/or units for each parameter of the proposed Groundwater Monitoring Program that will indicate a trigger for the need to undertake a Groundwater Assessment Program in accordance with Appendix A Benchmark Numbers 6 and 7 of the *Environmental Guidelines: Solid Waste Landfills 1996*.

U4 Groundwater monitoring: Bores "GWM1", GWM7 and "GWM9"

U4.1 The licensee must submit the groundwater monitoring results for "GWM1", "GWM7" and "GWM9" to the EPA by the 30 September 2000.

Note: "GWM1", "GWM7" and "GWM9" are defined in Figure 1 of the document titled *Hawkesbury City Council Waste Management Facility Environmental Monitoring Program Annual Report* dated August 1999.

U5 Surface water monitoring program

U5.1 For each location specified below the licensee must monitor (by sampling and obtaining results by analysis) each parameter specified in column one (1). The licensee must use the sampling method and frequency specified in the other columns.

1. **Surface water sample sites as shown as "SW1", "SW2", "SW3" and "SW4" in Figure 1 of the document titled *Hawkesbury City Council Waste Management Facility Environmental Monitoring Program Annual Report* dated August 1999 and compiled by Australian Water Technologies.**

Parameter	Unit of measure	Frequency	Method
Conductivity	uS/cm	Quarterly	Grab sample
pH	pH	Quarterly	Grab sample
Redox potential	mV	Quarterly	Grab sample
Salinity	ppt	Quarterly	Grab sample
Turbidity	NTU	Quarterly	Grab sample
Total dissolved solids	mg/L	Quarterly	Grab sample
Dissolved oxygen	mg/L	Quarterly	Grab sample
Temperature	oC	Quarterly	Grab sample
Total suspend solids	mg/L	Quarterly	Grab sample
Ammonia	mg/L	Quarterly	Grab sample
Filtered NOx	mg/L	Quarterly	Grab sample
Total nitrogen	mg/L	Quarterly	Grab sample
Total phosphorus	mg/L	Quarterly	Grab sample
Faecal coliforms	cfu/100mL	Quarterly	Grab sample
Biochemical oxygen demand	mg/L	Quarterly	Grab sample
Total phenolics	mg/L	Quarterly	Grab sample

U5.2 The monitoring required by condition U5.1 must be undertaken during the period of 1 January 2000 to 1 January 2002.

U5.3 The licensee must submit the surface water monitoring results to the EPA by 31 March 2002.

U5.4 The licensee must submit the following to the EPA by 31 March 2002:

(c) a list of parameters and sampling frequencies to be used for the proposed ongoing Surface Water Monitoring Program; and

(d) a list of concentrations and/or units for each parameter of the proposed Surface Water Monitoring Program that will indicate a trigger for the need to undertake a Surface Water Assessment Program in accordance with Appendix A Benchmark Numbers 6 and 7 of the *Environmental Guidelines: Solid Waste Landfills 1996*.

Special conditions

E1.1 Not applicable.

Dictionary

General Dictionary

In this licence, unless the contrary is indicated, the terms below have the following meanings:

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998

BOD	Means biochemical oxygen demand
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 1998.
flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
industrial waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
inert waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997

premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
reprocessing of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
treatment of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TSP	Means total suspended particles
TSS	Means total suspended solids
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste code	Means the waste codes listed in Appendix 5 of the EPA document A Guide to Licensing Part B.
waste type	Means Group A, Group B, Group C, inert, solid, industrial or hazardous waste

Ms Nadia Kanhoush

Principal Licence Conversion Officer

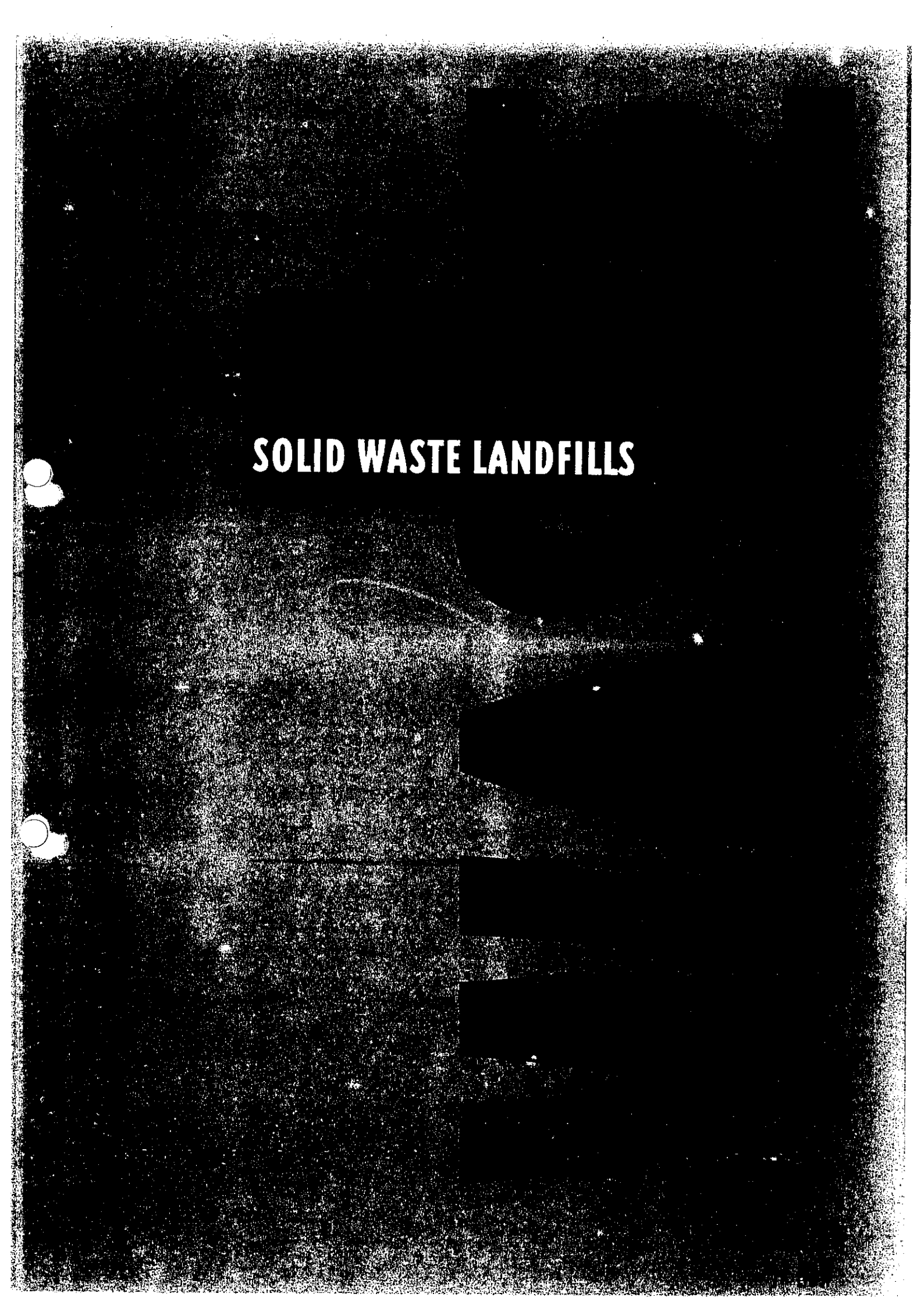
(By Delegation)

08-Aug-2000

End Notes

Appendix 1-2

EPA Guidelines Solid Waste Landfills


SOLID WASTE LANDFILLS

ENVIRONMENTAL GUIDELINES: SOLID WASTE LANDFILLS

- Non chemical Waste including Composites

For technical information about these Guidelines contact:
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CONTENTS

1. INTRODUCTION

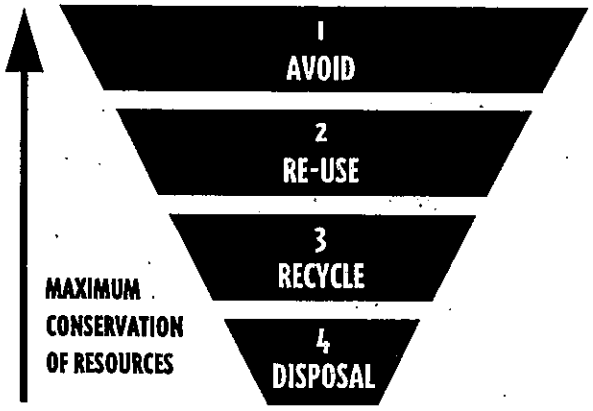
1.1 WASTE MANAGEMENT IN PERSPECTIVE

The number one priority in waste management in NSW is to reduce the amount of waste we produce. The NSW Government is committed to reducing the waste that is disposed of by 60% per capita by the year 2000, using 1990 as the base year. This target is consistent with worldwide trends and is underpinned by the philosophy of ecologically sustainable development (ESD), which requires us to use scarce natural resources more efficiently, and avoid the environmental impacts of waste disposal.

Figure 1 shows the framework that is guiding waste management in NSW. Our primary aim is to maximise conservation of resources through the effective avoidance and diversion of waste. Although we recognise that waste is best reduced or avoided at the point of production or generation, we also recognise the need for strategies for re-using and recycling those wastes that are generated. Inevitably, some waste will need to be disposed of to landfill, but this is now viewed as a last resort which also needs to be carried out in an environmentally effective and efficient manner, consistent with ESD principles.

FIGURE 1

THE WASTE MANAGEMENT HIERARCHY



1. Avoiding waste
2. Re-using materials
3. Recycling and reprocessing materials
4. Waste disposal (if the first three are not possible)

Source: EPA

Our current policy and program priorities reflect the philosophy and principles outlined above, and place the greatest emphasis on the following:

- supporting local government efforts to improve the efficiency and effectiveness of waste management
- developing green waste reprocessing systems, and facilitating the development of markets to enable the phasing out of garden waste going to landfill
- increasing re-use and recycling of building and demolition wastes
- setting targets and specific actions for reducing waste produced by significant waste-generating industries (tyres, paper, packaging)
- educating the community to reduce waste through more selective purchasing of recycled, recyclable, re-usable or refillable products, and by rejecting excessive packaging
- requiring government agencies to set the pace as model waste managers through progressive purchasing and recycling policies.

1.2 THE ROLE OF LANDFILLING

Within this framework, landfills are a mechanism for effectively treating and disposing of those wastes which, at the present time, it is neither technically feasible nor economically viable to avoid, re-use, recycle or reprocess.

The EPA is committed to ensuring that this unavoidable waste disposal is conducted in an environmentally responsible way. This includes ensuring that existing and potential landfill occupiers are aware of the risks landfilling poses to the quality of air, water, land and community amenity. It also involves ensuring that these occupiers take responsibility for managing these risks in the most effective way possible, e.g. by encouraging stabilisation of landfilled waste within one generation.

1.3 THE PERFORMANCE-BASED APPROACH

The purpose of these Guidelines is to launch a consistent and environmentally responsible approach to managing landfills across NSW. This is vital to instilling community confidence in landfilling activities and avoiding extremely costly land remediation programs.

Rather than prescribing actions, design specifications and standards, the EPA has selected a **performance-based** approach for these Guidelines to promote and achieve the best environmental outcomes. The inflexibility of a prescriptive approach would not reward occupiers for

judicious site selection nor technical nor management innovation, which are generally the best mechanisms for arriving at the most environmentally beneficial solution.

Under the performance-based approach, the emphasis is on achieving the most environmentally beneficial outcomes for the effective treatment and disposal of waste. These performance outcomes are defined in these Guidelines as Environmental Goals.

There is no single uniform winning solution for achieving all Environmental Goals. Many different landfill operation strategies have been developed and practised around the world, and new methods are being developed all the time. Strategies used in the last decade are quickly being superseded by new strategies, and different countries favour different options. There is particularly strong debate on the question of landfill design, construction and operations management, which largely stems from differing views about whether a landfill is a construction job, a processing operation, or something in between. This debate has been summarised in the recent study by Rudolph & Krol (1994), who argue that there are three competing strategies for solid waste disposal by landfill:

1. The containment approach used in the US and to a lesser extent in Europe.
2. The semi-aerobic method used in Japan and in some Asian areas influenced by Japan.
3. Enhanced stabilisation, a processing route which seeks to stabilise the waste as quickly as possible.

Each of these landfill strategies, and indeed any others yet to be developed, will have advantages and disadvantages for a particular landfill site. An integrated environmental approach will recognise that a given design or managerial benchmark technique may help to achieve a number of Environmental Goals. The best mix of techniques will depend on the location and the type and quantity of waste to be received.

These Guidelines assume that there are five principal environmental management techniques for landfills which a landfill occupier must consider in order to achieve the best environmental outcome:

- **site selection** - an appropriate location will have natural barriers and buffer distances to help reduce environmental risk
- **design and construction** - including all aspects of the design and construction of the landfill and associated infrastructure
- **monitoring** - including all monitoring and reporting of air, water, noise and waste
- **site operations management** - including all operational measures required to manage a landfill in an environmentally acceptable manner
- **remediation and post-closure management** - including the measures needed to minimise the impact of closed landfills and ensure the beneficial use of landfill sites after closure.

Applicants for of new facilities need to realise that environment protection is achieved through a combination of good planning and an integrated and thorough approach to design, operation and management. There is no substitute for selecting an environmentally sound site and adopting ongoing management measures to protect the environmental integrity of the site.

In the case of existing landfills, the chance to select the best site is long gone. Instead, the priority is to ensure that the facilities are operated in a manner that minimises environmental impact, and achieves effective site remediation. For existing facilities, the performance-based approach recognises that retrospective requirement of design and construction techniques could place an undue burden of cost on the industry (which would in turn be passed on to the community via waste disposal fees). In some cases, such costs may be disproportionate to the environmental benefit received. The location of a facility, the wastes it receives and/or its remaining life span may be such that there are techniques other than design and construction techniques which achieve the desired environmental outcome. The environmental solutions must be appropriate to deal with the problems at hand. The performance-based approach encourages the occupiers of landfills to use their initiative to develop solutions appropriate for their landfill.

Companion guidelines developed by the Department of Urban Affairs and Planning (DUAP 1996) provide advice about landfill site selection, and the environmental assessment of new landfill proposals or substantial extensions to existing landfills. Although primarily directed at landfill proposals that require an Environmental Impact Statement (EIS), the principles contained in those guidelines are relevant to all landfill proposals.

These Guidelines focus on the environmental management of landfills, which needs to be considered both 'up front' during the planning process and during the life of the landfill. They have been developed to provide the community, local councils and landfill occupiers with:

- a clear outline of the environmental issues that need to be managed

- a system for regulating landfills which ensures that Environmental Goals are met using the most effective, affordable and innovative mix of mechanisms available, recognising that the level and timing of regulation should be influenced by:
  - the environmental qualities and location of the landfill site
  - the quantity and type of waste received
  - whether the landfill is new or existing
- an outline of some of the techniques currently available to manage the environmental issues.

These Guidelines require current and future occupiers to:

- acknowledge the environmental issues the EPA expects them to manage
- recognise the Environmental Goals associated with managing the environmental issues, and the level of performance the EPA expects
- consider their strategic approach to landfilling when establishing their siting, design, monitoring, management and remediation techniques and to consider the benchmark techniques when arriving at their preferred approach to meeting the Environmental Goals.

2. ENVIRONMENTAL ISSUES AND GOALS IN LANDFILLING

The environmental issues of primary concern to the community and the EPA in relation to landfilling operations are:

1. **Water pollution** - i.e. discharges of pollutants to ground and surface waters.
2. **Air pollution** - i.e. emissions of pollutants to the atmosphere.
3. **Land management** and **conservation.**
4. **Hazards** and **loss of amenity.**

2.1 WATER POLLUTION

Ground and surface waters can be contaminated by untreated leachate from landfill sites. Leachate is the liquid that percolates through landfills as a result of infiltration and/or decomposition of the wastes. It may cause serious water pollution if it is not properly managed.

Surface water run-off from a landfill site can cause unacceptable sediment loads in receiving waters, while uncontrolled surface water run-on can lead to excessive generation of leachate.

Environmental Goals

Landfill design, monitoring, management and remediation must comply with the following Environmental Goals:

2.1.1 Preventing pollution of water by leachate

Leachate must be controlled within the landfill site, ensuring that neither groundwater nor surface water is polluted.

2.1.2 Detecting water pollution

Effective mechanisms must be developed for early detection of groundwater and surface water pollution.

2.1.3 Remediating water pollution

Any detected groundwater or surface water pollution needs to be speedily remediated.

2.2 AIR POLLUTION

Uncontrolled landfill gas emissions are not a sustainable landfill practice. Landfills primarily produce methane and carbon dioxide which, if not contained, can contribute to the 'greenhouse effect'. Unmanaged gas emissions also represent a lost energy/fuel source. Landfill gas can also contain a variety of corrosive, toxic or odorous components. Methane represents an explosion risk which may occur on-site or off-site.

Environmental Goals

Landfill design, monitoring, management and remediation must comply with the following Environmental Goals:

2.2.1 Preventing landfill gas emissions

Landfill gas must be controlled in such a way that:

- it does not reach explosive concentrations
- greenhouse gas emissions are minimised
- landfill gas is sustainably utilised
- odorous emissions meet relevant environmental legislation
- airborne impurities, pathogens and toxins do not pose a health risk to the community.

2.2.2 Detecting landfill gas emissions

Effective mechanisms for detecting landfill gas emissions must be put in place.

2.2.3 Remediating landfill gas emissions

Any uncontrolled gas emissions detected must be effectively remediated.

2.3 LAND MANAGEMENT AND CONSERVATION

All land is valuable, and the impact of its use as landfill needs to be sustainable. Proper care of a landfill as a valuable asset should result in efficient remediation, enabling land to be used for other purposes following closure. Land management and conservation goals include diverting waste materials that can be re-used or recycled from landfills to minimise the loss of capacity, and managing the site to ensure that unsuitable wastes are not received and that the nature of wastes that are received is known.

Environmental Goals

Landfill design, monitoring, management and remediation must comply with the following Environmental Goals:

2.3.1 Assuring quality of design, construction and operation

All design, construction and operation activities must be carried out in accordance with a quality system acceptable to the EPA.

2.3.2 Assuring quality of incoming waste

Each site must receive only those wastes that it is licensed to receive, and due diligence should be exercised in screening incoming wastes.

2.3.3 Recording of wastes received

The nature and quantity of all wastes received must be known and recorded.

2.3.4 Minimising landfill space used

Landfill space must be used optimally, and valued as a scarce resource.

2.3.5 Maximisation of recycling

Before each licence renewal, a recycling plan must be prepared for all types of waste which the site is licensed to receive.

2.3.6 Remediating landfill after closure

Operational and post-closure procedures must ensure that the former landfill site can be used by the community for other beneficial purposes as soon as practicable after landfilling is completed.

2.4 HAZARDS AND LOSS OF AMENITY

The potential hazards and amenity impacts from landfills include fire, birds, dust, odour, pests, vermin and litter. Each of these potential impacts may occur on-site or off-site.

Environmental Goals

Landfill design, monitoring, management and remediation must comply with the following Environmental Goals:

2.4.1 Preventing unauthorised entry

Unauthorised entry to the site and to the tipping face needs to be prevented.

2.4.2 Preventing degradation of local amenity

Vehicles leaving a landfill site must not distribute litter and site materials in surrounding streets. Odours, dust, vermin, weeds and litter must be effectively controlled on-site.

2.4.3 Preventing noise pollution

Noise emissions from the landfill operation must comply with noise control legislation.

2.4.4 Adequate fire-fighting capacity

Each landfill site must have adequate fire-fighting plans, equipment and staff to effectively manage fire outbreaks at any part of the landfill site.

2.4.5 Adequate staffing and training

The level and nature of staffing at each landfill site must be adequate for environmentally responsible and safe management of a landfill.

3. ENVIRONMENTAL MANAGEMENT OF LANDFILLS

The challenge in landfill management is to address environmental concerns by achieving the Environmental Goals set out in section 2 above. The goals are geared towards:

- preventing water pollution
- preventing air pollution
- promoting responsible land management and conservation
- preventing hazards and loss of amenity.

The EPA approach to managing landfills has four components:

1. Economic and educational measures to discourage over-reliance on waste disposal and promote waste management alternatives (*see* 3.1 below).
2. A focused system of licensing landfills to ensure effective control of those facilities which, because of the location and type of waste received, pose the greatest threat to the environment (*see* 3.2 below).
3. A performance-based site assessment and management strategy set out in a Landfill Environmental Management Plan (LEMP) for each site, to ensure landfill occupiers select the most appropriate and innovative means of meeting the specified Environmental Goals, given the location of the site and the type and quantity of waste received (*see* 3.3 below).
4. Performance reporting (*see* 3.4 below).

3.1 ECONOMICS AND EDUCATION

The EPA uses economic and educative tools alongside regulatory measures to achieve desired environmental outcomes.

In the case of landfills, the EPA may require different levels of licence fees and financial assurances from different occupiers, depending on the nature of a facility and its established or proposed location. These licence fees and assurances may be reduced over time if there is a greater degree of certainty that the facility will not harm the environment.

The broad goal of promoting waste reduction, the associated need to discourage the disposal of waste, and the need to cover the cost of environmental externalities created by landfills will be recognised through the promotion of true cost pricing at landfills and the retention of the existing levy on waste disposal. The extension of the levy to landfills outside Sydney is subject to ongoing consideration.

Rebates and exemptions will apply as an incentive where recycling and waste recovery initiatives are introduced.

The EPA is also developing a range of **education and information programs** to encourage source separation, recycling, reprocessing, and composting of waste, and to conserve landfills and reduce their environmental impact.

For wastes such as green waste and tyres, reprocessing is the most desirable waste management option. A range of policy, education and economic instruments will be applied to promote reprocessing, and bans on landfilling these wastes will be phased in.

3.2 REGULATION

Landfills are subject to environment protection regulation in two stages - planning and operation.

Regulation at the **planning stage** involves gaining approval for a new landfill or a significant extension to an existing landfill. This may require the preparation of an EIS and public consultation before consent from the consent authority under Part 4 or approval under Part 5 of the Environmental Planning and Assessment Act. The Department of Urban Affairs and Planning (DUAP) can nominate what should be included in an EIS. In order to assist, the DUAP has produced the *EIS Practice Guideline: Landfilling* (1996), which should be read in conjunction with these Guidelines.

The Minister for Urban Affairs and Planning has introduced a State Environmental Planning Policy (SEPP) to provide a more ordered and strategic approach to landfill planning.

The SEPP establishes the Minister for Urban Affairs and Planning as the consent authority for regional putrescible landfill proposals from local councils, Waste Planning and Management Boards or from the Waste Service. The SEPP covers proposed extensions to existing putrescible landfills and proposed upgrading of non-putrescible landfills to putrescible status. Local councils are still responsible for determining applications for individual local council landfills.

In making decisions on landfill proposals the Minister may have regard to the need for additional landfill capacity and whether the facility is identified in an approved Regional Waste Plan as the preferred disposal option.

Regulation at the **operational stage** will occur through the new waste licensing scheme set down in the Waste Minimisation and Management Act 1995. A licence for

waste disposal will be required depending on the location of the facility and/or wastes received as set down below.

3.2.1 Locational criteria

As noted earlier, the location is a primary determinant of the extent to which a landfill poses an environmental risk. Judicious location of a landfill is the single most effective environmental management tool. The aim is to avoid the need for impact mitigation and ongoing management by selecting a site where natural barriers protect environmental quality and where there will not be adverse impact on existing and future development.

The hydrogeological characteristics of a site will have a critical bearing on the need for and nature of measures to control leachate. If a landfill is located in an area with permeable substrata, any leachate generated will rapidly pollute the groundwater (and even surface water) unless an adequate barrier system is installed.

The potential damage by leachate can also be more critical if the landfill is located in a drinking water catchment, in a floodway subject to washout, or in a high rainfall area. Landfills can also cause a localised loss of amenity due to litter, dust, odour, noise, and vermin problems. Proximity to existing and proposed developments and the strength and direction of prevailing winds will be key issues in this regard.

Applicants are advised about aspects of dealing with locational issues in the *EIS Practice Guideline: Landfilling* (DUAP 1996). The schedule of environmentally sensitive sites set down in those guidelines is particularly relevant. The schedule is designed to acknowledge the importance of determining as early as practicable whether a proposed landfill site is subject to a significant environmental constraint, or is of such environmental value that it should be excluded from further consideration as a potential site. Table 1 below identifies areas which are considered to be inappropriate for landfills because of their environmental sensitivity.

To ensure the environmental protection of these areas, and to provide certainty to developers seeking sites for landfill, DUAP recommends that: 'proponents ensure that areas included in Table 1 are excluded from consideration for a landfill early in the site selection process' (DUAP 1996).

The DUAP guidelines also set out the steps to be taken when selecting an appropriate site, with heavy emphasis on conducting appropriate geological, hydrogeological, topographic and meteorological evaluations to establish the appropriateness of a site. A formal EIS is required under Schedule 3 of the Environmental Planning and Assessment Act if a proposed landfill is to dispose of solid waste that comprises:

- more than 100,000 tonnes per annum of clean fill (such as soil, sand and gravel) that is likely to cause significant impacts on drainage or flooding
- more than 1,000 tonnes per annum of sludge or effluent
- more than 200 tonnes per annum of other waste material.

A formal EIS is also required if a landfill is proposed in one of the following locations:

- in or within 100 metres of a natural waterbody, wetlands, coastal dune fields or an environmentally sensitive area
- in an area of high watertable, highly permeable soils, acid sulphate, sodic or saline soils
- within a drinking water catchment
- within a catchment of an estuary where the entrance to the sea is intermittently open
- on a floodplain
- within 500 metres of a residential zone or 250 metres of a dwelling not associated with the development and, in the opinion of the consent authority (having regard to topography and local meteorological conditions), likely to significantly affect the amenity of the neighbourhood by reason of noise, visual impact, air pollution (including odour, smoke, fumes or dust), vermin or traffic.

Following introduction of the Waste Minimisation and Management Act 1995, the licensing requirements will be set down in regulations.

In the case of **new landfills**, the EPA will:

- require licences for all landfills proposed for sensitive areas listed in Table 1 irrespective of the volume or type of waste received - however, the EPA will generally **not** be prepared to issue a licence for landfills in such locations
- require licences for all landfills proposed in the Sydney, Hunter and Illawarra regions (see Appendix E) irrespective of the quantity or type of waste received.

In the case of **existing landfills**, the EPA will:

- require licences for any currently unlicensed landfills located in a sensitive area listed in Table 1 irrespective of the quantity or type of waste received
- continue to require licences from all currently licensed or registered landfills in NSW

TABLE 1
ENVIRONMENTALLY SENSITIVE AND INAPPROPRIATE AREAS FOR LANDFILLING

Objective	Inappropriate areas

To avoid the risk of damaging areas of high environmental value.	A site within an area of significant environmental value, as identified under relevant legislation, including:
	• Areas reserved or dedicated in the National Parks and Wildlife Act 1974 (NP&W Act), such as:
	  - National Parks
	  - nature reserves
	  - historic sites
	  - areas covered by a Conservation Agreement
	  - other areas protected under this Act
	• World Heritage Areas
	• Wilderness Areas identified or declared under the Wilderness Act 1987
	• items included on the Register of National Estate
	• Marine Reserves, Aquatic Reserves, Marine National Parks or Nature Reserves
	• sites within 250 m of any of the above areas.

To avoid the risk of polluting drinking water should failure of the landfill occur.	Sites within an identified serisitive location within a drinking water catchment, being:
	• any site mapped as 'Special Areas' under the 'Sydney Water' regulation (formerly Sydney Water Board)
	• lands within 3 km of the top water level of the following storage:
	  - Wingecarribee Reservoir
	  - Fitzroy Falls Reservoir
	  - Tallowa Dam
	• any lands nominated as 'Special Areas' (or similar wording) by local water supply authorities (e.g. Councils).

To ensure that the environmental values of these areas are protected.	Sites which have: • known high scenic, scientific, cultural, heritage or environmental value and which are zoned under a planning instrument for environmental protection purposes • special protection under a planning instrument - e.g. SEPP 14 Wetlands, REP 20 Wetlands, SEPP 26 Littoral Rainforests, areas identified as core koala habitat under SEPP 44 Koala Habitats or areas similarly protected.
To protect groundwater and surface water resources.	Sites located: • within watercourses or within 40 m of a permanent or intermittent watercourse • on alluvial soil which has been identified by the Department of Land and Water Conservation as having highly vulnerable groundwater.
To avoid sites which may be susceptible to slippage, or which may have unsuitable substrata.	Sites within a karst region (either protected under the NP&W Act or not), or with substrata which are prone to slippage.
To avoid the risk of landfill washout in the event of significant flood.	Sites within a floodway which may be subject to washout during a major flood. (Councils should be consulted for information about local flooding characteristics. A major flood is considered to be a 1:100 year event.)
To control amenity impacts on residents.	Sites within 250 m of a residential zone or dwelling.

Adapted from *EIS Practice Guideline: Landfilling*, Table 1 (DUAP 1996)

- require licences for all existing unlicensed landfills located within the Sydney, Hunter and Illawarra regions (see Appendix E) irrespective of the quantity or type of waste received.

These provisions are designed to protect environmental values irrespective of the type or quantity of waste received. It is, however, recognised that existing rural landfills located in 'sensitive areas' may be regulated for the first time. The transitional arrangements set down in the implementation program in section 3.5 below are designed to address this.

3.2.2 Waste type and quantity criteria

The types of waste received at a landfill determine the potential pollutants that can be generated and hence the potential environmental risk.

If a landfill is only receiving relatively **inert materials** such as building and demolition wastes which have no potentially hazardous characteristics, the potential environmental impacts are generally restricted to dust, noise and sedimentation, which can be readily controlled.

Inert waste is defined as waste which does not undergo environmentally significant physical, chemical or biological transformations and has no potentially hazardous content once landfilled. This waste from building and demolition activities includes bricks, concrete, glass, plastics, metal and timber. It must not be contaminated or mixed with any other material. (For levels of unacceptable contamination, see relevant EPA guidelines or seek EPA advice.) Inert waste does not include clean excavated natural materials received with no other waste.

If a landfill is receiving wastes with a **degradable content**, polluting leachate and odours are more likely to be generated and require careful management.

These wastes are defined as **solid waste**, which means any non-hazardous, solid, degradable waste. These include putrescible wastes; garden wastes; uncontaminated biosolids; and clinical and related waste (including contaminated waste) sterilised to a standard acceptable to the Department of Health. Solid waste shall contain less than 200 mL/tonne or 200 g/tonne of hazardous wastes. All solid waste shall have an angle of repose of greater than five degrees (5°) and have no free liquids.

Hazardous wastes pose the most significant management challenge given their higher potential to cause harm as a result of their:

- flammability
- corrosivity
- potential to cause infection
- reactivity (violently reactive, oxidising or explosive)
- toxicity.

Depending on the location and the types of waste received, the environmental risk posed by a landfill can also be proportional to the **amount** of waste received at the landfill. If a landfill is well located, receival of small amounts of inert and solid wastes will have minimal environmental impact, and the cost of many of the environmental management techniques that apply to managing larger landfills is difficult to justify. Many of the amenity impacts of smaller landfills (such as noise, odour and dust) may be easily managed through passive controls, but more active tools are required for larger landfills.

3.2.3 Proposed landfill categories

For the purposes of regulation, **three categories** of landfill have been established.

Inert waste landfill means any landfill that accepts only inert wastes.

Inert waste landfills are subdivided into two classes:

- Class 1 - all inert wastes including stabilised asbestos cement and physically, chemically or biologically fixed, treated or processed waste in accordance with any special requirements that may be set by the EPA.
- Class 2 - all inert wastes except stabilised asbestos cement or physically, chemically or biologically fixed, treated or processed waste.

Solid waste landfill means any landfill that accepts solid waste. A solid waste landfill may also receive inert waste.

Solid waste landfills are subdivided into two classes:

- Class 1 - all solid waste including putrescible waste and other wastes approved by the EPA.
- Class 2 - all solid waste with the exception of putrescible waste and other wastes approved by the EPA.

Putrescible waste means food or animal matter (including dead animals or animal parts), or unstable or untreated biosolids.

It should be noted that the Government envisages banning garden wastes from landfills in the near future.

Hazardous waste landfill means any landfill that accepts any wastes formally defined as 'hazardous wastes' in statutory instruments (*see* Appendix B for current definition) or as specifically determined through any special requirements that may be set by the EPA.

3.2.4 Landfills that *will* need to be licensed

Inert waste landfills that receive more than 20,000 tonnes of waste per annum will need to be licensed irrespective of where they are located. All licensed inert landfills will have to comply with the following Environmental Goals (taken from section 2 above):

- Preventing pollution of water by leachate (2.1.1)
- Detecting water pollution (2.1.2)
- Remediating water pollution (2.1.3)
- Assuring quality of design, construction and operation (2.3.1)
- Assuring quality of incoming waste (2.3.2)
- Recording of wastes received (2.3.3)
- Minimising landfill space used (2.3.4)
- Maximisation of recycling (2.3.5)
- Remediating landfill after closure (2.3.6)
- Preventing unauthorised entry (2.4.1)
- Preventing degradation of local amenity (2.4.2)
- Preventing noise pollution (2.4.3)
- Adequate fire-fighting capacity (2.4.4)
- Adequate staffing and training (2.4.5)

Solid waste landfills that receive more than 5,000 tonnes of waste per annum need to be licensed irrespective of where they are located. They also need to meet all Environmental Goals set down in section 2.

Hazardous waste landfills will need to be licensed irrespective of their location or the quantity of waste received. They also need to meet all the performance goals set down in section 2, plus any other special requirements that may be set by the EPA in future special purpose guidelines relating to the disposal of hazardous wastes.

3.2.5 Class 1 solid waste landfill licensing: special arrangements involving supervisory licences

In order to give effect to the Government's policy of public sector control of 'putrescible landfills', the Waste Minimisation and Management Act provides that a licence for a Class 1 solid waste (putrescible) landfill must be held by a public authority. A private entity can only hold a licence for a Class 1 solid waste landfill if a public authority holds a separate 'supervisory licence' in respect of the site. As a result, in the case of putrescible landfills, there may be more than one licence issued by the EPA for the site. The aim of the supervisory licence is to ensure that a public authority is accountable for controlling key aspects of the site's management that are linked to meeting environmental goals:

- the charge for waste disposal
- the quantity and nature of the waste received
- the design of new facilities
- the separation, re-use, reprocessing and recycling of waste at the facility.

3.2.6 Landfills that *won't* need to be licensed

Some landfills will not need to be licensed under this regulatory scheme due to the relatively small quantity of waste received and the optimal or remote location of the facility, which together means that they do not pose a significant environmental risk. However, it is recognised that if these small landfills are poorly managed, localised environmental degradation can occur.

In relation to landfills that do not require licensing under the proposed new waste legislation, landfill occupiers will still be required to notify the EPA annually of the location, type and quantity of waste received, and ownership details of the landfill.

3.2.7 Offences and penalties

The Waste Minimisation and Management (WMM) Act rectifies the current inadequate penalty structure and provides an added incentive for environmentally responsible handling and disposal of waste.

Failure to hold a licence where this is required under these guidelines and the associated WMM regulations is an offence. There is a maximum penalty of $125,000 for a corporation (with a daily maximum of $60,000 if the offence continues) and a maximum penalty of $60,000 for an individual (with a daily maximum of $30,000 if the offence continues). Similar penalties may also apply for contravention of any conditions attached to licences, for example, the requirement to prepare and comply with a LEMP.

The WMM Act also enables authorised EPA officers to issue on the spot fines of $500 for contravention of licence conditions.

There will be a strict liability offence for the unauthorised disposal of waste. A breach of the provision will be an offence under the Environmental Offences and Penalties (EOP) Act. The owner of a dumped substance (as well as the dumper) will be liable for the offence unless the owner can establish 'due diligence' - a defence similar to that provided by section 7 of the EOP Act. This is consistent with the existing provision in section 6 of the EOP Act, and with the philosophy of 'cradle to grave' responsibility for proper disposal of waste.

A maximum penalty of $125,000 for a corporation (with a daily maximum of $60,000), and a maximum penalty of $60,000 for an individual (with a daily maximum of $30,000) will apply to the new dumping offences.

3.3 PERFORMANCE-BASED SITE ASSESSMENT AND MANAGEMENT STRATEGIES

3.3.1 Landfill Environmental Management Plans

When a facility is to be licensed, the key issue is that it must achieve the Environmental Goals set down in section 2. The onus is on the occupier to select the best mix of techniques for site development and management to achieve the required outcome. The scheme is in this sense **performance-based** and not prescriptive.

The preferred mix of techniques is to be set out by the occupier in a Landfill Environmental Management Plan (LEMP). The LEMP must systematically cover the following points:

- **Site overview** - covering the broad locational and environmental characteristics of the site. The site overview should include:
  - a real property description, including ownership and tenure details, existing and previous use, existing buildings and other developments on-site
  - details of zoning, including permissibility and land use constraints, any easements, relevant provisions of any regional or local management plan for the area, and any heritage, environment protection or other restrictions affecting the site
  - details of any current development approval including conditions of consent (if any of the measures proposed in the LEMP conflict with any development consents for the site, the consent authority should be consulted and the results of this consultation should be included in the LEMP)
  - information about the surrounding environmental characteristics, including details of topography, soils and geology, groundwater and surface water, local meteorology, flora and fauna, significant environmental features, areas affected by conservation agreements, and details of planning approvals applying to the site.
- **Landfill structure and operations overview** - outlining the landfill design/construction concepts, specifications, general operating philosophy, the nature and quantity of wastes to be received, recycling to be conducted, the intended life of the landfill and predicted financial guarantees over the life of the landfill. In the event that a public authority supervisory licence is involved in the application, the public authority must ensure that the arrangements are specified in the LEMP under which the public authority has the capacity to exercise control over the waste facility with respect to the matters referred to in 3.2.5.
- **Discharges of pollutants to waters** - describing in detail mechanisms for preventing groundwater and surface water contamination to meet the Environmental Goals contained in section 2. This must include detailed groundwater and surface water monitoring programs, and an erosion sediment control program, including details identifying the volume and concentration of pollutants that may be discharged to either surface water or ground water from the landfill site.
- **Emission of pollutants to the atmosphere** - describing in detail mechanisms for controlling emissions to meet the Environmental Goals in section 2.
- **Land management and conservation** - describing in detail the measures to be adopted to help meet waste reduction goals, the degree of control over waste taken into the site, and the proposed approach to site closure and remediation (including post-closure monitoring, final site contouring, proposed future uses etc.) to meet the Environmental Goals in section 2.
- **Prevention of hazard and loss of amenity** - identifying mechanisms for managing dust, birds, litter, noise, pests, vermin, odour, traffic and fire to meet the Environmental Goals in section 2.

In the case of new landfills, most of these matters will have been documented in the EIS phase. Documentation can be reproduced from the EIS, the 'Draft Environmental Management Plan' and/or the 'Proposals for Ongoing Monitoring' required under the *EIS Practice Guideline: Landfilling* (DUAP 1996), with necessary supplementation.

3.3.2 Benchmark techniques

Appendix A of these Guidelines sets out possible benchmark techniques which (depending on the location of the site and the type and quantity of waste received) may be suitable for a landfill and help to achieve each of the specified Environmental Goals. These benchmark techniques can be included in the LEMP. The EPA will use these benchmark techniques as a point of reference when assessing LEMPs and licence applications from landfill occupiers or applicants.

These benchmark techniques for design and construction, management, monitoring, remediation and post-closure management will apply to all landfills that need to be licensed under section 3.2, unless the EPA is satisfied that:

- In the case of **existing landfills**, the location and prevailing design, monitoring and management techniques indicate that the facility does not pose a significant threat to the environment and that effective

operational monitoring and management practices are in place.

or

- In the case of **new landfills** or **substantial extensions** to existing landfills, the natural attributes of the site or proposed alternative environment protection techniques will enable the occupier to meet the Environmental Goal(s) and provide environmental performance at least equal to or better than the benchmark techniques. This performance must be able to be demonstrated to the EPA.

All LEMPs must be accompanied by a statement which highlights those areas of design, monitoring, management and remediation where there is to be a departure from the benchmark techniques set down in Appendix A, and describe the alternative approach(es) to be adopted.

Where alternative benchmark techniques are proposed, the applicant will also need to provide documentation which does either one of the following:

1. Identifies the extent to which the system is used successfully elsewhere and certifies that:
   - the conditions are comparable
   - the system has been operating long enough to be sure of the possible consequences
   - the prospective occupier can duplicate the system
   - it can be demonstrated why the system works
   - there is no countervailing evidence, and
   - the proposal is compatible with other aspects of the proposed landfill operation.

   or

2. Demonstrates the soundness of the proposal in field or laboratory tests and:
   - the conditions simulate the proper operating conditions
   - it is demonstrated why the system works
   - there is little or no countervailing evidence
   - the EPA can, if desired, replicate the test results produced by the applicant, and
   - the proposal is compatible with other aspects of the proposed landfill operation.

If, in the opinion of the EPA, the proposed departures from the benchmark techniques may represent an increased risk of harm to the environment, the EPA may request an independent risk assessment.

The risk assessment will need to follow a professional and recognised ecological, health or operational hazard risk assessment technique. The assessment should systematically analyse site conditions, contaminant sources, exposure pathways, and receptor characteristics related to the proposed or established site in order to estimate the risks to the natural environment.

The risk assessment should be conducted by a competent risk assessor and demonstrate that the alternative technique(s) will achieve the Environmental Goal(s) and provide at least equal or better environmental performance than the most suitable and relevant combination of benchmark techniques, and that this performance can be demonstrated to the EPA. The uncertainty in this assessment should be characterised, and the person performing this analysis must present a clear and explicit explanation of their findings. An EPA guideline for risk assessment must be followed.

3.3.3 Special requirements for supervisory licences

In relation to applications for a supervisory licence (*see* 3.2.5) the Landfill Environmental Management Plan (LEMP) must specify the arrangements under which the public authority has the capacity to exercise control over the waste facility with respect to:

- the types and volume of waste received at the waste facility
- the design of the waste facility
- the separation, re-use, reprocessing and recycling of waste received at the facility
- the cost of waste disposal

In practical terms, the major focus of the supervisory licensee with respect to meeting Environmental Goals will be land management and conservation (section 2.3). The meeting of all Environmental Goals from 2.3.1 to 2.3.6 will be the joint responsibility of the supervisory licensee and the occupier. This will include the co-signing of all reports by the supervisory licensee and the occupier for forwarding to the EPA as defined in section 3.4 Performance Reporting Requirements.

3.4 PERFORMANCE REPORTING REQUIREMENTS

3.4.1 Incident reporting

The EPA should be notified of any incident that represents a threat to the environment and which may lead to a breach of licence conditions as soon as practicable within three hours of the incident first being identified. Initial contact can be made via the EPA's 24-hour Pollution Line and a written notice should follow within 14 days. Such incidents include:

- identifying non-domestic quantities (more than 200 mL/tonne or 200 g/tonne) of hazardous substances among waste
- fires at the landfill, either surface or subsurface
- mixing of leachate and stormwater or waste and stormwater
- identification of any failure of an environmental protection system
- identification of significant difference in groundwater indicator parameters
- detection of subsurface gas migration in a perimeter gas well at greater than 1.25 per cent methane (volume for volume (v/v))
- any other incident or observation that could potentially pose an immediate environmental hazard outside normal operating conditions
- any proposed change in the landfill's ownership or occupier. (EPA approval required before the ownership or occupier may change, i.e. transfer of licence.)

3.4.2 Monthly reports

Each month, the occupier will be required to send to the EPA a report on the total tonnage of waste received and tonnages of specific source-separated wastes. This report is due by the 14th day of the following month in a format specified by the EPA in Appendix D.

3.4.3 Annual report

Each year, the following information shall be provided in support of the annual licence renewal application (with all information up-to-date to within 30 days of the licence renewal date):

- Summary Report of the total non-hazardous waste received during the past 12 months (including cover material), its composition, broken down into tonnes of municipal, commercial and industrial, building and demolition waste, and its eventual fate (including recycling markets).
- A report from a registered surveyor or an alternative approved by the EPA of the volume of landfill space consumed in the period for which the report is prepared and the estimate of compaction that this volume represents.
- An estimate of remaining landfill capacity and life based on current and projected waste acceptance rates.
- A hydrogeological report that assesses the changes detected in the groundwater monitoring results over the period of operation, updated for the last 12 months. Any changes in hydraulic gradient or statistically significant variations in contaminant concentrations should be highlighted and explained.
- A leachate collection report that identifies the quantity and composition of any leachate generated over the past 12 months. Any trends should be highlighted and explained in terms of the biological activity within the landfill. The trends should generally be related to monthly rainfall and quarterly sampling results.
- A landfill gas emissions report to demonstrate achievement of the appropriate environmental objectives in the past 12 months. Perimeter well monitoring results shall be presented in graphical and tabular format. If extraction is being carried out, the volume and composition of the raw gas and the stack gases should be identified, and any changes over time explained. Where energy is being recovered from the gas, the energy recovered should be quoted in kilowatts per hour or megajoules where applicable.
- The record of odour, litter or other complaints received by the facility in the past 12 months and comments on their correlation with prevailing weather conditions or waste reception circumstances.
- A summary report of surface water monitoring results over the period of operation updated for the past 12 months. Any changes in water levels and statistically significant variations in contaminants should be highlighted and explained.
- A summary of all dust monitoring results gathered over the past 12 months, with statistically significant variations explained.
- A summary of any incident reports for the 12-month period.
- Any other specific information requested by the EPA.

In the event that a landfill is subject to a supervisory licence the supervisory licensee must co-sign (with the occupier) all reports to the EPA, i.e. the reports outlined in sections 3.4.1, 3.4.2 and 3.4.3.

For identification purposes every report must contain the following information:

- the EPA licence number(s)
- the location of the landfill (lot and DP number)
- the size of the landfill lot (in hectares)
- the name and address of the occupier of the landfill.

3.5 PHASED IMPLEMENTATION PROGRAM

3.5.1 New landfills or substantial extensions

The Guidelines will apply immediately to new landfills. This means that all new landfill licence applications and applications for a substantial extension to an existing licence (being an extension requiring an EIS under Schedule 3 of the Environmental Planning and Assessment Regulations) will need to be accompanied by a Landfill Environmental Management Plan (LEMP) which outlines a robust regime of environmental regulation, based on the location of the landfill and the type and quantity of waste received.

3.5.2 Existing metropolitan landfills

It is recognised that LEMPs will take significant time and resources to develop, particularly if baseline geological and hydrogeological work is not available.

Therefore, every established registered landfill in the former Metropolitan Waste Disposal Region will have until 31 December 1996 to provide an LEMP addressing the same matters to be covered in the LEMP for new landfills (see section 3.3). This requirement will be attached as a condition of all landfill licences.

3.5.3 Existing rural landfills

To date, landfills outside the Sydney area have generally not been regulated. Some have been regulated under the pollution control legislation, but many have never been required to hold a licence.

An immediate shift to state-of-the-art facilities for unlicensed landfills would be practically and financially difficult for rural communities to achieve. For that reason, existing unregistered landfills outside the former Metropolitan Waste Disposal Region which need to be licensed under the new regulatory scheme, must produce an LEMP by 31 December 1997. The plan itself will set down a sustainable program for implementing the plan.

Landfills outside the former Metropolitan Waste Disposal Region currently licensed under the pollution control legislation will be bound by the 31 December 1996 deadline that applies to existing landfills in the Sydney Region.

3.5.4 Existing non-putrescible landfills in Sydney

There is no non-putrescible landfill class in the new classification scheme as set down in 3.2.3 Proposed Landfill Categories. It is recognised that the absence of a formal waste classification process and *ad hoc* licence amendments to date have led to a situation where many existing 'non-putrescible' landfills will not readily fall into the inert or solid waste category. Immediate application of the new classification scheme could mean either substantial new expenditure to keep receiving the solid wastes currently being accepted lawfully, or a substantial loss of business for these landfills.

To deal with this situation, those landfills currently registered as 'non-putrescible' in the former Metropolitan Waste Disposal Region will be given an initial licence to operate as a Solid Waste Class 2 Landfill and have until 31 December 1997 to submit an LEMP. The landfill occupier will have to choose before that deadline whether to demonstrate that their landfill meets the Solid Waste Class 2 standard, or to severely restrict the nature of wastes received and comply with the more modest management requirements of an Inert Waste Landfill.

FIGURE 2

LICENSING ASSESSMENT PROCESS FOR NEW LANDFILLS AND SUBSTANTIAL VARIATIONS THAT REQUIRE AN ENVIRONMENTAL IMPACT STATEMENT (EIS)

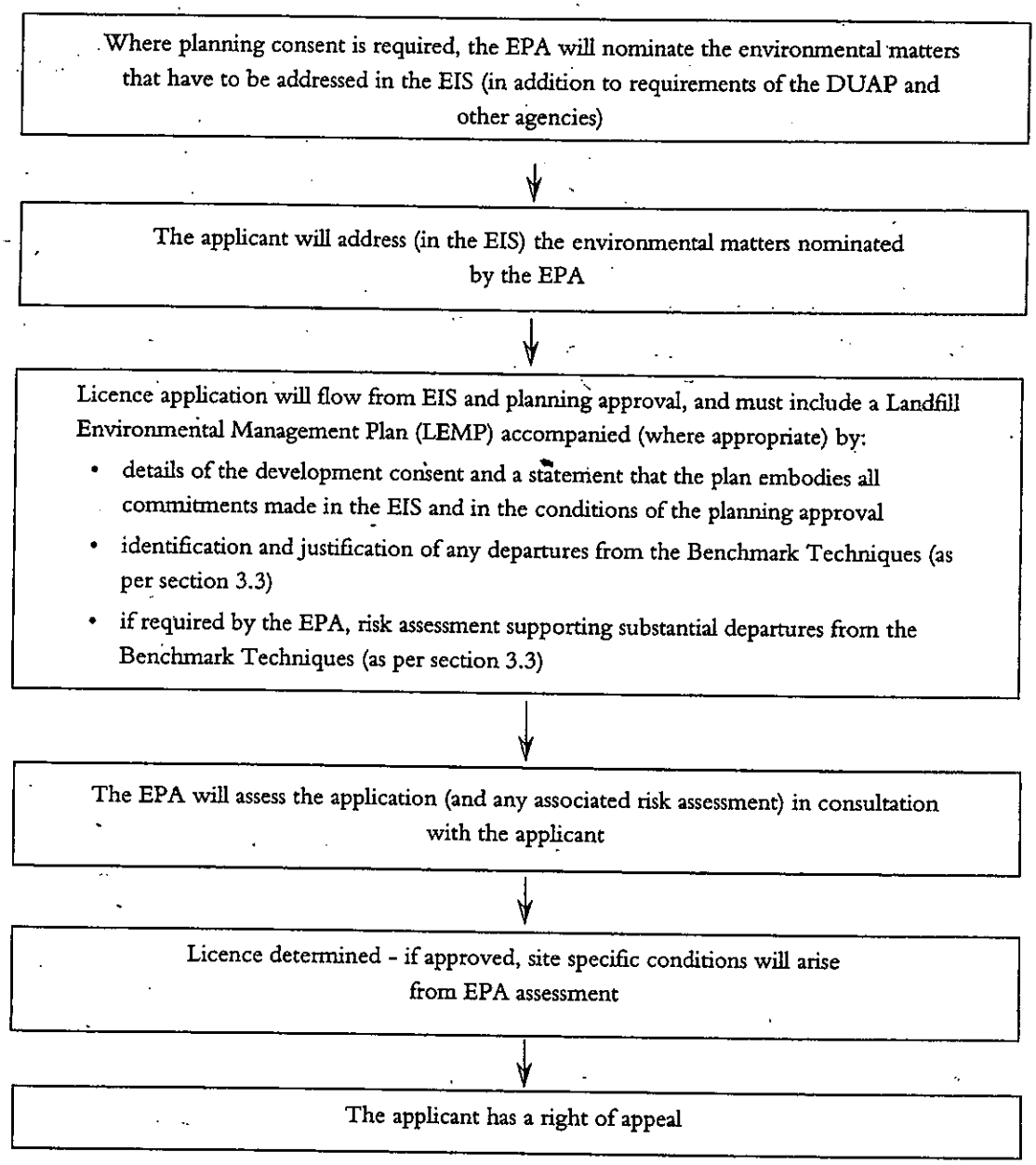


FIGURE 3
LICENSING ASSESSMENT PROCESS FOR EXISTING REGISTERED/LICENSED LANDFILLS

A new condition on the certificate of registration/licence will require landfill occupiers to prepare a Landfill Environmental Management Plan (LEMP) by 31 December 1996.*. Where relevant, the LEMP must include:

- details of the development consent and a statement that the plan embodies all commitments made in the EIS and in the conditions of the planning approval
- identification and justification of departures from the Benchmark Techniques (as per section 3.3)
- if required by the EPA, risk assessment supporting substantial departures from the Benchmark Techniques (as per section 3.3)

↓

The EPA will assess the LEMP (and any associated risk assessment) in consultation with the landfill occupier

↓

New licence conditions for every existing Sydney Metropolitan landfill and all licensed landfills outside Sydney by June 1997*

* Except in the case of existing non-putrescible landfills where the LEMP will not be due until 31 December 1997 (these landfills can continue to receive solid waste components of the waste stream until that time - *see* section 3.5.4)

FIGURE 4
LICENSING ASSESSMENT PROCESS FOR EXISTING UNLICENSED LANDFILLS

A licence condition will require landfill occupiers to prepare a Landfill Environmental Management Plan (LEMP) by 31 December 1997. Where relevant, the LEMP must include:

- details of the development consent and a statement that the plan embodies all commitments made in the EIS and in the conditions of the planning approval
- identification and justification of departures from the Benchmark Techniques (as per section 3.3)
- if required by the EPA, risk assessment supporting substantial departures from Benchmark Techniques (as per section 3.3)

↓

The EPA will assess the LEMP (and any associated risk assessment) in consultation with the landfill occupier

↓

New licence conditions issued by June 1998

APPENDIX A
BENCHMARK TECHNIQUES

INTRODUCTION

The Environmental Goals set out in section 2 of these Guidelines provide the basis for performance-based environmental management and regulation of landfills. The benchmark techniques listed in this Appendix provide guidance on possible solutions for effectively achieving these goals.

The selection of a mix of techniques for meeting the Environmental Goals in relation to any given site should be considered in the light of four key points:

- The best environmental result will be achieved via 'up front' decisions on the location of a facility, and the types of wastes to be received. The management, design, and construction techniques to be applied will be dependent on the nature of these early decisions.
- There is no impediment to rejecting some techniques in relation to a given facility. The occupier should select those techniques that are applicable to meeting the goals, identify those that are not, and justify the omissions or alternatives put forward. The benchmark techniques provided in this section are to be used primarily to indicate the level of confidence required to meet the Environmental Goals.
- A combination of design and construction, operations management, monitoring, remediation and post-closure management measures will generally be required to deal with the range of potential environmental impacts for a given site. For example, the need for design of the leachate containment system for a particular facility (which can be one of the most expensive components of a landfill) should be based on:
  - geological formation
  - hydrology
  - style of landfill operation
  - anticipated nature and quantity of wastes to be received
  - meteorology
  - elevation
  - quality of groundwater, and
  - leachate detection and controls.
- There is no impediment to using operational or design techniques not listed in this Appendix. But the use of a unique management option to meet an Environmental Goal must not cause a reduction in certainty with regard to environment protection. The use of alternative techniques may necessitate additional requirements to ensure the Environmental Goal will be reached. This extra support may, for example, take the form of additional monitoring or higher financial assurances.

This Appendix lists the Benchmark Techniques which should be considered by occupiers when developing an LEMP. Each Benchmark Technique is related to a primary Environmental Goal, but the techniques are part of an integrated environment protection system, and a change in one Benchmark Technique may affect other related Environmental Goals. These primary and related goals are signalled for each Benchmark Technique. The implication of this is that, in making a decision not to adopt a particular technique or to substantially vary the technique, the occupier will be expected to clearly state the alternative method by which the primary Environmental Goal will be met, and satisfy the EPA that the decision does not impact on the ability to meet the related Environmental Goals.

II. EXTRACTION AND DISPOSAL OF LANDFILL GAS

Primary Environmental Goal

2.2.1 Preventing landfill gas emissions

Related Environmental Goals

2.2.2 Detecting landfill gas emissions

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

A gas extraction system should be used to extract and, where possible, combust landfill gases. This system should reduce the risk of explosion and fire, reduce the contribution to greenhouse gases (methane is 20 to 30 times more potent than carbon dioxide), and lower the level of toxic organic compounds emitted from landfills. In conformance with the EPA's commitment to using landfill as a resource, applicants should evaluate generation of electricity as an option when designing the extraction system.

An appropriate and effective gas extraction/control system is recommended where the building monitoring or perimeter well testing shows methane concentrations exceeding 1.25% methane (v/v) or 25% of the lower explosive limit.

Any landfill gas condensate collected should be handled in the same manner as leachate, with the exception that it should not be spray-irrigated because of the low pH and the potential odour. Condensate should be disposed of in a manner approved by the EPA.

Energy should be recovered from the landfill gas where possible, either by directly using the gas or by generating electricity for export. All electricity-generation equipment should be designed in a manner that ensures the following air quality goals are not exceeded:

- One hour maximum NO_2 concentration - 320 $\mu g/m^3$
- Annual average NO_2 concentration - 103 $\mu g/m^3$

For any landfill gas oxidation system, landfill occupiers should quantify non-methane organic compounds (NMOC) emissions prior to and following thermal oxidation. Thermal oxidation in this context may mean flaring or electricity generation.

NMOC should be destroyed by a landfill gas oxidation system (flares or engines). Landfill gas contains a large number of NMOCs. Some of these compounds are toxic air contaminants that occur in the parts per million by volume (ppmv) concentration range. Gas extraction has the net effect of moving these compounds from within the landfill to the atmosphere, and oxidation systems or similar pollution control devices are needed to destroy these contaminants.

The sampling and analysis will need to be undertaken in accordance with requirements issued by the EPA's Air, Noise and Transport Branch. It is necessary to have greater than a 98% destruction efficiency for NMOC prior to atmospheric emission.

12. FIRE PREVENTION

Primary Environmental Goal

2.2.1 Preventing landfill gas emissions

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.4.4 Adequate fire-fighting capacity

2.4.5 Adequate staffing and training

The licensed landfill occupier should prevent fires at the landfill in order to minimise emissions to the atmosphere. The following points should be covered:

- The occupier should have clear signs on display to the public advising that flammable liquids are not permitted on the site. This will be reinforced by advice to customers at the gatehouse and inspection of loads at the tip face.
- Stockpiles of approved amounts of combustibles for recycling and composting (such as tyres, wood or vegetation) should be divided into small piles or windrows so that any burning material can be kept away from or readily separated from additional fuel.
- Cell construction, compaction and use of cover material should be undertaken in a manner conducive to the prevention of a landfill fire.
- All sealed or contaminated drums should be banned from landfill unless they are delivered as a special waste whose contents are clearly identified and suitable for acceptance.
- All fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store. This store should be located on unfilled land, and all flammable liquids should be stored within a bund of 110% capacity of the volume of those flammable liquids so that any release of raw or burning fuel would not cause a fire in the filled waste, or impact on stormwater.

13. CONTROLLED BURNING

Primary Environmental Goal

2.2.1 Preventing landfill gas emissions

Related Environmental Goals

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.4 Adequate fire-fighting capacity

2.4.5 Adequate staffing and training

The release of leachate and/or pollutants into the atmosphere as a result of burning waste at landfills should be prevented. The increases in particulate emissions and decreases in site safety arising from landfill fires outweigh any perceived benefit in waste reduction. Waste reduction strategies (e.g. composting and mulching) and materials re-use are approved methods for reducing waste.

Open burning of waste will continue to be banned in the Sydney metropolitan area. In rural areas, the occupier should not burn any materials without the written permission of the EPA. But in any event, rural occupiers may not burn the 'banned wastes' listed below. This consent will set specific conditions regarding the materials that can be burned, the way they are burned and the person responsible for setting and controlling the fire. The EPA permission does not remove the occupier's obligation to ensure that permission is granted by other control bodies such as the local Council and/or fire authority or National Parks and Wildlife Service where appropriate.

Any burning of waste should comply with the following provisions:

- The following materials are banned from burning at all landfills:
  - hazardous wastes
  - chemical containers
  - municipal garbage
  - food wastes
  - paint or paint containers
  - petroleum, oil or bitumen
  - plastics or rubber (including tyres)
  - wet materials
  - chemically treated timbers
  - clinical wastes.

- Vegetation, timber, paper and cardboard are the only waste materials suitable for burning.
- Where the clearing of on-site vegetation or the preparation of fire breaks is to involve burning, approval needs to be obtained from the local Council and/or fire authority.
- A person, authorised by the occupier, should be in attendance at all times of burning, and shall be solely responsible for lighting and controlling fires.
- Waste materials for burning should be arranged in windrows, trenches or pits.
- A fire should not be located within 50 metres of any site perimeter or working face of the landfill.
- A fire should not be located over a previously filled area of the landfill or in a location that is likely to contain landfill gas, unless it is proven to the EPA that landfill gas is not present in that area.
- A fire should not be located so that it may be offensive or potentially harmful to any person at or beyond the landfill boundary.
- Burning should be restricted to daylight hours.

14. SITE CLOSURE

Primary Environmental Goal

2.2.1 Preventing landfill gas emissions

Related Environmental Goals

2.2.2 Detecting landfill gas emissions

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

A landfill site should be closed in a manner that reduces to a minimum the emission of landfill gases. This may involve capping and revegetation designed to have the net effect of decreasing the emission of landfill gas through the surface of the landfill. This measure will also improve the potential for containing landfill gas. Landfill occupiers should be aware that as escape through the surface becomes more difficult there is a potential for greater lateral movement of gas. Closure and capping are covered in significant detail in '28. Site capping and revegetation' below.

15. SUBSURFACE GAS MONITORING DEVICES

Primary Environmental Goal

2.2.2 Detecting landfill gas emissions

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

Landfill gas monitoring devices should be capable of detecting landfill gas in sufficiently low concentrations to ensure that landfill gas is not migrating off-site, and toxic air emissions are not a threat to the community.

Monitoring wells should be installed around the perimeter of the site, at a depth equal to the minimum groundwater level, the greatest depth of refuse, or 10 metres below underground utilities or manholes within 50 metres of the landfill. These wells should be placed at intervals sufficiently small to be able to detect any potential off-site migration.

The spacing and design of these wells should be determined based on a site investigation, and detailed in the LEMP. If distinct lithological units that could act as a conduit for landfill gas were identified in the site investigation, then either multi-port wells that are able to monitor the distinct lithological units separately, or separate wells for every distinct unit should be installed.

Well construction details should be submitted to the EPA for approval prior to installation. Generally, the EPA will require individual slotted probes with bentonite seals between monitoring zones, with the monitoring zones back-filled with pea gravel to facilitate movement of gas.

16. SUBSURFACE GAS MONITORING PROGRAM

Primary Environmental Goal

2.2.2 Detecting landfill gas emissions

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

A subsurface gas monitoring program should be implemented to demonstrate that gas is not migrating off-site.

Monitoring should be conducted on a quarterly frequency. Detection above 1.25% methane (v/v) will require notification to the EPA within 24 hours, and an increase in the frequency of monitoring. Procedures for sampling should be nominated in the LEMP and should include the flushing of one probe casing volume prior to taking the reading.

Where landfill gas odours are of concern, hydrogen sulfide (H_2S) gas may also need to be measured. The testing should be conducted *in situ* using a properly maintained, zeroed and calibrated field instrument.

The tabulated results of all monitoring are to be submitted as part of an annual report, unless subsurface methane is detected above 1.25% (v/v), in which case more frequent reporting will be required by the EPA.

17. SURFACE GAS EMISSION MONITORING

Primary Environmental Goal

2.2.2 Detecting landfill gas emissions

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

Surface gas-migration monitoring should demonstrate that the cover material and extraction system is controlling the emission of landfill gas. This can be achieved by the landfill occupier testing the atmosphere five centimetres above the ground surface in areas with intermediate or final cover where wastes have been placed. A field technician would start at a point five metres away from the waste perimeter. The technician would then walk across the waste parallel to the boundary of the landfill until reaching the opposite side, and then repeat this procedure every 25 metres inward from the perimeter across the centre of the site to the opposite side of the waste landfill. This monitoring is to be performed on calm days (winds below 10 kilometres per hour).

The occupier is expected to instruct the technician on the need for due diligence following this procedure. Depressions in the cover material or surface fissures away from the sampling grid nominated above must also be investigated for methane emissions.

This monitoring should be conducted on a monthly frequency using a zeroed and calibrated methane gas detector, unless the landfill occupier obtains approval from the EPA to vary the frequency of monitoring based on site assessment or monitoring results.

The threshold concentration for closer investigation and potential action is 500 parts per million (v/v) of methane at any point on the landfill surface. Corrective action is necessary if this threshold is exceeded. This action can take the form of repairing or replacing cover material and/or adjusting or installing gas extraction equipment.

Reports on monitoring and corrective action will form part of the annual report. This monitoring is to continue until the certificate of completeness is issued or the occupier satisfies the EPA that landfill gas is no longer present in significant quantities to pose an environmental risk or inhibit revegetation.

18. GAS ACCUMULATION MONITORING

Primary Environmental Goal

2.2.2 Detecting landfill gas emissions

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.2.3 Remediating landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

Landfill gas must not accumulate in buildings and pose a danger of explosion. All buildings within 250 metres of deposited waste or areas identified in the LEMP as having potential to have methane concentrations of greater than 1.25% (v/v) in the subsurface should be tested on a monthly frequency with a tested and calibrated methane detector. If any buildings are to be built within this area they should be designed so as not to accumulate methane gas.

Buildings are not to have gas concentrations exceeding 1.25% methane (v/v). If methane is detected above this threshold, daily testing is required until ventilation or other measures control the methane build-up.

Reports on building monitoring are to be retained on-site for four years. These records will need to be available for inspection upon demand by an authorised EPA officer.

19. REMEDIATION OF UNCONTROLLED LANDFILL GAS EMISSIONS

Primary Environmental Goal

2.2.3 Remediating landfill gas emissions

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.2.2 Detecting landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

The EPA must be notified within 24 hours of detection of:

- methane at concentrations greater than 1.25% (v/v) in the surface, subsurface or building monitoring
- a one hour average NO_2 above 320 $\mu g/m^3$ from electricity generating equipment
- NMOC destruction below 98% from gas burning flare or engine.

A written assessment of the emissions and management controls implemented or proposed to be implemented to prevent further emissions should be provided to the EPA within 14 days of the incident.

20. ASSURANCE OF QUALITY

Primary Environmental Goal

2.3.1 Assuring quality of design, construction and operation

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.1.2 Detecting water pollution

2.2.1 Preventing landfill gas emissions

2.2.2 Detecting landfill gas emissions

2.3.4 Minimising landfill space used

2.3.6 Remediating landfill after closure

2.4.1 Preventing unauthorised entry

2.4.2 Preventing degradation of local amenity

2.4.3 Preventing noise pollution

2.4.5 Adequate staffing and training

To minimise the risk of the landfill having deleterious effects on the surrounding environment, the occupier should construct and operate the landfill to an appropriate quality management system. The following techniques are recommended:

- A fully documented Construction Quality Assurance System be developed in accordance with Australian Standard (AS) 3905.2. All the materials and processes associated with site development, landfill liner and the leachate drainage system must be in accordance with AS 3905.2. A suitable level of quality assurance may be selected for other materials or processes on the site (e.g. slurry wall construction) in accordance with the environmental implications posed by failure.
- A fully documented Environmental Management Quality System be developed and implemented, using for guidance the AS/NZS/ISO 9001/9004:1994 Quality Standards and the Interim AS/NZS/ISO 14 000 Environment Management Standards. These systems should cover all aspects of the operation which have actual or potential impacts on the environment.

2i. SCREENING OF WASTES RECEIVED

Primary Environmental Goal

2.3.2 Assuring quality of incoming waste

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.2.1 Preventing landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.3.3 Recording of wastes received

2.3.4 Minimising landfill space used

2.3.5 Maximisation of recycling

2.3.6 Remediating landfill after closure

2.4.2 Preventing degradation of local amenity

2.4.5 Adequate staffing and training

The landfill occupier should have in place waste acceptance and screening procedures to ensure that the site does not accept wastes that are prohibited from entry.

The complexity of a screening program does not necessarily increase as the wastes received at the site increase in sensitivity. In fact, in some instances the reverse could be seen to apply. That is, an Inert Waste Landfill would generally require extensive screening procedures to ensure that putrescible and other solid wastes and hazardous wastes are not received, while a Solid Waste Landfill with sophisticated design controls in place may require a less detailed program. Similarly, a Solid Waste Class 2 Landfill would be expected to develop and implement a plan to screen incoming waste for putrescible wastes and hazardous wastes, and to ensure that these loads are not accepted.

Generally, the following practices will be applied:

- The landfill occupier should ensure that signs clearly indicating the types of wastes that are to be accepted and those that are not to be accepted are prominently displayed at the point of entry.
- The landfill occupier should nominate a program of inspection for incoming waste loads. This may involve directing selected loads to a separate area to dump the load, then closely examining the dumped load for any unapproved wastes.
- The landfill occupier should check that all waste sludges and wastes that are controlled under a tracking system have all appropriate documentation prior to acceptance at the site.
- The landfill occupier should have a process to establish that soil and other inert material received is not contaminated according to the relevant EPA guideline. In the case of inert and solid waste landfills, this process must be able to screen out any single amount of hazardous waste greater than 200 mL/tonne or 200 g/tonne.
- The landfill occupier should ensure that records of all inspections are maintained for at least four years.
- The EPA's Regional Office should be notified if any unauthorised hazardous wastes have been found on-site, and notified of the identity of any party responsible for dumping hazardous waste with other waste types according to incident reporting requirements in section 3.4.1 above.
- Supervision of tipping activity at the tip face should be maintained when wastes are received at all landfills to ensure the accountability of those depositing unacceptable wastes at the site. Where facilities receive in excess of 500 tonnes per week (25,000 tonnes per annum) this supervision should be undertaken by someone other than the compactor driver.
- All landfill occupiers should ensure adequate training of landfill staff to recognise and handle hazardous or other unapproved wastes.

22. MEASUREMENT OF QUANTITIES OF WASTES RECEIVED

Primary Environmental Goal

2.3.3 Recording of wastes received

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation,

2.3.6 Remediating landfill after closure

2.4.1 Preventing unauthorised entry

2.4.5 Adequate staffing and training

All landfill operations accepting in excess of 25,000 tonnes per annum of waste should:

- install a weighbridge, and
- lodge a report on the total quantity of waste received every 12 months, compiled by a registered surveyor or by an alternative method approved by the EPA.

Any weighbridge used should have a valid Calibration Certificate from the Department of Consumer Affairs at all times.

Any weighbridge used should be operational at all times of landfill activity. Should the weighbridge be inoperative, the occupier will notify the EPA immediately and ensure that it is repaired as soon as practicable. While the weighbridge is inoperable, all vehicles will be recorded and tonnages calculated from the truck factors provided in Appendix D.

Landfills which accept less than 25,000 tonnes per annum of waste will be required to lodge a report every 12 months on the total quantity of waste received and at the facilitity the previous 12 months. The report is to be compiled by a registered surveyor or by an alternative method approved by the EPA.

23. RECORDING OF THE QUANTITIES, TYPES AND SOURCES OF WASTES RECEIVED

Primary Environmental Goal

2.3.3 Recording of wastes received

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.3.6 Remediating landfill after closure

2.4.1 Preventing unauthorised entry

2.4.2 Preventing degradation of local amenity

2.4.5 Adequate staffing and training

Each month, landfill occupiers must provide data to the EPA on the amount, type and source of waste according to the National Waste Classification System. This requirement extends to all materials accepted on-site. A copy of the reporting form can be found in Appendix D.

The landfill occupier must have a survey of the site compiled by a registered surveyor or by an alternative method approved by the EPA on an annual basis to confirm the volume of landfill space consumed in the past 12 months.

The landfill survey specified above will form part of the landfill's annual report to the EPA reconciling these quantities with the monthly waste acceptance reports.

Controls should be established to prevent vehicles from entering and exiting the site without generating a permanent record.

24. COMPACTION OF WASTE

Primary Environmental Goal

2.3.4 Minimising landfill space used

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.2.1 Preventing landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.3.6 Remediating landfill after closure

2.4.5 Adequate staffing and training

The amount of landfill space and land used to dispose of waste can be minimised by proper compaction. Compaction also improves the stability of landfills, and minimises voids that would encourage vermin, fires or excess generation of leachate.

Landfill occupiers are expected to ensure that maximum compaction is achieved for the capacity of the machines used. For landfills receiving over 50,000 tonnes of waste per annum, the waste compaction goal is 850 kg/m^3, excluding cover material. For landfills receiving less than 50,000 tonnes per annum, the waste compaction goal is 650 kg/m^3, excluding cover material. An exception to this is where the landfill is being operated as a bioreactor, and the landfill is to be mined or stabilised after degradation is completed. The achieved compaction rate (excluding cover material) will be submitted in the annual report to the EPA.

25. RECYCLING

Primary Environmental Goal

2.3.5 Maximisation of recycling

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.2.1 Preventing landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.3.4 Minimising landfill space used

2.4.5 Adequate staffing and training

The LEMP should include a plan to recover and recycle, re-use or reprocess wastes that can be viably recycled. Landfill occupiers should:

- nominate amounts and areas to receive and store recyclable/re-usable materials, and
- submit a plan for the processing and/or marketing of all materials separated, and for disposing of any materials separated but not suitable for recycling/re-use/reprocessing.

26. FINANCIAL ASSURANCE

Primary Environmental Goal

2.3.6 Remediating landfill after closure

Related Environmental Goals

2.1.3 Remediating water pollution

2.2.3 Remediating landfill gas emissions

2.4.2 Preventing degradation of local amenity

Financial assurance is a means of ensuring that landfill occupiers adequately plan for emergency closure, site remediation and post-closure care, by providing a specific mechanism to accumulate requisite funding during the life of the landfill. This mechanism encourages development of the necessary long-term financial planning to protect all environmental objectives.

- The LEMP should include a well-documented assessment of the potential cost, prepared by an independent consultant, for a third party contractor to undertake each of the following:
  - close down the current operation at any time and remediate the site to a standard acceptable for its planned future use
  - continue post-closure care and monitoring (bearing in mind that the period of after-care is significantly influenced by the design philosophy)
  - complete the required remediation of environmental impacts that may be identified.
- The financial assurance required by the EPA will be negotiated in one or more of the following forms:
  - an insurance policy
  - a bank guarantee of funds or letter of credit
  - a bond
  - a third party guarantee
  - a fund established and maintained by a public authority
  - any other form of security that the EPA considers appropriate and specifies in the licence as a condition.

  The preferred approach must be nominated in the LEMP.
- The annual report for a landfill (see section 3.4.3 above) may nominate any variations for the level at which the financial guarantee is set for the forthcoming years' activity for a particular site based on the current operations and the extent of site activity planned. The nominated variations must be approved by the EPA.
- A financial assurance (or any part of it) may be called on by the EPA if the EPA:
  - is satisfied that the last licensee has failed to comply with the requirements of the closure plan approved by the EPA, or
  - is satisfied that a licensee has contravened any condition of the licence relating to site remediation work, or
  - incurs or proposes to incur costs or expenses in taking action that is covered by the financial assurance.
- The requirement to provide a financial assurance lapses and no longer binds the person who was required to provide it if the EPA is satisfied:
  - that the site remediation work has been completed in accordance with a post-closure plan approved by the EPA (as detailed in 29. Closure of Landfill), and
  - that further environmental management of the premises is not required.

The person may provide the EPA with a certified statement of completion to the effect that site remediation work has been completed and that further environmental management of the premises is not required. If the EPA approves the statement, the requirement for provision of the financial assurance lapses.

27. FILLING PLAN/CONTOURS

Primary Environmental Goal

2.3.4 Minimising landfill space used

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.3.6 Remediating landfill after closure

The landfill contours should be managed in a systematic manner as outlined in the LEMP.

Regular filling plan surveys that document the process by which land is filled allow the licensed landfill occupier to demonstrate that site operations are under control and to estimate the volume of waste landfilled. These surveys assist in updating calculations in relation to remaining capacity.

- The landfill occupier will update the filling plan section of the LEMP when each cell is started or completed, or when directed by the EPA.
- The filling plan will identify the type of waste in each cell and the location of any special burials such as asbestos or decontaminated soil.
- This survey will be conducted by a registered surveyor or by an alternative method agreed to by the EPA, and will ensure that the same grid and standard height datum is used for successive filling plan contour recordings.

28. SITE CAPPING AND REVEGETATION

Primary Environmental Goal

2.3.6 Remediating landfill after closure

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.2.1 Preventing landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.3.4 Minimising landfill space used

2.4.2 Preventing degradation of local amenity

2.4.5 Adequate staffing and training

Site capping and revegetation should ensure that the final surface provides a barrier to the migration of water into the waste, controls emissions to water and atmosphere, promotes sound land management and conservation, and prevents hazards and protects amenity. This would include the following points:

- The occupier will commence capping the completed filling areas within 30 days of completion of landfilling in that area, weather permitting.
- The landfill should have a final capping comprising five parts:
  - the seal-bearing surface
  - the gas drainage layer
  - the sealing layer
  - the infiltration drainage layer, and
  - the revegetation layer.
- The seal-bearing surface should consist of a properly designed and engineered layer of material.
- The gas drainage layer should have a minimum thickness of 30 centimetres. The calcium carbonate content of the gas drainage layer must not exceed 10% by weight to prevent encrustation.
- A sealing layer should consist of a clay layer at least 50 centimetres thick and having a permeability less than $K = 10^{-8}\ ms^{-1}$.
- A drainage layer of permeability not less than $K = 10^{-5}\ ms^{-1}$ should be placed over the sealing layer. The drainage layer will be not less than 30 centimetres deep.
- A revegetation layer of depth of not less than 100 centimetres should be placed over the drainage layer. Plants selected for revegetation shall have root systems

which will not penetrate beyond the revegetation layer or block the drainage layer.

- The final settlement of the seal-bearing surface should leave a gradient of greater than 5% to defined drainage points.
- If the sealing layer is left for a period exceeding seven days before being covered by the revegetation layer, it should be covered by a flexible membrane liner protection layer.

29. LANDFILL CLOSURE AND POST-CLOSURE MONITORING AND MAINTENANCE

Primary Environmental Goal

2.3.6 Remediating landfill after closure

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.1.2 Detecting water pollution

2.2.1 Preventing landfill gas emissions

2.2.2 Detecting landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.1 Preventing unauthorised entry

2.4.2 Preventing degradation of local amenity

2.4.3 Preventing noise pollution

2.4.5 Adequate staffing and training

The Waste Minimisation and Management Act requires that within three months of the completion of a landfill's waste receipt operations, the last licensee must submit for approval to the EPA a written Closure Plan.

To ensure that the landfill continues to be non-polluting and does not cause environmental harm after site closure, the Closure Plan will include putting into place a post-closure monitoring and maintenance program which ensures the long-term integrity of the landfill. As with many other activities, post-closure monitoring and maintenance will control multiple environmental objectives, including emissions to water, emissions to the atmosphere, and protection of land use and local amenity. This monitoring and maintenance must be provided until the landfill does not pose a threat to the environment.

Specifically the Plan should:

- specify the steps taken or to be taken in closing and stabilising the premises concerned and the time frame for doing so
- ensure that all leachate collection, gas collection and stormwater sediment controls, monitoring and reporting practices, are maintained at a standard equivalent to that employed during the operational life of the landfill
- ensure that neighbouring residents are advised of contact persons to discuss any problems (e.g. odour emissions). Records of these complaints should be kept in the same manner as approved during operation.

- ensure that waste materials are not received for disposal by the facility after landfill operations cease. Waste materials that are intended for use in the remediation should be documented and reported in the same way as for an operating facility.
- The EPA may approve the Closure Plan as submitted, or it may vary the Plan before approving it.

When sufficient evidence can be provided that the landfill is stable and non-polluting, the occupier may seek to complete all obligations and retrieve the financial assurance by submitting a certified statement of completion to the effect that site remediation work has been completed and further environmental management of the premises is not required.

Generally, this statement will be expected to show that:

- Gas concentration levels in all perimeter gas wells have fallen to less than 1% methane (v/v) and less than 1.5% carbon dioxide for a period of 24 months.
- Waste stabilisation has been completed. This would be documented by the composition of the leachate changing to a low level of contamination, and posing no hazard to the environment.
- Groundwater monitoring has indicated no failure of the landfill liner that would pose a threat to groundwater quality.
- The landfill capping has been assessed over some years and found to be stable with acceptable surface water drainage.
- Documentation to demonstrate that all functions in the closure planning segment of the LEMP and the written confirmation of procedures have been completed.
- The site has been placed on the Unhealthy Building Land Register.

Once the EPA has approved the certified statement of completion, the last licensee can cease the maintenance and monitoring of the site, and any the financial assurance requirements will lapse.

30. SECURITY OF SITE

Primary Environmental Goal

2.4.1 Preventing unauthorised entry

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.3.3 Recording of wastes received

2.4.2 Preventing degradation of local amenity

2.4.5 Adequate staffing and training

Unauthorised entry to landfills can lead to waste dumping, fires, and vandalism of pollution control devices, as well as loss of amenity. The occupier should generally ensure that:

- Lockable security gates are installed and maintained.
- Landfills in urban areas, those located on extractive industry sites and all those receiving more than 25,000 tonnes per annum install and maintain a physical barrier that may include a 1.8 metre high wire mesh fence around the perimeter of the site.
- Landfills in rural areas receiving less than 25,000 tonnes per annum should install perimeter stock fences and 1.8 metre high wire mesh fences around the active tipping area and all flammable storage areas.

31. LITTER CONTROL

Primary Environmental Goal

2.4.2 Preventing degradation of local amenity

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.4.1 Preventing unauthorised entry

2.4.5 Adequate staffing and training

Local amenity should not be degraded by litter. Wind-blown litter is a nuisance to the community in the vicinity of landfill sites, and should generally be controlled by the following techniques:

- The occupier should introduce procedures that prevent the unnecessary proliferation of litter. Such procedures might include continuous compaction and use of litter fences, and the occupier is responsible for ensuring that all wind-blown litter that leaves the site is retrieved.
- All litter fences, perimeter fences and gates should be inspected daily and cleared of litter on a daily basis or as required.
- Entry and exit signs need to advise transport operators that they can be fined for any litter on public roads resulting from their improper transportation of waste.
- All litter that leaves the site should be retrieved on a daily basis.

32. CLEANING OF VEHICLES

Primary Environmental Goal

2.4.2 Preventing degradation of local amenity

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

To minimise effects on both local amenity and quality of stormwater run-off, all mud and waste materials on vehicles that leave the site should generally be removed. Vehicles using landfill sites will inadvertently collect mud and litter on their wheels as they proceed to and return from the active face.

- The landfill occupier should provide a wheel-washing or wheel-cleaning facility for use by customers. The occupier is responsible for deciding the appropriate cleaning method, taking into consideration site traffic and local road conditions. Hand-held pressure washing hoses, drive-through immersion bunds and vibration grids are all options which may suit different operations.
- The landfill occupier should display signs advising customers that it is the vehicle operator's responsibility to ensure that the remnants of their load or the material stuck to the underside of the vehicle or the wheels does not litter public roads.

33. COVERING OF WASTE

Primary Environmental Goal

2.4.2 Preventing degradation of local amenity

Related Environmental Goals

2.1.1 Preventing pollution of water by leachate

2.2.1 Preventing landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.3.4 Minimising landfill space used

2.3.6 Remediating landfill after closure

2.4.5 Adequate staffing and training

Use of cover material helps to protect the full range of environmental management objectives by limiting run-on and infiltration of water, controlling and minimising risk of fire, minimising emission of landfill gas, suppressing site odour, reducing fly propagation and rodent attraction, and decreasing litter generation.

Cover material is classified as daily, intermediate or final, depending on operation phase and function. Intermediate cover is used to close off a cell that will not receive additional lifts of refuse or final cover for some time. Final cover forms a low permeability barrier to control water entering the site and gas emissions, and promote revegetation.

Landfill occupiers are free to specify any alternative cover material (foams, mulch, etc.) provided they can demonstrate compliance with the performance goals.

To ensure that there will always be sufficient cover material available to meet the performance requirement, landfill occupiers will be expected to maintain a stockpile or an area where cover can be won on-site in all weather conditions, adequate to meet the cover requirements of the landfill for two weeks.

1. Daily cover

Daily soil cover should be applied to a minimum depth of 15 centimetres over wastes. All waste should be covered prior to ceasing operations at the end of each day.

2. Intermediate cover

Suitably selected intermediate cover should be applied to a depth of 30 centimetres over surfaces which will be exposed for more than 90 days. The approach taken will be decided by the design philosophy, and various cover options will be considered as long as the environmental issues are addressed.

3. Cover material stockpile

Where cover material cannot be won on-site, a cover stockpile should be maintained in accordance with the LEMP.

Where all the cover material must be provided from a stockpile, a two-week supply should be maintained. As a guide, this is estimated to be one cubic metre of cover for every six tonnes of waste received.

34. DUST CONTROLS

Primary Environmental Goal

2.4.2 Preventing degradation of local amenity

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.3.6 Remediating landfill after closure

2.4.5 Adequate staffing and training

Dust controls should minimise pollutants leaving the site as airborne dust, reduce stormwater sediment load, and protect local amenity. The generally expected maximum level for dust deposition is 4 g/m² per month as an annual mean for total solids, but the limit could be lower for landfills adjacent to sensitive areas. This deposition rate from the landfill should not be exceeded outside the site boundary.

The following measures are necessary to minimise generation of dust:

- Sealed or gravel roads should be constructed from the public roadway to the gatehouse/waste reception section of the landfill.
- Water spraying is an approved method of dust suppression for unsealed roads, but dust suppression methods additional to water spraying may be required in areas of fine soils and windy conditions.
- If required, all dust gauges are to be installed in accordance with AS 2724.1-1984 or later editions. The number of gauges and locations should be nominated by the landfill occupier and approved by the EPA. Alternatively, high-volume samplers may be installed if approved by the EPA.
- Monitoring of dust movement off-site will be required for all sites with residential development within one kilometre of the site boundary. Sampling and testing shall be carried out by a suitably qualified person and a NATA registered laboratory.

35. PEST, VERMIN AND NOXIOUS WEED CONTROLS

Primary Environmental Goal

2.4.2 Preventing degradation of local amenity

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.3.6 Remediating landfill after closure

2.4.1 Preventing unauthorised entry

2.4.5 Adequate staffing and training

Pests, vermin and noxious weeds should not be present at the site in sufficient numbers to pose an environmental hazard or loss of amenity in the areas neighbouring the site.

- Waste should be compacted and covered, keeping the amount of exposed waste to a minimum. Additional effort may be required for loads containing large amounts of highly biodegradable wastes.
- The landfill occupier should take steps to ensure that surfaces are adequately drained to prevent ponds of water forming on the site.
- If alternative cover materials or systems (*see* 33. Covering of waste) are used, occupiers should specify the method by which they will quantitatively monitor changes in vermin population as a result of the new cover.
- A plan to manage pests, vermin and declared noxious weeds should be developed and detailed in the LEMP.

36. ODOUR CONTROLS

Primary Environmental Goal

2.4.2 Preventing degradation of local amenity

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.2.2 Detecting landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.5 Adequate staffing and training

Landfills must have no odour impacts, in accordance with the Clean Air Act. Acceptance of wastes that are highly biodegradable, and improper gas management can lead to odour problems. Applicants are encouraged to consider at the planning stage the use of a separation distance/buffer zone as a technique for controlling the off-site movement of landfill odours. The use of sufficient distance between the landfill and sensitive receptors (i.e. residential zones) will minimise the requirement for other stringent odour controls.

The following measures will apply:

- The landfill occupier needs to take appropriate good housekeeping steps to prevent the production of odours. The use of daily cover and immediate attention to odorous waste loads will minimise the transmission of odours off-site.
- The occupier of any landfill which is identified by an odour dispersion modelling investigation (as required by DUAP 1996) as having a potential odour impact on neighbours must install and operate a meteorological station that monitors wind speed, wind direction, *sigma theta* (standard deviation of the horizontal fluctuation in the wind direction) and temperature.
- The landfill occupier will maintain a record of complaints regarding odours. This should be correlated with weather conditions and deliveries of particularly odorous wastes.

37. NOISE CONTROL

Primary Environmental Goal

2.4.3 Preventing noise pollution

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.4.2 Preventing degradation of local amenity

2.4.5 Adequate staffing and training

Unless specified under an existing Noise Control Act licence, the noise generated during the operation of the landfill facility should be managed so that the following objectives can be met:

- noise from any single source does not intrude generally above the prevailing background noise level, and
- the background noise level does not exceed the level appropriate for the particular locality and land-use.

The determination of an appropriate noise limit for a particular site will therefore depend on the adjacent land-use, the existing background noise, and the nature of the noise source. Guidance on noise planning and control techniques can be found in the EPA's *Environmental Noise Control Manual* (EPA 1994a). The following are generally acceptable noise levels:

- Noise emanating from the site must not exceed a $L_{A,10T}$ sound pressure level of 50 dB(A) (daytime) or 40 dB(A) (night time) when measured or computed at any point within one metre of any residential boundary or other noise-sensitive areas such as schools, hospitals, etc. in the vicinity of the premises.
- Noise emanating from the site must not exceed a $L_{A,10T}$ sound pressure level of 70 dB(A) when measured or computed at any point within one metre of any boundary of the premises.

For the above criteria, the $L_{A,10T}$ is taken as the dB(A) level measured using a sound level meter set on the 'FAST' response over a period between 10 and 15 minutes. Five dB(A) must be added to the measured or computed level of noise if the noise is substantially tonal or impulsive in nature. Daytime is defined as between 7:00 a.m. and 10:00 p.m. on Monday to Saturday, and between 8:00 a.m. and 10:00 p.m. on Sunday and Public Holidays; and night time as between 10:00 p.m. and 7:00 a.m. on Monday to Saturday, and between 10:00 p.m. and 8:00 a.m. on Sunday and Public Holidays.

Acceptable noise attenuation measures include buffer zones, acoustical barriers, and acoustical treatment of equipment. Particular attention must be paid to the design of items such as speed humps and vibration grids to prevent noise generation.

38. FIRE-FIGHTING CAPACITY

Primary Environmental Goal

2.4.4 Adequate fire-fighting capacity

Related Environmental Goals

2.2.1 Preventing landfill gas emissions

2.3.1 Assuring quality of design, construction and operation

2.4.1 Preventing unauthorised entry

2.4.2 Preventing degradation of local amenity

2.4.5 Adequate staffing and training

Occupiers should have the ability to adequately fight fires at any part of the landfill site. Landfill occupiers shall demonstrate sufficient fire-fighting capacity through development of a site-specific fire management plan to minimise the incidence and impact of fire. This plan should identify:

- The procedure to follow, persons responsible, and equipment to be used in the event of a fire. This should include on-site resources and external resources (Bush Fire Brigade etc.), and how they will operate on a 24-hour-a-day basis.
- The maintenance schedule for all fire-fighting equipment and facilities. This should, at a minimum, include all equipment and facilities being visually checked for damage on a weekly basis, and test operated on a three-monthly basis.
- Details of all the fire-fighting equipment that will be installed at the flammable store and at-site buildings.
- How all fire-fighting equipment will be clearly signposted and access ensured at all times.
- How appropriate fire breaks are to be constructed and maintained around all filled areas, stockpiles of combustibles, gas extraction equipment and site buildings.
- Landfill staff training in landfill fire-fighting techniques.

39. STAFFING AND TRAINING REQUIREMENTS

Primary Environmental Goal

2.4.5 Adequate staffing and training

Related Environmental Goals

2.3.1 Assuring quality of design, construction and operation

2.4.4 Adequate fire-fighting capacity

The level and nature of staffing and training should be adequate for environmentally responsible and safe management of the landfill. Staffing requirements will vary as a function of size, type of wastes, diversity and complexity of site operations.

- Landfill occupiers are to provide adequate staff to ensure that during operating hours all continuous tasks (including waste reception and security, compaction and covering) are completed in compliance with an approved LEMP.
- At a minimum, staff training is to ensure that:
  - all operators of compaction or earthworks equipment are skilled at undertaking all tasks required of them
  - all those who operate gas testing, water sampling or water testing apparatus are familiar with required testing and sample retention protocols, to a standard approved by the EPA
  - all those who are to inspect or direct the placement of incoming wastes are are capable of accurate data recording, and skilled at identifying wastes that are unacceptable.

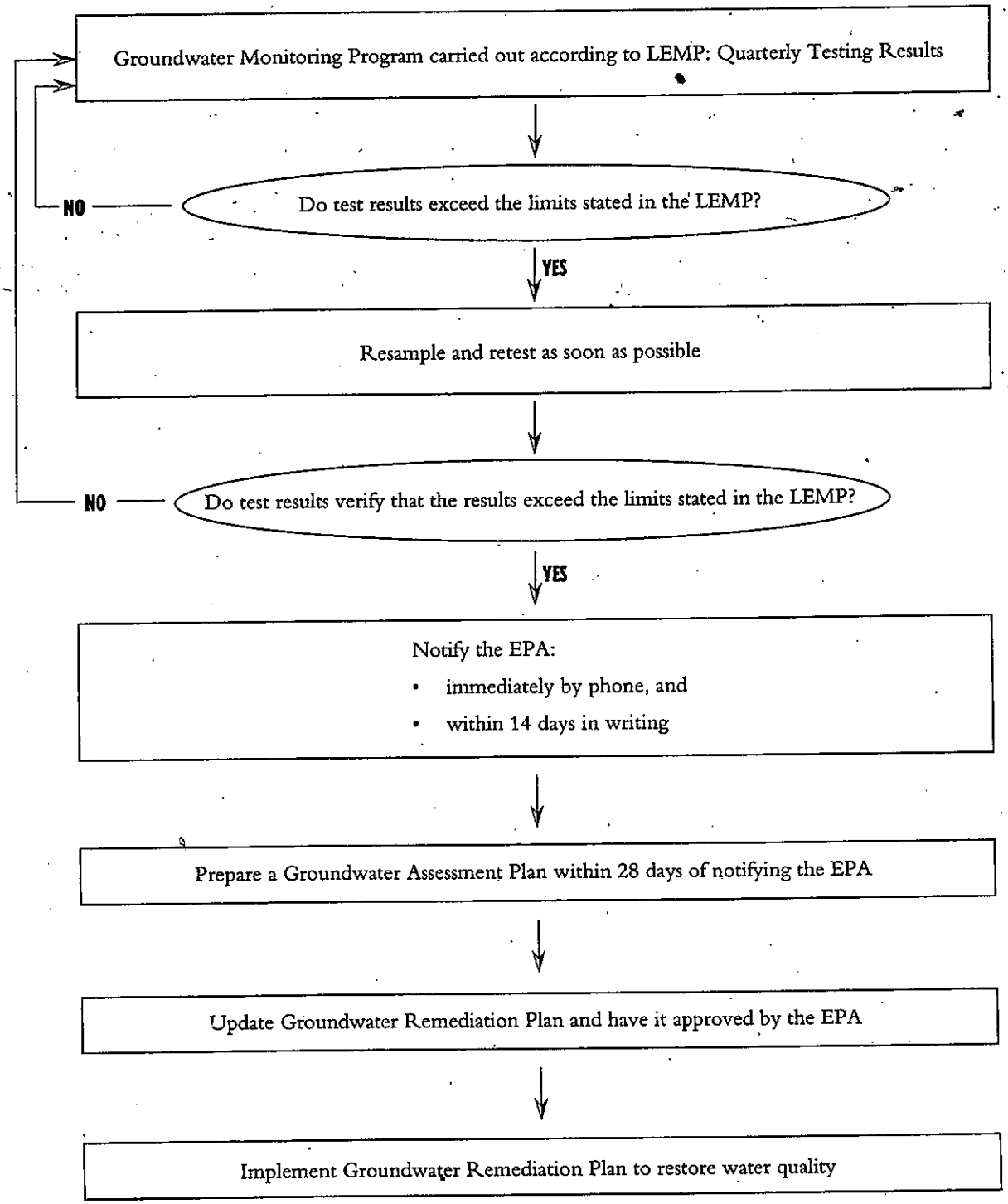
APPENDIX B
DEFINITION OF 'HAZARDOUS WASTE'

(to be finalised in the Regulations under the Waste Minimisation and Management Act)

Hazardous Waste means any waste which, through toxicity, carcinogenicity, mutagenicity, teratogenicity, flammability, explosivity, chemical reactivity, corrosivity, infectiousness or other biologically damaging properties, which may present danger to the life or health of living organisms when released into the environment, excluding:

- wastes, the discharge of which is in accordance with the provisions of a licence issued by the EPA; and
- municipal wastes (other than chemical wastes specially collected); and
- legal discharges to sewer, subject to a trade waste or customer contract; and
- biosolids when managed in accordance with the EPA's draft *Environmental Management Guidelines for the Use and Disposal of Biosolids.*

APPENDIX C
GROUNDWATER MONITORING, ASSESSMENT AND REMEDIATION



APPENDIX D
REPORTING FORM AND VEHICLE WEIGHT FACTORS

WASTE FACILITY RETURNS

Sheet 1 of 2

Depot Name: _____ **Date Return Lodged** ___/___/___

(As per licence registration)

This return covers the period from _____ **to** _____ **in the year** _____

1A. Municipal Waste received for disposal during the reporting period

LOCAL GOVERNMENT AREA (LGA)	Domestic Waste	Other Domestic	Other Council	**Total (Tonnes)**
			Total Municipal Waste disposed	**A**

1B. Municipal Waste received for reprocessing during the reporting period***

LOCAL GOVERNMENT AREA (LGA)	Domestic Waste (for reprocessing)	Other Domestic (for reprocessing)	Other Council (for reprocessing)	**Total (Tonnes)**
			Total Municipal Waste received for reprocessing* **	**B**

*** This section(1B) is for statistical purposes only. Include this total in section 6.0 in the "Received" column.

2. Other Municipal Waste transported by small vehicles

	No of Vehicle		Weight Factor		(Tonnes)
Cars and Station Wagons		X	0.06		
Utes, Vans and Trailers		X	0.30		
			Total Small Vehicle Waste disposed		**C**

3. Commercial and Industrial (C&I) Waste received for disposal during the reporting period

Waste Component*				(Tonnes)
Commercial/Industrial (Mixed Waste)				
Tyres				
Putrescible/Organic				
Sludges and Bio-solids				
Clinical/Pharmaceutical				
Contaminated Soils				
Ferrous/Car body				
Hazardous Waste**				
Other C&I Waste (specify)*				
Other C&I Waste (specify)*				
No of small vehicles (utes,vans & trailers)		X	0.30	
			Total Commercial/Industrial Waste disposed	**D**

*Use extra page if necessary

**Includes all other hazardous wastes subjected to the National Hazardous Waste Management Guidelines

WASTE FACILITY RETURNS

Sheet 2 of 2

Depot Name: _____ Date Return Lodged ___/___/___

(As per licence registration)

This return covers the period from _____ **to** _____ **in the year** _____

4. Building and Demolition (B&D) Waste received for disposal during the reporting period

Waste Component*				(Tonnes)
Building/Demolition (Mixed Waste)				
Asbestos (Type 3 only)				
Separated Building Materials				
Other B&D Waste (specify)*				
Other B&D Waste (specify)*				
No of small vehicles (utes,vans & trailers)	X	0.30		
			Total Building/Demolition Waste disposed	E

*Use extra page if necessary

5A. Transfer Waste (Out)

(To be filled in by Transfer Station only)

WASTE TRANSFERRED OUT (Tonnes)		
Enter Depot Name	Reprocessing	Disposal

(Not to be added to "F")

5B. Transfer Waste (In)

(Depots accepting waste from Transfer Stations)

WASTE TRANSFERRED IN (Tonnes)		
Enter Depot Name	Reprocessing	Disposal
	Total Transferred Waste For Disposal	F

(Add only the disposal tonnage to total "F")

6. Recycling and Composting Products/Materials

	(All Units in Tonnes)	
	Received	Transported Out
Organic Compostable (See note below)		
Brick/Tile		
Concrete		
Building Materials		
Paper/Cardboard		
Glass		
Ferrous/Car body		
Non-Ferrous/Aluminium		
Plastics/PET		
Tyres		
Other (Specify)*		
Other (Specify)*		
Total Recycling/Composting/Reprocessing Materials		G

Note: Include cell 1B total and all other organic compostable from other waste streams

7. Clean Fill and Operational Materials

	Received (Tonnes)	
Clean fill, cover & capping materials		
Cell lining materials		H

8. Total Waste Disposed at Disposal Site (Tonnes) (A+C+D+E+F) = _____ I

Waste Disposal Levy @ $7.20 Per Tonne (I X $7.20) = $_____

Waste factors by vehicle and waste type (All units in tonnes)

Vehicle type	Description	Weight factor		
Small vehicle		**All mixed waste**		
A	Car/station wagon	0.06		
B	Van/utility/trailer	0.30		
Open truck		**Municipal, commercial and industrial waste**	**Building and demolition waste**	**Clean natural excavated materials**
C	Single rear axle with two rear wheels or four small rear wheels	0.62	0.98	2.47
D	Single rear axle with four normal-size wheels	1.16	2.76	5.58
E	Tandem rear axle (bogie drive)	3.74	7.14	10.97
F	Twin steer with twin rear axles	5.57	7.61	10.97
G	Tipping semi-trailer	5.79	15.00	15.00
Enclosed truck and compactor		**All mixed waste**		
H	Single steer with single rear axle		2.72	
I	Single steer with tandem rear axle		6.38	
J	Twin steer with tandem rear axle		7.96	
K	Waste transfer truck		19.89	

APPENDIX E
LOCAL GOVERNMENT AREAS IN THE SYDNEY, HUNTER AND ILLAWARRA REGIONS AFFECTED BY LICENSING PROVISIONS

SYDNEY AREA

Ashfield
Auburn
Bankstown
Baulkham Hills
Blacktown
Botany
Burwood
Camden
Campbelltown
Canterbury
Concord
Drummoyne
Fairfield
Hawkesbury
Holroyd
Hornsby
Hunters Hill
Hurstville
Kogarah
Ku-ring-gai
Lane Cove
Leichhardt
Liverpool
Manly
Marrickville
Mosman
North Sydney
Parramatta
Penrith
Pittwater
Randwick
Rockdale
Ryde
South Sydney
Strathfield
Sutherland
Sydney
Warringah
Waverley
Willoughby
Woollahra

HUNTER AREA

Cessnock
Gosford
Lake Macquarie
Maitland
Newcastle
Port Stephens
Wyong

ILLAWARRA AREA

Kiama
Shellharbour
Shoalhaven
Wingecarribee
Wollongong

GLOSSARY

Amenity

The current existence of healthy, pleasant and agreeable (community) surroundings.

Aquifer

A saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients.

Avoidance/reduction

Reducing the quantity and toxicity of wastes produced and the quantity of resources consumed during the manufacture and life-time of a product.

Batch

Samples taken from one site in one day.

Beneficial use

The environmentally benign and useful application or use of a resource which is of public benefit, including welfare, safety, health or aesthetic enjoyment.

Bioremediation

The remediation or decontamination of any contaminated matter by the use of processes involving biological organisms.

Biosolids

The particulate matter, mainly organic, removed during the treatment of sewage (previously referred to as sewage sludge).

Building and demolition waste

Solid and inert waste materials, arising from the demolition, erection, construction, refurbishment and alteration of buildings and the construction, repair and alteration of infrastructure including roads, bridges, dams, tunnels, railways and airports.

Buffer distance

The distance between the tipping area of a landfill site and a segment of the environment to be protected.

Cell

A section of a landfill.

Clean excavated natural material

Material consisting of clay, soil and crushed rock which is not contaminated or mixed with any other material.

Clinical and related waste - (also called Medical waste)

Any cytotoxic or contaminated waste.

Commercial and industrial waste

Solid and inert wastes generated by businesses and industries (including shopping centres, restaurants and offices) and institutions (such as schools, hospitals and government offices), excluding building and demolition waste and municipal waste.

Composting

The process of the aerobic conversion of organic materials by micro-organisms into soil conditioners, compost or humus. By definition, it is a process which must be carried out under controlled conditions yielding cured products.

Construction waste - *see Building and demolition waste.*

Contaminated waste

(a) Of clinical and related waste origin:

Contaminated waste is material with the potential to cause infection. Sources include medical, nursing, dental, veterinary, pharmaceutical and similar facilities engaged in treatment, investigation, teaching or research. Contaminated waste includes:

Sharps: Any object capable of inflicting a penetrating injury contaminated with blood and/or body fluids. This includes needles, needle or syringe combinations and any other sharp objects or instruments designed to perform invasive procedures.

Bulk body fluids, blood and blood products: Including any vessel, bag or tubing containing body fluids, blood or blood products.

Disposable and dressings linen: Heavily soiled with blood and/or body fluid.

Microbiological and pathological waste: Including discarded laboratory specimens, cultures and materials that have contact with such, and biological reagents.

Tissue: Human tissue, organs, body parts, placentas and products of autopsy and animal tissue.

(b) Other than of clinical and related waste origin:

Contaminated soil or other contaminated wastes are solid wastes containing more than 200 mL/tonne or 200 g/tonne of hazardous content or wastes formally defined as 'hazardous wastes' in statutory instruments (*see* Appendix B for current definition) or as specifically determined through any special requirements that may be set by the EPA.

Cover material

Material approved by the EPA for use to cover dumped waste at landfills.

Decomposition

The breakdown of organic waste materials by micro-organisms.

Degradation

An environmentally significant natural, physical, chemical or biological transformation to a lower state.

Demolition waste - ***see Building and demolition waste.***

DUAP

New South Wales Department of Urban Affairs and Planning.

EIS

Environmental Impact Statement.

EPA

New South Wales Environment Protection Authority.

Greenhouse gases

Gases, such as methane and carbon dioxide, which are implicated in the greenhouse effect, which in turn is thought to cause global warming.

Groundwater

Water saturating the voids in soil and rock; water in the zone of saturation in the Earth's crust.

Hazardous waste

Wastes currently defined as 'hazardous wastes' in the proposed Regulatory Impact Statement (*see* Appendix B).

Hazardous waste landfill

Any landfill that accepts hazardous waste (*see* definition above).

Industrial waste - ***see Commercial Waste***

Inert waste

Wastes which do not undergo environmentally significant physical, chemical or biological transformations and have no potentially hazardous content once landfilled. This waste from building and demolition includes bricks, concrete, glass, plastics, metal and timber. They must not be contaminated or mixed with any other material. (For levels of unacceptable contamination, see relevant EPA guidelines or seek EPA advice.)

Inert waste landfill

Any landfill that accepts only inert wastes (*see* definition above). Inert waste landfills are subdivided into two classes:

- Class 1 - all inert wastes including stabilised asbestos cement and physically, chemically or biologically fixed, treated or processed waste, in accordance with any special requirements that may be set by the EPA.
- Class 2 - all inert wastes except stabilised asbestos cement or physically, chemically or biologically fixed, treated or processed waste.

Landfill Environmental Management Plan (LEMP)

A detailed plan for the operations of a landfill site from its greenfield state to its fully rehabilitated state including after-care.

Landfill gas

Gaseous emissions from the decomposition of waste. Also called 'biogas'.

Landfill site

A waste facility used for the purposes of disposing of waste to land.

Leachate

Liquid released by, or water that has percolated through, waste and which contains dissolved and/or suspended liquids and/or solids and/or gases.

Licence

A licence (including a supervisory licence) granted under the Waste Minimisation and Management Act 1995 and in force.

Litter

Solid waste that is outside the tipping area of the landfil. site and is not part of the formal waste collection system.

Lysimeter

An instrument to collect water flowing through the vadose zone or unsaturated zone in soil.

Material recovery

A form of resource recovery of wastes otherwise destined for disposal in which the emphasis is on separating and processing waste materials.

Medical waste - ***see Clinical and related waste and Contaminated waste***

Methane (CH_4)

An explosive, odourless and colourless gas produced in a landfill by organic waste undergoing anaerobic decomposition.

Mulching

The size-reduction of organic materials using one or more of the following processes: cutting, milling, shredding, grinding and other means. The mulch is then usually pasteurised.

Municipal waste

Solid and inert wastes arising from the three waste sub-streams:

Domestic waste - household solid and inert wastes placed out for kerbside collection

Other domestic waste - residential solid and inert wastes arising from domestic clean-up and garden waste

Other council waste - council generated solid and inert wastes arising from street sweepings, litter bins, parks and garden clean-ups, tree loppings and council engineering work.

MWDR

Metropolitan Waste Disposal Region.

Occupier

A person who has the management or control of the landfill (other than as an employee).

Organic waste

One or more of the following types of waste: garden, untreated wood, fibrous, vegetables, fruits, cereals, biosolids, manures, fatty foods, meat, fish and fatty sludges.

Poorly stabilised material

A treated material which is prone to further degradation or decomposition.

Poorly stabilised or untreated biosolids

Biosolids that only meet stabilisation grade C under the EPA's draft *Environmental Management Guidelines for the Use and Disposal of Biosolids* (EPA 1995).

Public authority

A public or local authority constituted by or under an Act and includes:

(a) a Waste Board, or

(b) a department of Public Service, or

(c) a member of staff or other person who exercises functions on behalf of a public authority, or

(d) a State owned corporation or a subsidiary of such a corporation.

Putrescible waste

Waste being food or animal matter (including dead animals or animal parts), or unstable or untreated biosolids.

Recycling

The process by which waste otherwise destined for disposal is collected, reprocessed or remanufactured and used to make a product.

Relative per cent difference

The difference between duplicate samples divided by the average and expressed as a percentage.

Remediation

Work for the remediation, rehabilitation and monitoring of premises the subject of a licence and that is required by the conditions of a licence to be carried out:

(a) while the premises are being used for the purpose to which the licence relates, or

(b) after the premises cease being used for the purpose to which the licence relates,

or both.

Reprocessing

Physical, chemical or biological processing used to transform waste, otherwise destined for disposal, into a raw material used to make a product.

Resource recovery

The extraction and utilisation of materials from mixed waste. Materials recovered can be used in the manufacture of new products. Recovery of value includes energy by utilising components of waste as a fuel, production of compost using solid waste as a medium, and reclamation of land.

Re-use

A process by which waste otherwise destined for disposal is cleaned or repaired for use, for the purposes of prolonging the original product lifetime prior to treatment or reprocessing.

Run-off

The portion of precipitation that drains from an area as surface flow.

Run-on

Where surface water runs off one site and flows onto the site in question (i.e. the landfill site).

Sludge

Semi-liquid waste produced as a by-product of an industrial process.

Solid waste

Any non-hazardous, solid, degradable waste. This includes putrescible wastes; garden wastes; uncontaminated biosolids; and clinical and related waste (including contaminated waste) only where sterilised to a standard acceptable to the Department of Health. Solid waste shall contain less than 200 mL/tonne or 200 g/tonne of hazardous wastes. All solid waste shall have an angle of repose of greater than five degrees (5°) and have no free liquids.

Solid waste landfill

Any landfill that accepts solid wastes (irrespective of whether it also accepts some inert wastes). Solid waste landfills are subdivided into two classes:

- Class 1 - All solid waste including putrescible wastes and other wastes approved by the EPA.
- Class 2 - All solid waste with the exception of putrescible wastes and other wastes approved by the EPA.

It should be noted that the Government envisages banning garden wastes from landfill in the near future.

Spadable sludge

A sludge material that behaves sufficiently like a solid to be able to be moved by a spade in normal outdoor temperatures.

Stabilised material

Material not prone to further degradation or decomposition.

Supervisory licence

The licence whereby a public authority exercises control over a Solid Waste Class 1 Landfill with respect to:

- types and quantities of waste received
- facility design
- separation, re-use, reprocessing and recycling, and
- disposal charges.

Surface water

Surface water includes all natural and constructed waterways or channels whether flow is intermittent or not; all lakes and impoundments (except lined dams associated with landfilling activities); and other marshes, lagoons and swamps.

Toxins

Substances which are harmful to humans, animals or plants.

Transfer station

A waste facility used to transfer waste from collection vehicles to a bulk haul vehicle in order to achieve long-distance transportation efficiency.

Treatment

Physical, chemical or biological processing of a waste for disposal.

Uppermost aquifer

The nearest geological media to the base of the landfill which does or could potentially act as an aquifer.

Vadose zone

The zone beneath the topsoil and overlying the water table, in which water in pore spaces coexists with air or in which the geological materials are unsaturated.

Vector

A carrier that is capable of transmitting a pathogen from one organism to another.

v/v

Volume for volume.

Waste

Waste includes:

(a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such a volume, constituency or manner as to cause an alteration in the environment, or

(b) any discarded, rejected, unwanted, surplus or abandoned substance, or

(c) any otherwise discarded, rejected, unwanted surplus, or abandoned substance intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the substance, or

(d) any substance prescribed by the regulations to be waste for the purposes of this Act.

A substance is not precluded from being waste merely because it can be reprocessed, re-used or recycled.

Waste facility

Any premises used for the storage, treatment, reprocessing, sorting or disposal of waste.

Watertable

The surface of the groundwater.

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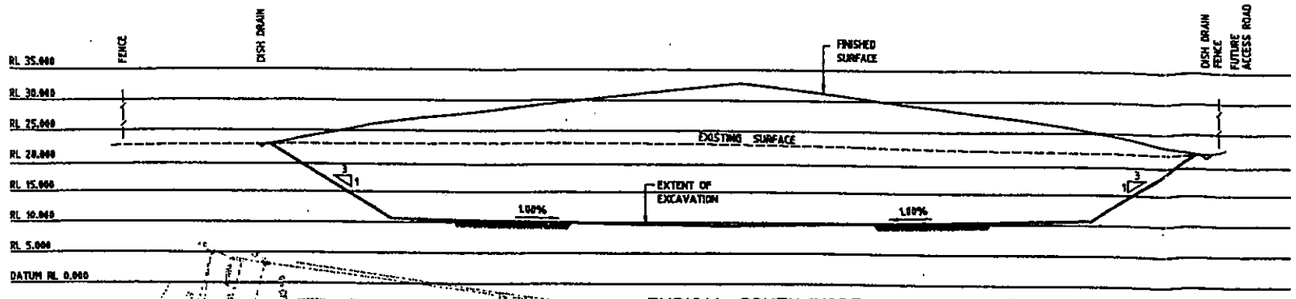
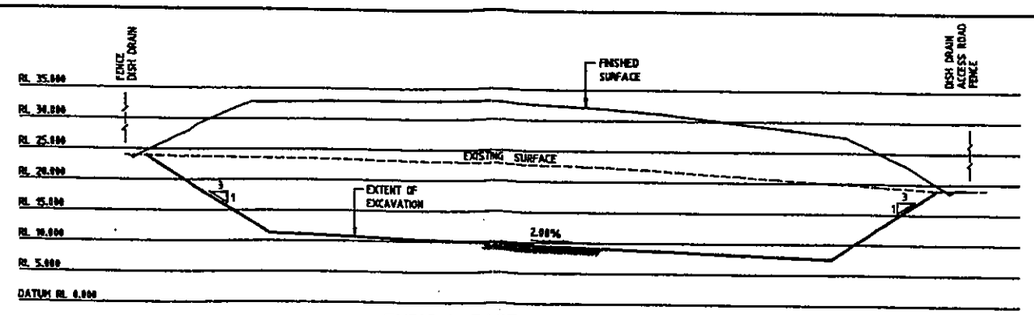
Appendix 1-3

Landfill Masterplan Drawings



TYPICAL SOUTH/NORTH CROSS SECTION

SCALE 1:1000 HORIZ
1:500 VERT



TYPICAL EAST/WEST CROSS SECTION

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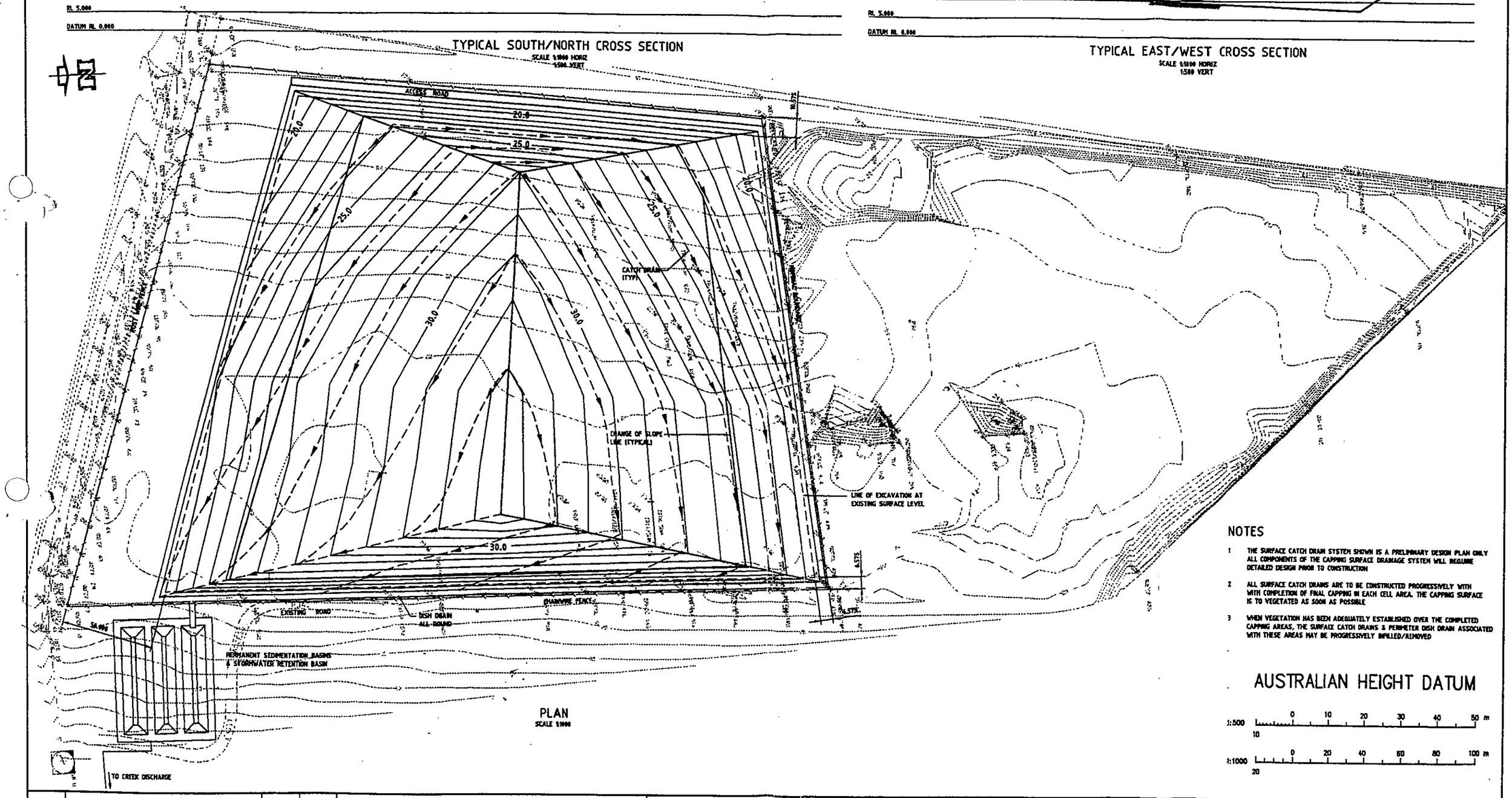
1:500 VERT



PLAN

SCALE 1:1000

NOTES

1. THE SURFACE CATCH DRAIN SYSTEM SHOWN IS A PRELIMINARY DESIGN PLAN ONLY ALL COMPONENTS OF THE CAPPING SURFACE DRAINAGE SYSTEM WILL REQUIRE DETAILED DESIGN PRIOR TO CONSTRUCTION
2. ALL SURFACE CATCH DRAINS ARE TO BE CONSTRUCTED PROGRESSIVELY WITH WITH COMPLETION OF FINAL CAPPING IN EACH CELL AREA. THE CAPPING SURFACE IS TO VEGETATED AS SOON AS POSSIBLE
3. WHEN VEGETATION HAS BEEN ADEQUATELY ESTABLISHED OVER THE COMPLETED CAPPING AREAS, THE SURFACE CATCH DRAINS & PERIMETER DISH DRAIN ASSOCIATED WITH THESE AREAS MAY BE PROGRESSIVELY INFILLED/REMOVED

AUSTRALIAN HEIGHT DATUM

1:500 0 10 20 30 40 50 m
10

1:1000 0 20 40 60 80 100 m
20

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.92m AHD

COORDINATES (ISG) 278 621.993 E
1 276 967.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID, "SURVEY" ON LID STAINLESS STEEL PIN INSIDE, (PM No STAMPED ON INSIDE OF LID)

Designed	Project Approval
GC	RC
Design Check	Cad Reference
JMcH	58G011M1
Drawn	Document No
GCS	58G011BM1 REV A
Drawing Check	Scale
GC	AS SHOWN

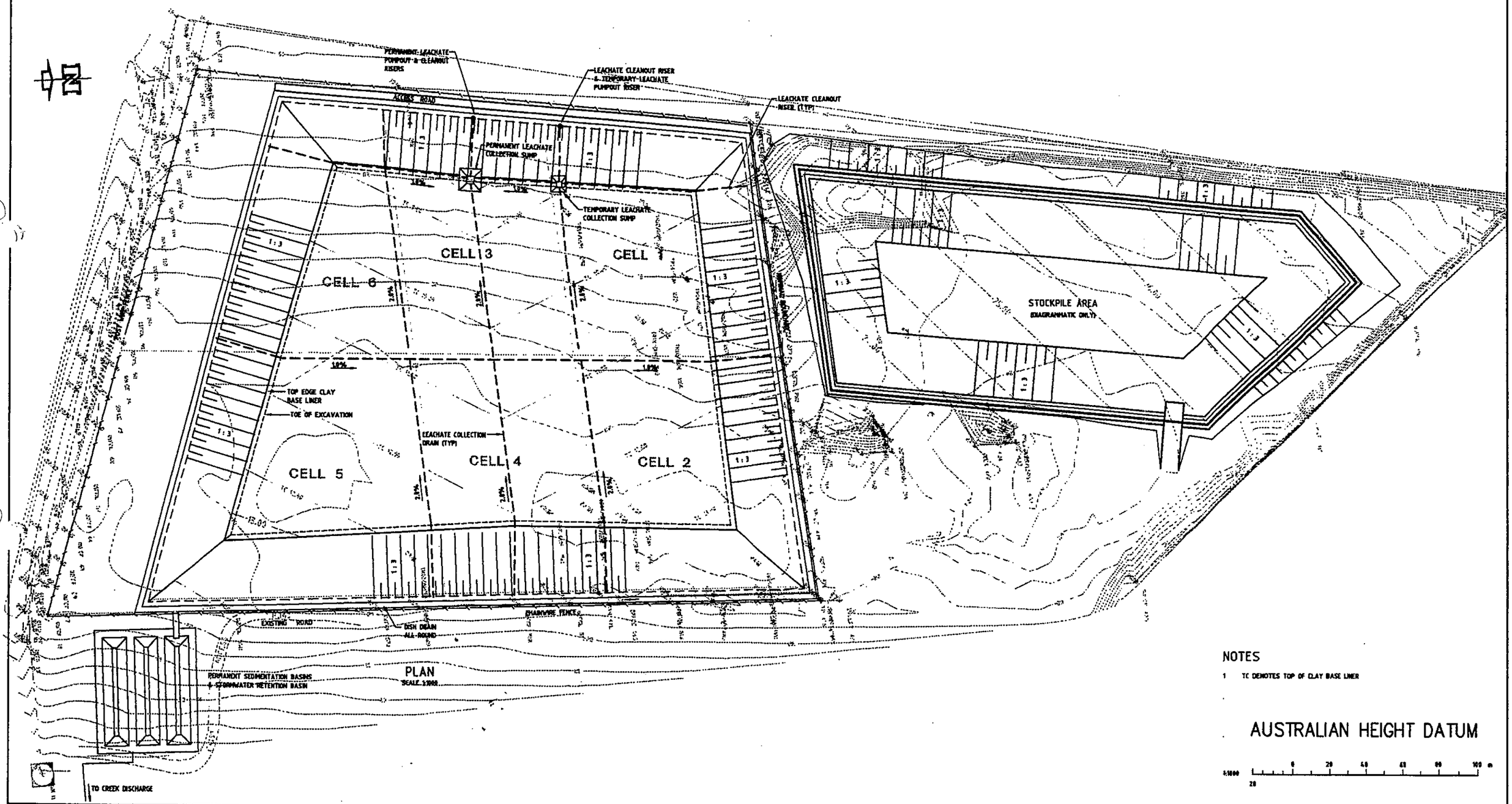
RUST PPK
Environment & Infrastructure
PPK HOUSE 8 Blaxland Road
Rhodes 2138 New South Wales Australia

SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2

FINAL LANDFORM

Project No	
58G011B	
Drawing No	Revision
M1	A



NOTES

1 TC DENOTES TOP OF CLAY BASE LINER

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 16.92m AHD

COORDINATES (ISG) 278 621.913 E
1 276 962.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID. "SURVEY" ON LID STAINLESS STEEL PIN INSIDE, (PM No STAMPED ON INSIDE OF LID)

Designed	Project Approval
GC	RC
Design Check	Civil Reference
JMcN	58G011M2
Drawn	Document No
GCS	58G011B.M2 REV A
Drawing Check	Scale
GC	AS SHOWN

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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
GENERAL ARRANGEMENT OF CELLS AND LEACHATE DRAIN SYSTEM

Project No	
58G011B	
Drawing No	Revision
M2	A

SUPERSEDED

SEQUENCE OF OPERATION

PRELIMINARIES

- CONSTRUCT TEMPORARY SEDIMENTATION BASIN AND ASSOCIATED PIPEWORK
- CONSTRUCT DOSING INJECTION SYSTEMS ADJACENT TO TEMPORARY SEDIMENTATION BASIN
- CONSTRUCT 450 OD DIA BLACK HDPE CLASS 6 PIPELINE FROM SEDIMENTATION BASIN DISCHARGE TO RICKABY CREEK TRIBUTARY
- CONSTRUCT TWO 200 OD DIA BLACK HDPE CLASS 6 PIPELINES, ONE LINE FROM CELL 1 STORMWATER PUMPOUT PIT TO THE INLET OF THE SEDIMENTATION BASIN AND THE SECOND LINE FROM THE MAIN STOCKPILE STORMWATER PUMPOUT PIT TO THE INLET OF THE SEDIMENTATION BASIN

NOTE: THE FINAL CONNECTION OF THE PIPELINES CANNOT BE COMPLETED UNTIL THE PUMPS ARE INSTALLED IN THE PUMP OUT PITS

- SUPPLY AND INSTALL ELECTRICAL POWER SUPPLY TO DOSING PUMPS, STORMWATER PUMPS AND PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM

INITAL EARTHWORKS FOR CELL 1

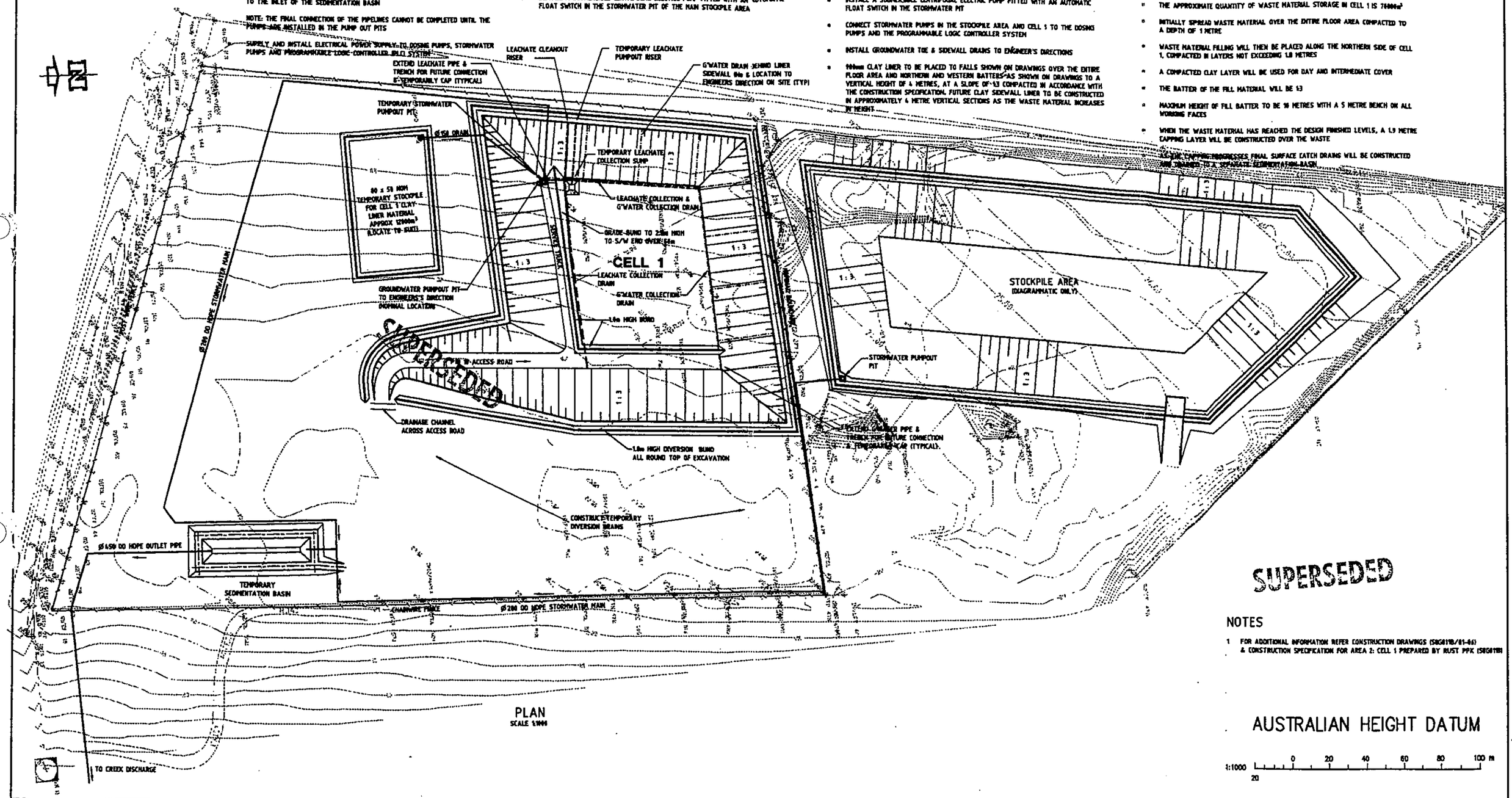
- CLEAR SITE FOR STOCKPILE AREAS, AND CONSTRUCTION AREA FOR CELL 1
- CONSTRUCT DIVERSION BUND AROUND CELL 1 TO PREVENT ANY INGRESS OF SURFACE WATER RUN OFF FROM THE SURROUNDING GROUND
- CONSTRUCT BUND WALLS AROUND STOCKPILE AREAS
- CONSTRUCT STOCKPILE PLATFORMS BY PLACING & COMPACTING SELECTED EXCAVATED MATERIAL TO LEVELS SHOWN
- INSTALL A SUBMERSIBLE CENTRIFUGAL ELECTRIC PUMP FITTED WITH AN AUTOMATIC FLOAT SWITCH IN THE STORMWATER PIT OF THE MAIN STOCKPILE AREA

CONSTRUCTION OF CELL 1

- CELL 1 TO BE EXCAVATED TO THE EXTENT AS SHOWN ON THE DRAWINGS. EXCAVATED MATERIAL APPROX 107300m³
- CONSTRUCT ACCESS ROAD TO FLOOR OF CELL 1 AT A GRADIENT OF 10%. THIS ROAD WILL ALSO PROVIDE ACCESS TO CELL 2
- EXCAVATE CHANNELS FOR LEACHATE DRAINS
- CONSTRUCT A STORMWATER PUMP OUT DRAINAGE PIT OUTSIDE BUND ALIGNMENT
- INSTALL A SUBMERSIBLE CENTRIFUGAL ELECTRIC PUMP FITTED WITH AN AUTOMATIC FLOAT SWITCH IN THE STORMWATER PIT
- CONNECT STORMWATER PUMPS IN THE STOCKPILE AREA AND CELL 1 TO THE DOSING PUMPS AND THE PROGRAMMABLE LOGIC CONTROLLER SYSTEM
- INSTALL GROUNDWATER TOE & SIDEWALL DRAINS TO ENGINEER'S DIRECTIONS
- 900mm CLAY LINER TO BE PLACED TO FALLS SHOWN ON DRAWINGS OVER THE ENTIRE FLOOR AREA AND NORTHERN AND WESTERN BATTERS AS SHOWN ON DRAWINGS TO A VERTICAL HEIGHT OF 4 METRES, AT A SLOPE OF 1:3 COMPACTED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION. FUTURE CLAY SIDEWALL LINER TO BE CONSTRUCTED IN APPROXIMATELY 4 METRE VERTICAL SECTIONS AS THE WASTE MATERIAL INCREASES IN HEIGHT
- CONSTRUCT BUND WALLS ON THE SOUTHERN AND EASTERN EXTREMITIES OF THE FLOOR LINER. BUND WALLS TO BE INTEGRAL WITH CLAY LINER
- CONSTRUCT LEACHATE PUMP OUT PIT IN SOUTHWEST CORNER OF CELL 1, INSIDE BUND WALL AS DETAILED ON THE DRAWINGS
- INSTALL LEACHATE DRAINS & PLACE 300mm GRANULAR BLANKET DRAINAGE LAYER OVER CLAY LINER

WASTE MATERIAL FILLING OPERATION

- THE APPROXIMATE QUANTITY OF WASTE MATERIAL STORAGE IN CELL 1 IS 74000m³
- INITIALLY SPREAD WASTE MATERIAL OVER THE ENTIRE FLOOR AREA COMPACTED TO A DEPTH OF 1 METRE
- WASTE MATERIAL FILLING WILL THEN BE PLACED ALONG THE NORTHERN SIDE OF CELL 1, COMPACTED IN LAYERS NOT EXCEEDING 1.0 METRES
- A COMPACTED CLAY LAYER WILL BE USED FOR DAY AND INTERMEDIATE COVER
- THE BATTER OF THE FILL MATERIAL WILL BE 1:3
- MAXIMUM HEIGHT OF FILL BATTER TO BE 10 METRES WITH A 5 METRE BENCH ON ALL WORKING FACES
- WHEN THE WASTE MATERIAL HAS REACHED THE DESIGN FINISHED LEVELS, A 1.9 METRE CAPPING LAYER WILL BE CONSTRUCTED OVER THE WASTE
- AS THE CAPPING PROGRESSES FINAL SURFACE CATCH DRAINS WILL BE CONSTRUCTED AND DRAINED TO A SEPARATE SEDIMENTATION BASIN



PLAN
SCALE 1:1000

SUPERSEDED

NOTES

1 FOR ADDITIONAL INFORMATION REFER CONSTRUCTION DRAWINGS (58G011B/01-06) & CONSTRUCTION SPECIFICATION FOR AREA 2: CELL 1 PREPARED BY RUST PPK (58G011B)

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.92m AHD

COORDINATES (ISG) 278 621.943 E
1 276 942.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID. "SURVEY" ON LID STAINLESS STEEL PIN INSIDE. (PM No STAMPED ON INSIDE OF LID)

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G011M3
Drawn: GCS	Document No: 58G011BM3 REV A
Drawing Check: GC	Scale: AS SHOWN

RUST PPK
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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
SEQUENCE OF OPERATION
CELL 1

Project No	
58G011B	
Drawing No	Revision
M3	A

A1

HAWKESBURY AGRICULTURAL COLLEGE PADDOCKS

DRIFTWAY

THE (40.235 WIDE)

BLACKTOWN ROAD

192

193

Pt POR 179

FORMER TIP SITE

BM SSM 68871
RL 18.92

BM SSM 68871
RL 17.335

INSPECTION HOLES

SUMP INV 6.09
SUMP INV 6.04

NEW CELL No.1 (GRAVEL BASE)

AIR SPACE VOLUME 150000m³ (24th OCTOBER 1995)

CRUSHED SANDSTONE FORMATION

HOLDING DAM

TOPSOIL STOCKPILE

VEGETATED AREA

STOCKPILE

METAL RECYCING AREA

RAMP

CELL IN USE

GARBAGE HOLDING AREA

GROUND SANDSTONE

ACCESS

SURFACE INLET PIT

GLASS RECYCLING AREA

PAPER RECYCING AREA

CONCRETE WASH BAY

BRICK OFFICE

METAL SHED

BASIN

HEADWALL

DRAIN

BANK

FENCE

CHAINWIRE

BITUMEN

ROAD

POLE

TOP

TOE

OF

TABLE

AMENDED

AMENDED

NOTES

- The position of features shown is subject to a boundary survey
- Individual trees have not been located
- Services shown hereon have been located where possible by field survey. Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.

20 0 20 40 60 80 100
METRES

DESIGN BY	
SURVEY BY	A EDWARDS
CALCS BY	
DRAWN BY	M.SANTORO
CHECKED BY	G.NELSON

REDUCTION RATIO 1:1000
CONTOUR INTERVAL 1m
ORIGIN OF LEVELS IS PM 68117 RL 18.92 AHD
DATUM AHD

AMENDMENTS	A	B	C	D
Date				

C.FILE: 89146

McKINLAY MORGAN & ASSOCIATES PTY LTD
CONSULTING SURVEYORS – PROJECT MANAGERS
A.C.N. 003 750 525
122 MACQUARIE STREET, WINDSOR 2756. PHONE: 045.776008, 045.776011 FAX: 045.774910
P.O. BOX 217, WINDSOR, N.S.W. 2756
DX8615 WINDSOR

DATE OF SURVEY 24th OCTOBER 1995
FILE No. 89146
COUNCIL REF ORDER No. 96276

CLIENT NAME HAWKESBURY CITY COUNCIL
LOCALITY SOUTH WINDSOR LGA HAWKESBURY
PLAN No. 89146:D.1

PLAN SHOWING DETAIL, CONTOURS & LEVELS OVER LOT 192 IN DP 729625 & PART OF Pt POR 179

SHEET No. OF SHEETS

SEQUENCE OF OPERATION

INITIAL EARTHWORKS FOR CELL 2

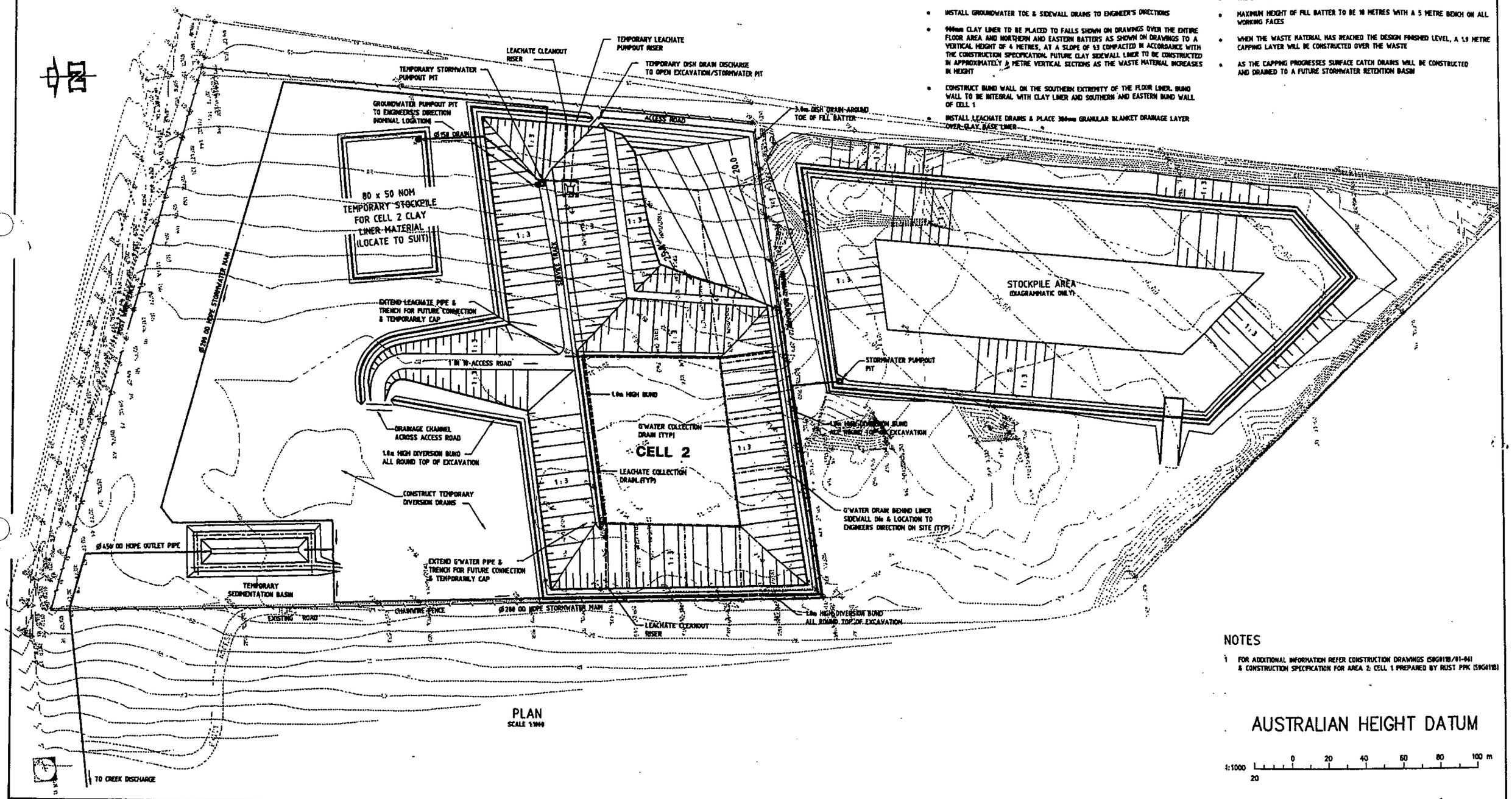
- CLEAR SITE IN CONSTRUCTION AREA FOR CELL 2
- CONSTRUCT DIVERSION BUND AROUND CELL 2 TO PREVENT ANY INGRESS OF SURFACE WATER RUN OFF FROM THE SURROUNDING GROUND

CONSTRUCTION OF CELL 2

- CELL 2 TO BE EXCAVATED TO THE EXTENT AS SHOWN ON THE DRAWINGS. EXCAVATED MATERIAL APPROX 164000m³
- EXCAVATE CHANNELS FOR LEACHATE DRAINS
- INSTALL GROUNDWATER TOE & SIDEWALL DRAINS TO ENGINEER'S DIRECTIONS
- 900mm CLAY LINER TO BE PLACED TO FALLS SHOWN ON DRAWINGS OVER THE ENTIRE FLOOR AREA AND NORTHERN AND EASTERN BATTERS AS SHOWN ON DRAWINGS TO A VERTICAL HEIGHT OF 4 METRES, AT A SLOPE OF 1:3 COMPACTED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION. FUTURE CLAY SIDEWALL LINER TO BE CONSTRUCTED IN APPROXIMATELY 4 METRE VERTICAL SECTIONS AS THE WASTE MATERIAL INCREASES IN HEIGHT
- CONSTRUCT BUND WALL ON THE SOUTHERN EXTREMITY OF THE FLOOR LINER. BUND WALL TO BE INTEGRAL WITH CLAY LINER AND SOUTHERN AND EASTERN BUND WALL OF CELL 1
- INSTALL LEACHATE DRAINS & PLACE 300mm GRANULAR BLANKET DRAINAGE LAYER OVER CLAY BASE LINER

WASTE MATERIAL FILLING OPERATION

- THE APPROXIMATE QUANTITY OF WASTE MATERIAL STORAGE IN CELL 2 IS 98000m³
- INITIALLY SPREAD WASTE MATERIAL OVER THE ENTIRE FLOOR AREA COMPACTED TO A DEPTH OF 1 METRE
- WASTE MATERIAL FILLING WILL THEN BE PLACED ALONG THE NORTHERN SIDE OF CELL 2, COMPACTED IN LAYERS NOT EXCEEDING 1.0 METRES
- A COMPACTED CLAY LAYER WILL BE USED FOR DAY AND INTERMEDIATE COVER
- THE BATTER OF THE FILL MATERIAL WILL BE 1:3
- MAXIMUM HEIGHT OF FILL BATTER TO BE 10 METRES WITH A 5 METRE BENCH ON ALL WORKING FACES
- WHEN THE WASTE MATERIAL HAS REACHED THE DESIGN FINISHED LEVEL, A 1.9 METRE CAPPING LAYER WILL BE CONSTRUCTED OVER THE WASTE
- AS THE CAPPING PROGRESSES SURFACE CATCH DRAINS WILL BE CONSTRUCTED AND DRAINED TO A FUTURE STORMWATER RETENTION BASIN



PLAN
SCALE 1:1000

NOTES

1 FOR ADDITIONAL INFORMATION REFER CONSTRUCTION DRAWINGS (58G011B/01-06) & CONSTRUCTION SPECIFICATION FOR AREA 2: CELL 1 PREPARED BY RUST PPK (58G011B)

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m
20

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.972m AHD

COORDINATES (ISG) 278 621.913 E
1 276 962.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID, 'SURVEY' ON LID STAINLESS STEEL PIN INSIDE. (PM No STAMPED ON INSIDE OF LID)

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G011M4
Drawn: GCS	Document No: 58G011B.M4 REV A
Drawing Check: GC	Scale: AS SHOWN

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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
SEQUENCE OF OPERATION
CELL 2

Project No	
58G011B	
Drawing No	Revision
M4	A

SEQUENCE OF OPERATION

INITIAL EARTHWORKS FOR CELL 3

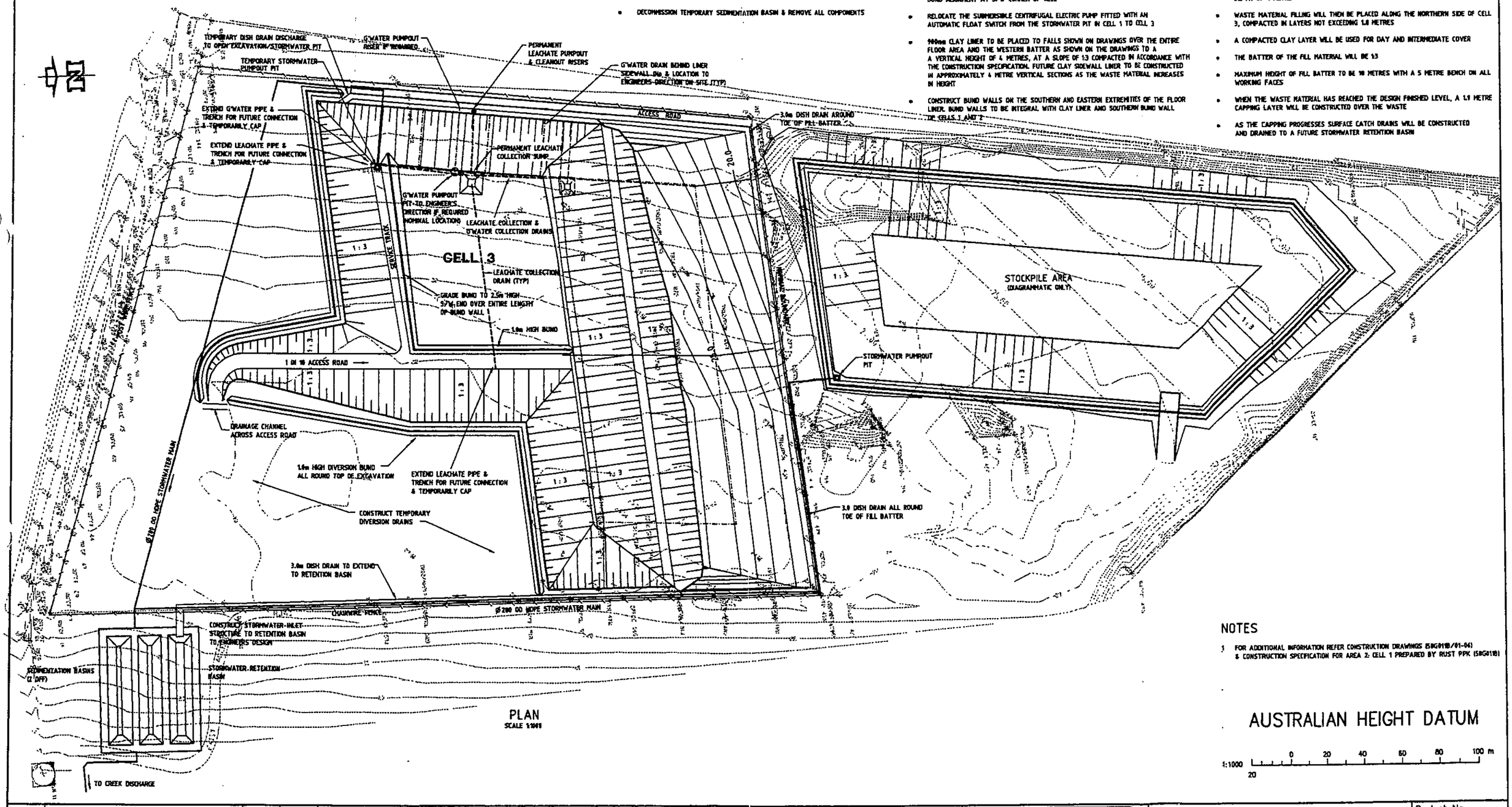
- CLEAR SITE IN CONSTRUCTION AREA FOR CELL 3
- CONSTRUCT DIVERSION BUND AROUND CELL 3 TO PREVENT ANY INGRESS OF WATER RUN OFF FROM THE SURROUNDING GROUND
- CONSTRUCT TWO NEW PERMANENT SEDIMENTATION BASINS COMPLETE WITH ALL STRUCTURES & CHEMICAL DOSING STATION & A STORMWATER RETENTION BASIN COMPLETE WITH INLET STRUCTURE & PUMPOUT STRUCTURE TO ENGINEERS DETAILS AT A LOCATION TO BE DETERMINED ON SITE
- INSTALL ALL ADDITIONAL PIPEWORK & CONNECT TO NEW SEDIMENTATION BASINS
- DECOMMISSION TEMPORARY SEDIMENTATION BASIN & REMOVE ALL COMPONENTS

CONSTRUCTION OF CELL 3

- CELL 3 TO BE EXCAVATED TO THE EXTENT AS SHOWN ON THE DRAWINGS. EXCAVATED MATERIAL APPROX 117900m³
- CONSTRUCT ACCESS ROAD TO FLOOR OF CELL 3 AT A GRADIENT OF 10%. THIS ROAD WILL ALSO PROVIDE ACCESS TO CELL 4
- EXCAVATE CHANNELS FOR LEACHATE DRAINS & SUMP
- INSTALL GROUNDWATER TOE & SIDEWALL DRAINS TO ENGINEER'S DIRECTIONS
- CONSTRUCT NEW TEMPORARY STORMWATER DRAINAGE PUMP OUT PIT OUTSIDE BUND ALIGNMENT AT S/W CORNER OF CELL
- RELOCATE THE SUBMERSIBLE CENTRIFUGAL ELECTRIC PUMP FITTED WITH AN AUTOMATIC FLOAT SWITCH FROM THE STORMWATER PIT IN CELL 1 TO CELL 3
- 900mm CLAY LINER TO BE PLACED TO FALLS SHOWN ON DRAWINGS OVER THE ENTIRE FLOOR AREA AND THE WESTERN BATTER AS SHOWN ON THE DRAWINGS TO A A VERTICAL HEIGHT OF 4 METRES, AT A SLOPE OF 1:3 COMPACTED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION. FUTURE CLAY SIDEWALL LINER TO BE CONSTRUCTED IN APPROXIMATELY 4 METRE VERTICAL SECTIONS AS THE WASTE MATERIAL INCREASES IN HEIGHT
- CONSTRUCT BUND WALLS ON THE SOUTHERN AND EASTERN EXTREMITIES OF THE FLOOR LINER. BUND WALLS TO BE INTEGRAL WITH CLAY LINER AND SOUTHERN BUND WALL OF CELLS 1 AND 2
- CONSTRUCT THE PERMANENT LEACHATE COLLECTION SUMP WITH PUMP OUT RISER AND CONNECT THE TEMPORARY SUMP IN CELL 1 WITH A LEACHATE DRAIN
- INSTALL LEACHATE DRAINS & PLACE 300mm GRANULAR BLANKET DRAINAGE LAYER OVER CLAY BASE LINER

WASTE MATERIAL FILLING OPERATION

- THE APPROXIMATE QUANTITY OF WASTE MATERIAL STORAGE IN CELL 3 IS 170600m³
- INITIALLY SPREAD WASTE MATERIAL OVER THE ENTIRE FLOOR AREA COMPACTED TO A DEPTH OF 1 METRE
- WASTE MATERIAL FILLING WILL THEN BE PLACED ALONG THE NORTHERN SIDE OF CELL 3, COMPACTED IN LAYERS NOT EXCEEDING 1.8 METRES
- A COMPACTED CLAY LAYER WILL BE USED FOR DAY AND INTERMEDIATE COVER
- THE BATTER OF THE FILL MATERIAL WILL BE 1:3
- MAXIMUM HEIGHT OF FILL BATTER TO BE 18 METRES WITH A 5 METRE BENCH ON ALL WORKING FACES
- WHEN THE WASTE MATERIAL HAS REACHED THE DESIGN FINISHED LEVEL, A 1.9 METRE CAPPING LAYER WILL BE CONSTRUCTED OVER THE WASTE
- AS THE CAPPING PROGRESSES SURFACE CATCH DRAINS WILL BE CONSTRUCTED AND DRAINED TO A FUTURE STORMWATER RETENTION BASIN



PLAN
SCALE 1:1000

NOTES

1 FOR ADDITIONAL INFORMATION REFER CONSTRUCTION DRAWINGS (58G011B/01-04) & CONSTRUCTION SPECIFICATION FOR AREA 2: CELL 1 PREPARED BY RUST PPK (58G011B)

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m
20

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.92m AHD

COORDINATES (ISG) 278 621.993 E
1 276 962.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID. "SURVEY" ON LID STAINLESS STEEL PIN INSIDE, (PM No STAMPED ON INSIDE OF LID)

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G011M5
Drawn: GCS	Document No: 58G011B.M5 REV A
Drawing Check: GC	Scale: AS SHOWN

RUST PPK
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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
SEQUENCE OF OPERATION
CELL 3

Project No	
58G011B	
Drawing No	Revision
M5	A

SEQUENCE OF OPERATION

INITIAL EARTHWORKS FOR CELL 4

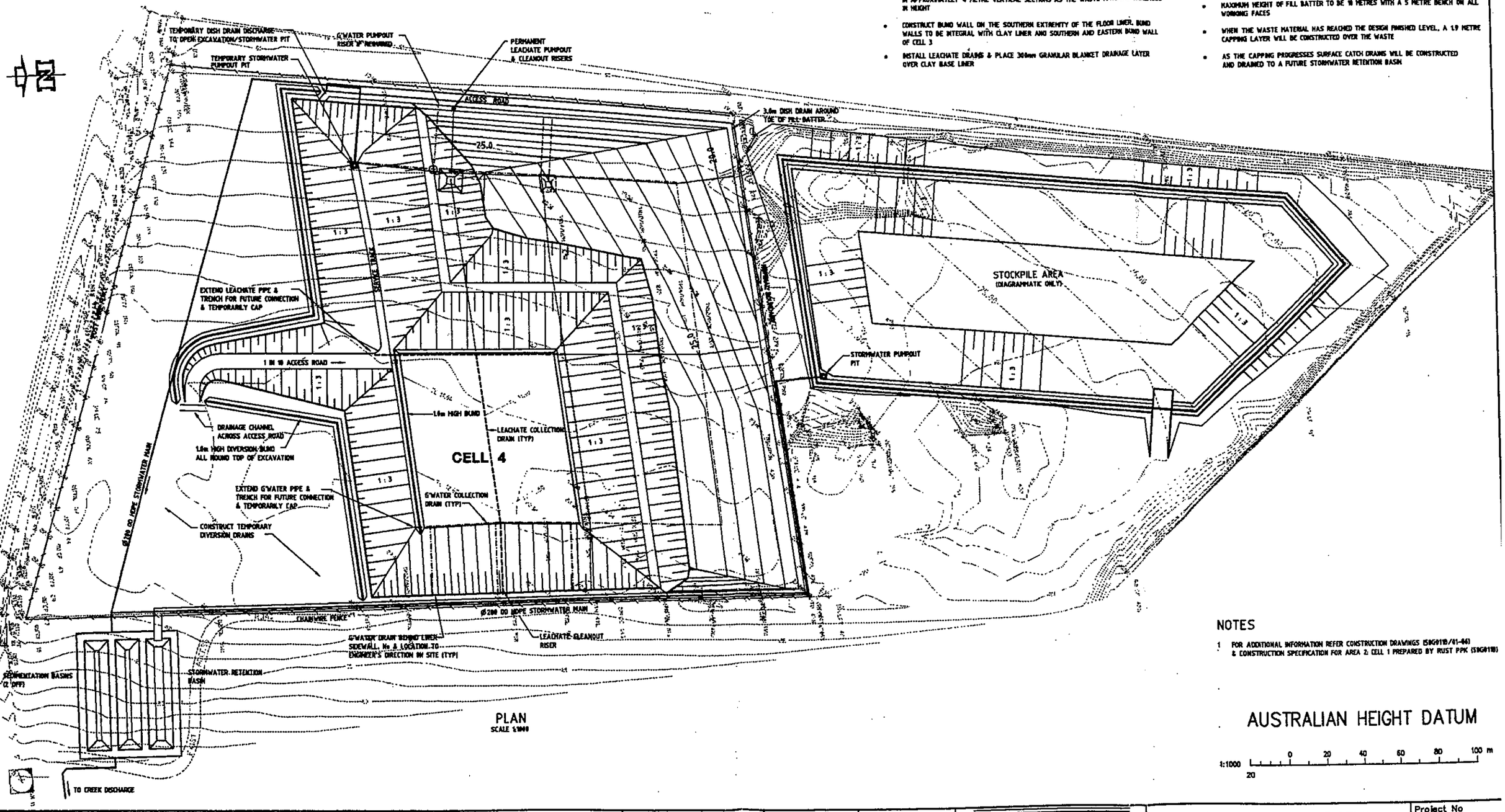
- CLEAR SITE IN CONSTRUCTION AREA FOR CELL 4
- CONSTRUCT DIVERSION BUND AROUND CELL 4 TO PREVENT ANY INGRESS OF SURFACE WATER RUN OFF FROM THE SURROUNDING GROUND

CONSTRUCTION OF CELL 4

- CELL 4 TO BE EXCAVATED TO THE EXTENT AS SHOWN ON THE DRAWINGS. EXCAVATED MATERIAL APPROX 100900m³
- EXCAVATE CHANNELS FOR LEACHATE DRAINS
- INSTALL GROUNDWATER TOE & SIDEWALL DRAINS TO ENGINEER'S DIRECTIONS
- 900mm CLAY LINER TO BE PLACED TO FALLS SHOWN ON DRAWINGS OVER THE ENTIRE FLOOR AREA AND THE EASTERN BATTER AS SHOWN ON DRAWINGS TO A VERTICAL HEIGHT OF 4 METRES, AT A SLOPE OF 1:3 COMPACTED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION. FUTURE CLAY SIDEWALL LINER TO BE CONSTRUCTED IN APPROXIMATELY 4 METRE VERTICAL SECTIONS AS THE WASTE MATERIAL INCREASES IN HEIGHT
- CONSTRUCT BUND WALL ON THE SOUTHERN EXTREMITY OF THE FLOOR LINER. BUND WALLS TO BE INTEGRAL WITH CLAY LINER AND SOUTHERN AND EASTERN BUND WALL OF CELL 3
- INSTALL LEACHATE DRAINS & PLACE 300mm GRANULAR BLANKET DRAINAGE LAYER OVER CLAY BASE LINER

WASTE MATERIAL FILLING OPERATION

- THE APPROXIMATE QUANTITY OF WASTE MATERIAL STORAGE IN CELL 4 IS 172000m³
- INITIALLY SPREAD WASTE MATERIAL OVER THE ENTIRE FLOOR AREA COMPACTED TO A DEPTH OF 1 METRE
- WASTE MATERIAL FILLING WILL THEN BE PLACED ALONG THE NORTHERN SIDE OF CELL 4, COMPACTED IN LAYERS NOT EXCEEDING 1.8 METRES
- A COMPACTED CLAY LAYER WILL BE USED FOR DAY AND INTERMEDIATE COVER
- THE BATTER OF THE FILL MATERIAL WILL BE 1:3
- MAXIMUM HEIGHT OF FILL BATTER TO BE 18 METRES WITH A 5 METRE BENCH ON ALL WORKING FACES
- WHEN THE WASTE MATERIAL HAS REACHED THE DESIGN FINISHED LEVEL, A 1.9 METRE CAPPING LAYER WILL BE CONSTRUCTED OVER THE WASTE
- AS THE CAPPING PROGRESSES SURFACE CATCH DRAINS WILL BE CONSTRUCTED AND DRAINED TO A FUTURE STORMWATER RETENTION BASIN



PLAN
SCALE 1:1000

NOTES

1 FOR ADDITIONAL INFORMATION REFER CONSTRUCTION DRAWINGS (58G011B/61-66) & CONSTRUCTION SPECIFICATION FOR AREA 2: CELL 1 PREPARED BY RUST PPK (58G011B)

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m
20

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.92m AHD

COORDINATES (ISG) 278 621.993 E
1 276 962.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID. 'SURVEY' ON LID STAINLESS STEEL PIN INSIDE, (PM No STAMPED ON INSIDE OF LID)

Designed	QC
Design Check	JMcN
Drawn	GCS
Drawing Check	GC
Project Approval	RC
Cad Reference	58G011M6
Document No	58G011A.M6 REV A
Scale	AS SHOWN

RUST PPK
Environment & Infrastructure
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Rhodes 2138 New South Wales Australia
Telephone (02) 743 0333 Fax (02) 736 1986

SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
SEQUENCE OF OPERATION
CELL 4

Project No	
58G011B	
Drawing No	Revisio
M6	A

SEQUENCE OF OPERATION

INITIAL EARTHWORKS FOR CELL 5

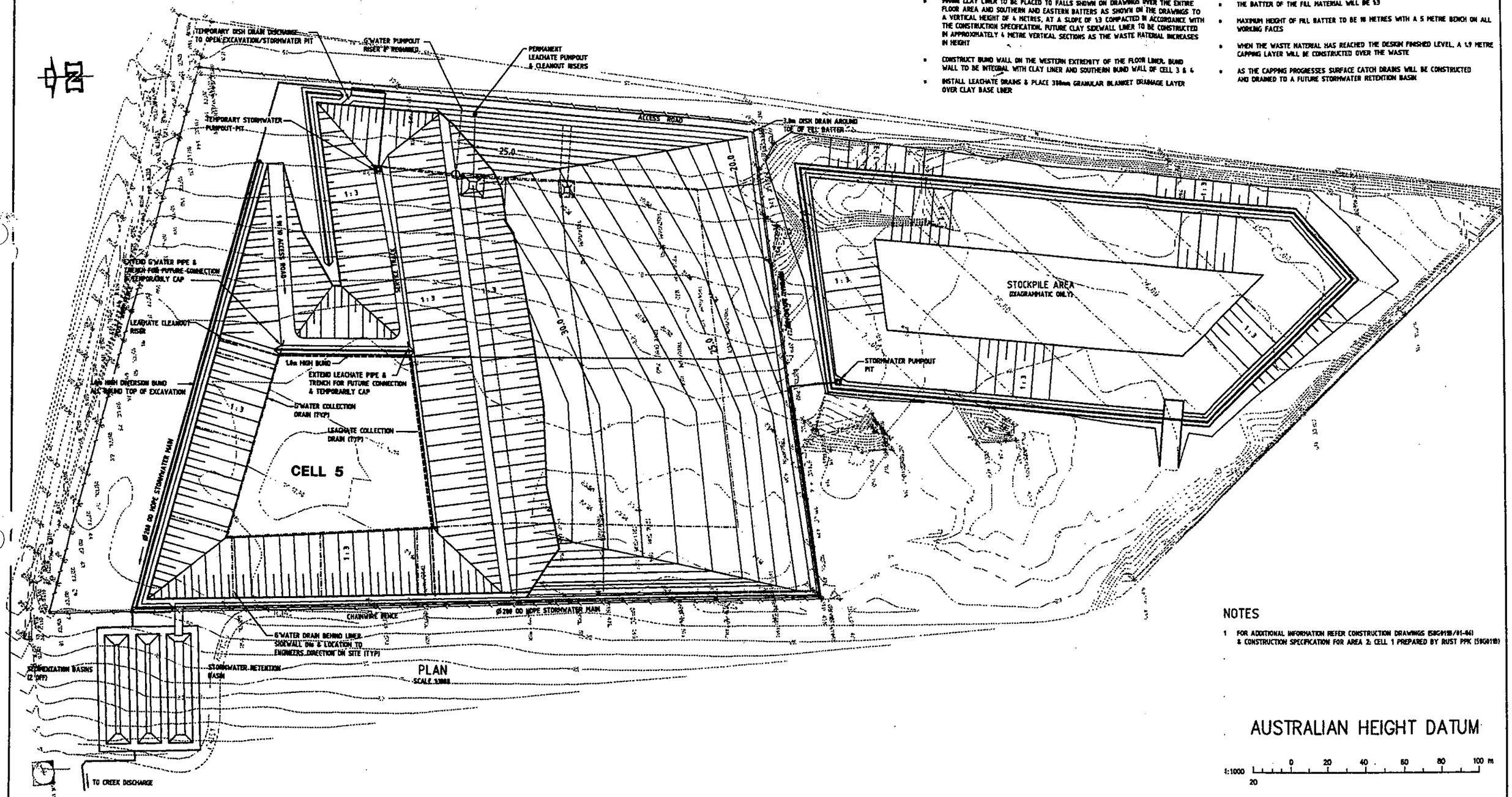
- CLEAR SITE IN CONSTRUCTION AREA FOR CELL 5
- CONSTRUCT DIVERSION BUND AROUND CELL 5 TO PREVENT ANY INGRESS OF SURFACE WATER RUN OFF FROM THE SURROUNDING GROUND

CONSTRUCTION OF CELL 5

- CELL 5 TO BE EXCAVATED TO THE EXTENT AS SHOWN ON THE DRAWINGS. EXCAVATED MATERIAL APPROX 153966m³
- CONSTRUCT ACCESS ROAD TO FLOOR OF CELL 5 AT A GRADIENT OF 19%
- EXCAVATE CHANNELS FOR LEACHATE DRAINS
- INSTALL GROUNDWATER TOE & SIDEWALL DRAINS TO ENGINEER'S DIRECTIONS
- 900mm CLAY LINER TO BE PLACED TO FALLS SHOWN ON DRAWINGS OVER THE ENTIRE FLOOR AREA AND SOUTHERN AND EASTERN BATTERS AS SHOWN ON THE DRAWINGS TO A VERTICAL HEIGHT OF 4 METRES, AT A SLOPE OF 1:3 COMPACTED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION. FUTURE CLAY SIDEWALL LINER TO BE CONSTRUCTED IN APPROXIMATELY 4 METRE VERTICAL SECTIONS AS THE WASTE MATERIAL INCREASES IN HEIGHT
- CONSTRUCT BUND WALL ON THE WESTERN EXTREMITY OF THE FLOOR LINER. BUND WALL TO BE INTEGRAL WITH CLAY LINER AND SOUTHERN BUND WALL OF CELL 3 & 4
- INSTALL LEACHATE DRAINS & PLACE 300mm GRANULAR BLANKET DRAINAGE LAYER OVER CLAY BASE LINER

WASTE MATERIAL FILLING OPERATION

- THE APPROXIMATE QUANTITY OF WASTE MATERIAL STORAGE IN CELL 5 IS 155400m³
- INITIALLY SPREAD WASTE MATERIAL OVER THE ENTIRE FLOOR AREA COMPACTED TO A DEPTH OF 1 METRE
- WASTE MATERIAL FILLING WILL THEN BE PLACED ALONG THE SOUTHERN SIDE OF CELL 5, COMPACTED IN LAYERS NOT EXCEEDING 1.8 METRES
- A COMPACTED CLAY LAYER WILL BE USED FOR DAY AND INTERMEDIATE COVER
- THE BATTER OF THE FILL MATERIAL WILL BE 1:3
- MAXIMUM HEIGHT OF FILL BATTER TO BE 18 METRES WITH A 5 METRE BENCH ON ALL WORKING FACES
- WHEN THE WASTE MATERIAL HAS REACHED THE DESIGN FINISHED LEVEL, A 1.9 METRE CAPPING LAYER WILL BE CONSTRUCTED OVER THE WASTE
- AS THE CAPPING PROGRESSES SURFACE CATCH DRAINS WILL BE CONSTRUCTED AND DRAINED TO A FUTURE STORMWATER RETENTION BASIN



PLAN
SCALE 1:1000

NOTES

1 FOR ADDITIONAL INFORMATION REFER CONSTRUCTION DRAWINGS (58G011B/01-06) & CONSTRUCTION SPECIFICATION FOR AREA 2: CELL 1 PREPARED BY RUST PPK (58G011B)

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m
20

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.92m AHD

COORDINATES (ISG) 278 621.983 E
1 276 942.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID. 'SURVEY' ON LID STAINLESS STEEL PIN INSIDE, (PM No STAMPED ON INSIDE OF LID)

Designed: CC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G011M7
Drawn: GCS	Document No: 58G011A.M7 REV A
Drawing Check: CC	Scale: AS SHOWN

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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
SEQUENCE OF OPERATION
CELL 5

Project No	
58G011B	
Drawing No	Revision
M7	A

SEQUENCE OF OPERATION

INITIAL EARTHWORKS FOR CELL 6

- CLEAR SITE IN CONSTRUCTION AREA FOR CELL 6
- CONSTRUCT DISH DRAIN AROUND CELL 6 TO PREVENT ANY INGRESS OF SURFACE WATER RUN OFF FROM THE SURROUNDING GROUND

CONSTRUCTION OF CELL 6

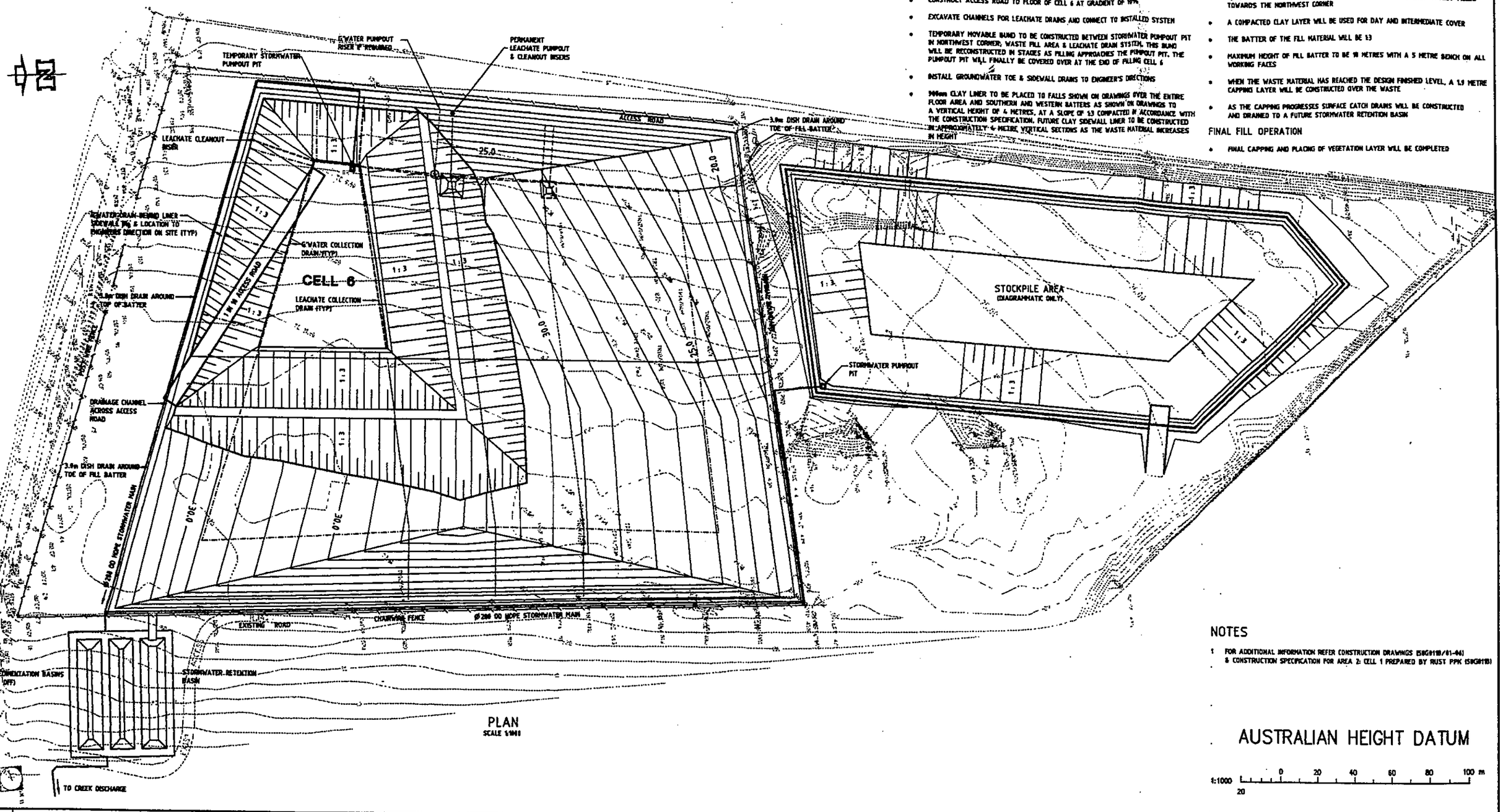
- CELL 6 TO BE EXCAVATED TO THE EXTENT AS SHOWN ON THE DRAWINGS. EXCAVATED MATERIAL APPROX 41440m³
- CONSTRUCT ACCESS ROAD TO FLOOR OF CELL 6 AT GRADIENT OF 16%
- EXCAVATE CHANNELS FOR LEACHATE DRAINS AND CONNECT TO INSTALLED SYSTEM
- TEMPORARY MOVABLE BUND TO BE CONSTRUCTED BETWEEN STORMWATER PUMPOUT PIT IN NORTHWEST CORNER; WASTE FILL AREA & LEACHATE DRAIN SYSTEM. THIS BUND WILL BE RECONSTRUCTED IN STAGES AS FILLING APPROACHES THE PUMPOUT PIT. THE PUMPOUT PIT WILL FINALLY BE COVERED OVER AT THE END OF FILLING CELL 6
- INSTALL GROUNDWATER TOE & SIDEWALL DRAINS TO ENGINEER'S DIRECTIONS
- 900mm CLAY LINER TO BE PLACED TO FALLS SHOWN ON DRAWINGS OVER THE ENTIRE FLOOR AREA AND SOUTHERN AND WESTERN BATTERS AS SHOWN ON DRAWINGS TO A VERTICAL HEIGHT OF 4 METRES, AT A SLOPE OF 1:3 COMPACTED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION. FUTURE CLAY SIDEWALL LINER TO BE CONSTRUCTED IN APPROXIMATELY 4 METRE VERTICAL SECTIONS AS THE WASTE MATERIAL INCREASES IN HEIGHT
- INSTALL LEACHATE DRAINS & PLACE 300mm GRANULAR BLANKET DRAINAGE LAYER OVER CLAY BASE LINER

WASTE MATERIAL FILLING OPERATION

- THE APPROXIMATE QUANTITY OF WASTE MATERIAL STORAGE IN CELL 6 IS 163000m³
- INITIALLY SPREAD WASTE MATERIAL OVER THE ENTIRE FLOOR AREA COMPACTED TO A DEPTH OF 1 METRE
- WASTE MATERIAL FILLING WILL THEN BE PLACED ALONG THE EASTERN SIDE OF CELL 6, COMPACTED IN LAYERS NOT EXCEEDING 1.8 METRES AND PROGRESSIVELY FILLED TOWARDS THE NORTHWEST CORNER
- A COMPACTED CLAY LAYER WILL BE USED FOR DAY AND INTERMEDIATE COVER
- THE BATTER OF THE FILL MATERIAL WILL BE 1:3
- MAXIMUM HEIGHT OF FILL BATTER TO BE 18 METRES WITH A 5 METRE BENCH ON ALL WORKING FACES
- WHEN THE WASTE MATERIAL HAS REACHED THE DESIGN FINISHED LEVEL, A 1.9 METRE CAPPING LAYER WILL BE CONSTRUCTED OVER THE WASTE
- AS THE CAPPING PROGRESSES SURFACE CATCH DRAINS WILL BE CONSTRUCTED AND DRAINED TO A FUTURE STORMWATER RETENTION BASIN

FINAL FILL OPERATION

- FINAL CAPPING AND PLACING OF VEGETATION LAYER WILL BE COMPLETED



PLAN
SCALE 1:1000

NOTES

1. FOR ADDITIONAL INFORMATION REFER CONSTRUCTION DRAWINGS (58G011B/01-06) & CONSTRUCTION SPECIFICATION FOR AREA 2: CELL 1 PREPARED BY RUST PPK (58G011B)

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

SURVEY DATUM

PM 68117 RL 18.92m AHD

COORDINATES (GG) 278 621.963 E
1 276 942.311 N

DESCRIPTION PERMANENT MARK, CAST BOX WITH LID. "SURVEY" ON LID STAINLESS STEEL PIN INSIDE, (PM No STAMPED ON INSIDE OF LID)

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G011MB
Drawn: GCS	Document No: 58G011LMB REV A
Drawing Check: GC	Scale: AS SHOWN

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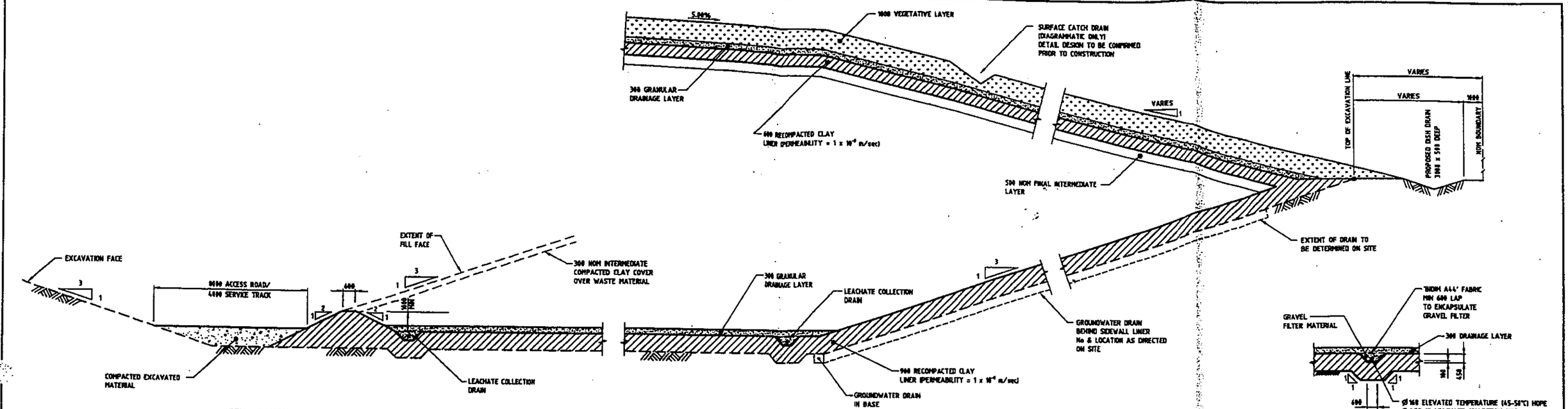
SOUTH WINDSOR WASTE DEPOT

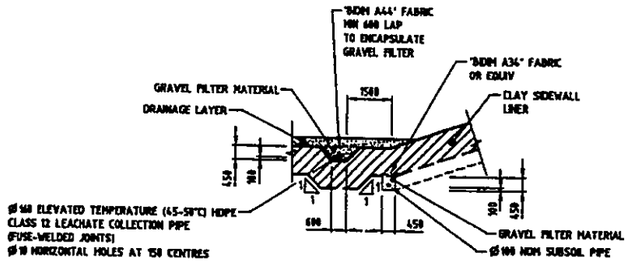
MASTER PLAN – AREA 2

SEQUENCE OF OPERATION
CELL 6

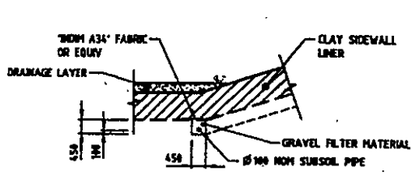
Project No	
58G011B	
Drawing No	Revision
M8	A



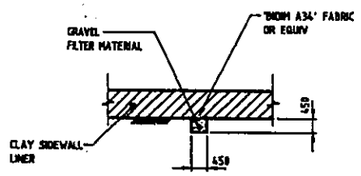
TYPICAL CROSS SECTION THROUGH CELL
SCALE 1:100



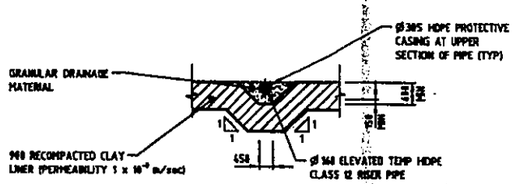
LEACHATE PIPE TRENCH & GROUNDWATER TOE DRAIN AT BATTER
SCALE 1:100



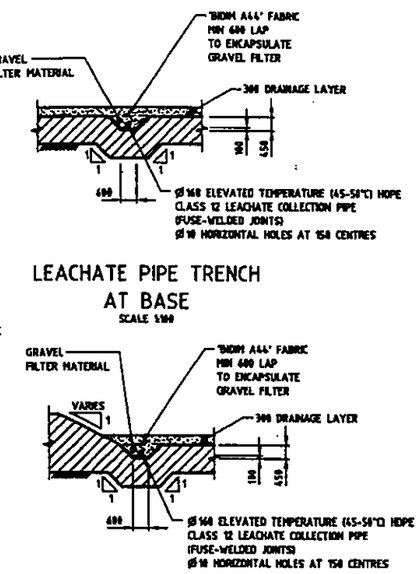
GROUNDWATER TOE DRAIN
SCALE 1:100



GROUNDWATER DRAIN BEHIND SIDEWALL LINER
SCALE 1:100



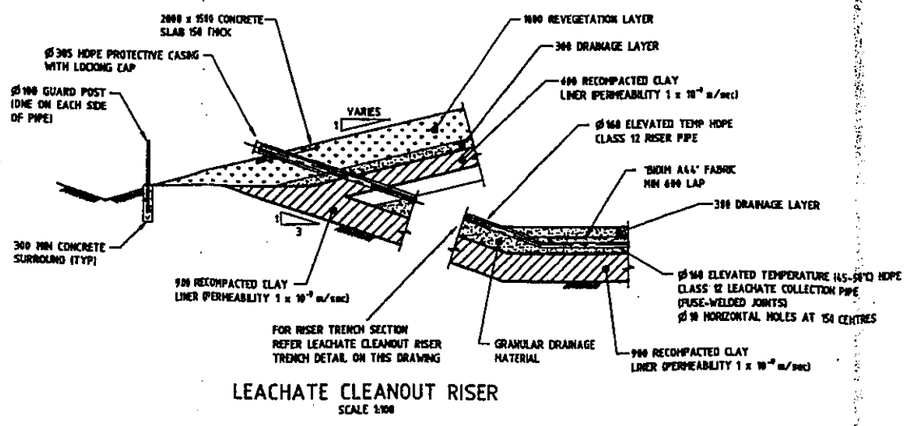
LEACHATE CLEANOUT RISER TRENCH
SCALE 1:100



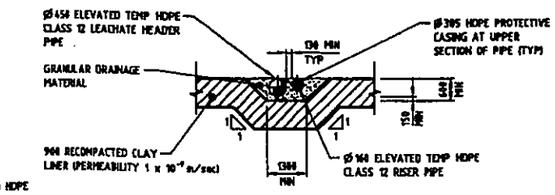
LEACHATE PIPE TRENCH AT BASE
SCALE 1:100

PERMANENT LEACHATE COLLECTION SUMP & RISER DETAIL
SCALE 1:100

NOTE
FOR TEMPORARY SUMP DETAIL
REFER CONSTRUCTION DRAWINGS FOR CELL 1
(DRG No 58G011B/04)



LEACHATE CLEANOUT RISER
SCALE 1:100



LEACHATE PIPE TRENCH AT BATTER
SCALE 1:100

SUMP RISER TRENCH
SCALE 1:100

1:100 0 1 2 4 6 8 10 m

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G011M9
Drawn: JSC	Document No: 58G011B.DM9 REV A
Drawing Check: GC	Scale: AS SHOWN

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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2

TYPICAL CONSTRUCTION DETAILS

Project No	
58G011B	
Drawing No	Revision
M9	A

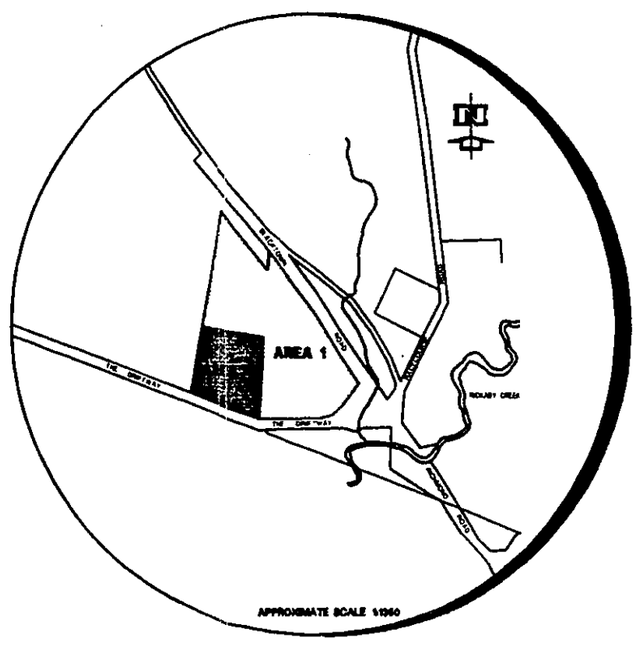
SOUTH WINDSOR WASTE DEPOT

MASTER PLAN - AREA 2

JULY 1995

REGIONAL MAP

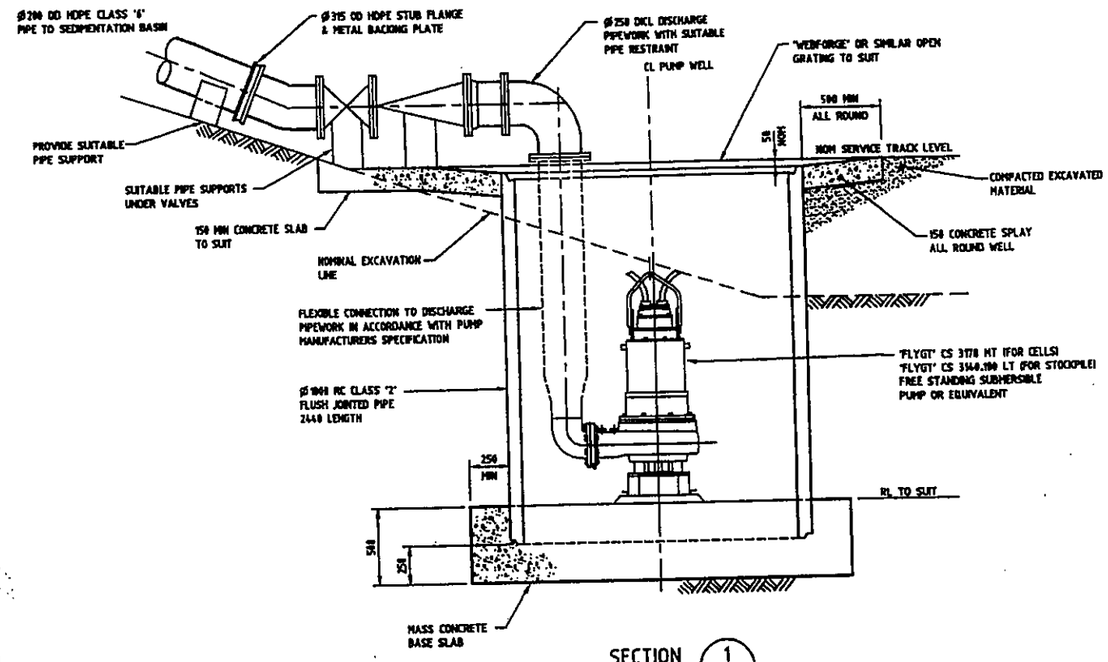
LOCAL MAP



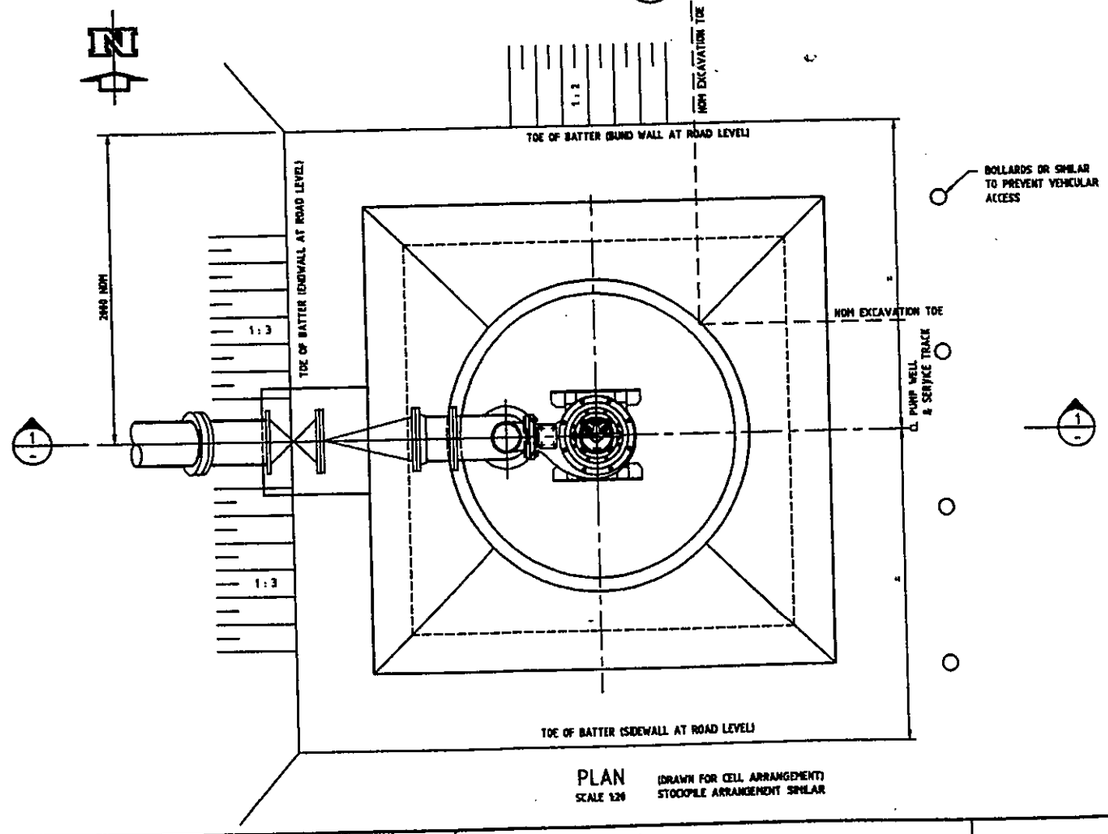
DRAWING INDEX

RUST PPK

Environment & Infrastructure



SECTION 1/- SCALE 1:20



PLAN (DRAWN FOR CELL ARRANGEMENT) STOCKPILE ARRANGEMENT SIMILAR
SCALE 1:20

NOTE

1 ALL CONCRETE TO BE 'PORTLAND' CEMENT CONCRETE WITH MINIMUM COMPRESSIVE STRENGTH OF 25 MPa (28 DAYS)

AUSTRALIAN HEIGHT DATUM

1:20 0 400 800 1200 1600 2000mm
400

Amendment	Description	Date	Approved
A	ISSUED FOR CONSTRUCTION	11/07/95	

Designed: CC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G11M10
Drawn: GCS	Document No: 58G011B.D10 REV A
Drawing Check: CC	Scale: AS SHOWN

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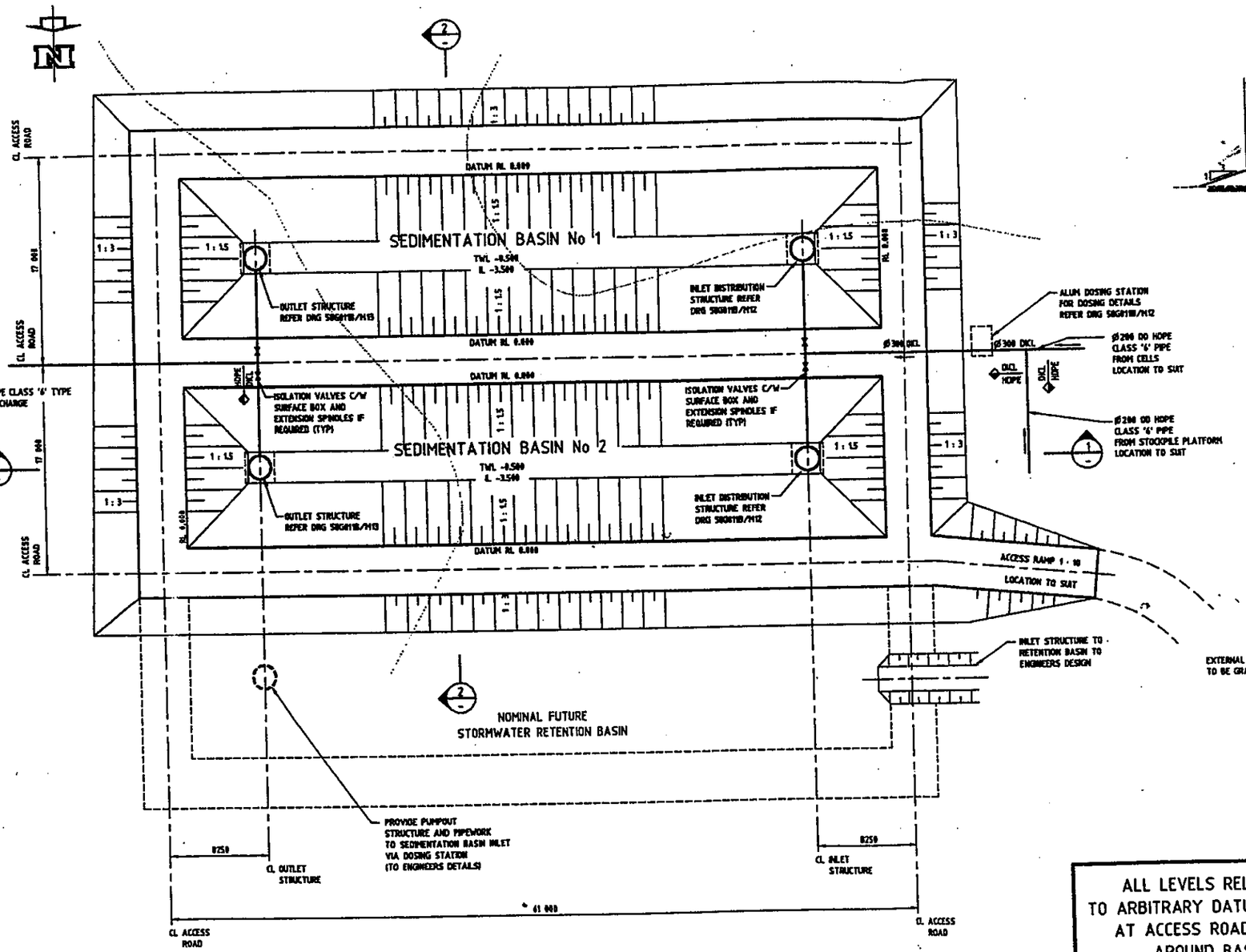
SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2

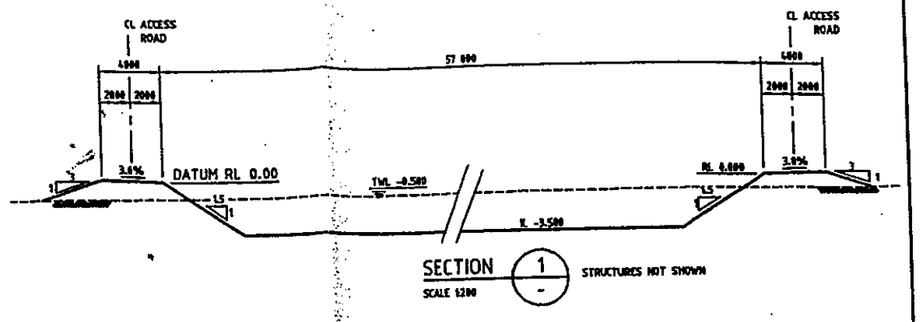
STORMWATER PUMPOUT PIT DETAILS

Project No: 58G011E

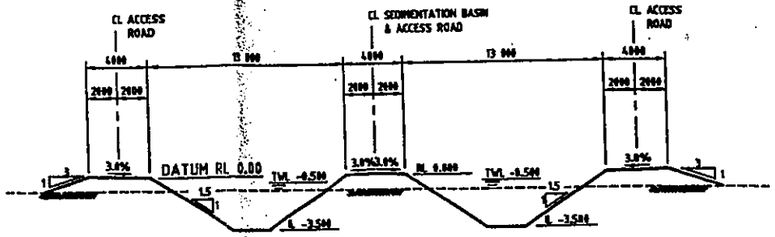
Drawing No: M10 | Revis: A



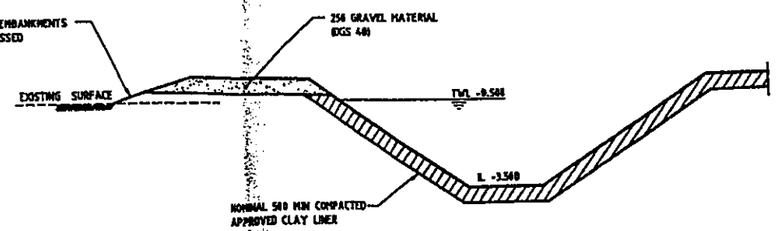
PLAN
SCALE 1:200



SECTION 1
SCALE 1:200
STRUCTURES NOT SHOWN



SECTION 2
SCALE 1:200



TYPICAL TANK LINING DETAILS
SCALE 1:100

ALL LEVELS RELATIVE TO ARBITRARY DATUM RL 0.00 AT ACCESS ROAD LEVEL AROUND BASIN

AUSTRALIAN HEIGHT DATUM

1:100 0 2 4 6 8 10 m

1:200 0 4 8 12 16 20 m

Amendment	Description	Date	Approved
A	ISSUED FOR CONSTRUCTION	11/07/95	

Designed	GC
Design Check	JMcN
Drawn	GCS
Drawing Check	GC
Project Approval	RC
Cad Reference	S8G11M11
Document No	S8G011B.DM11 REV A
Scale	AS SHOWN

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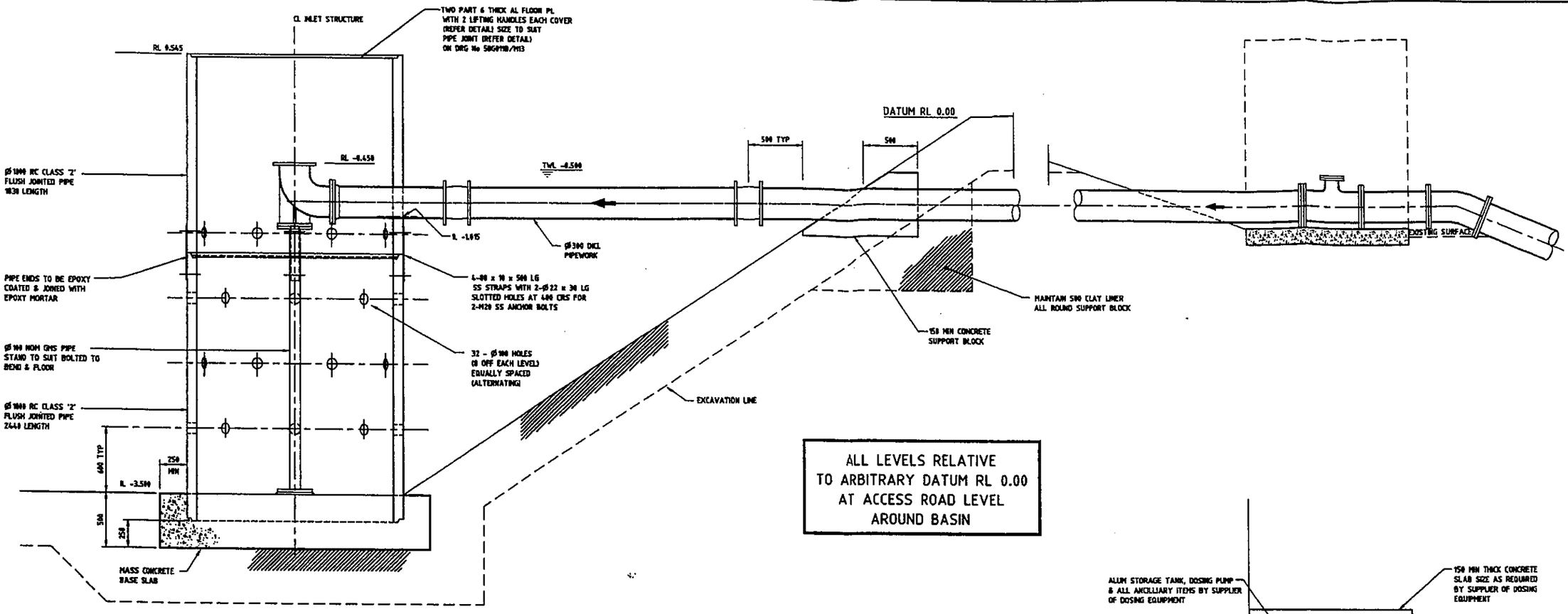
SOUTH WINDSOR WASTE DEPOT

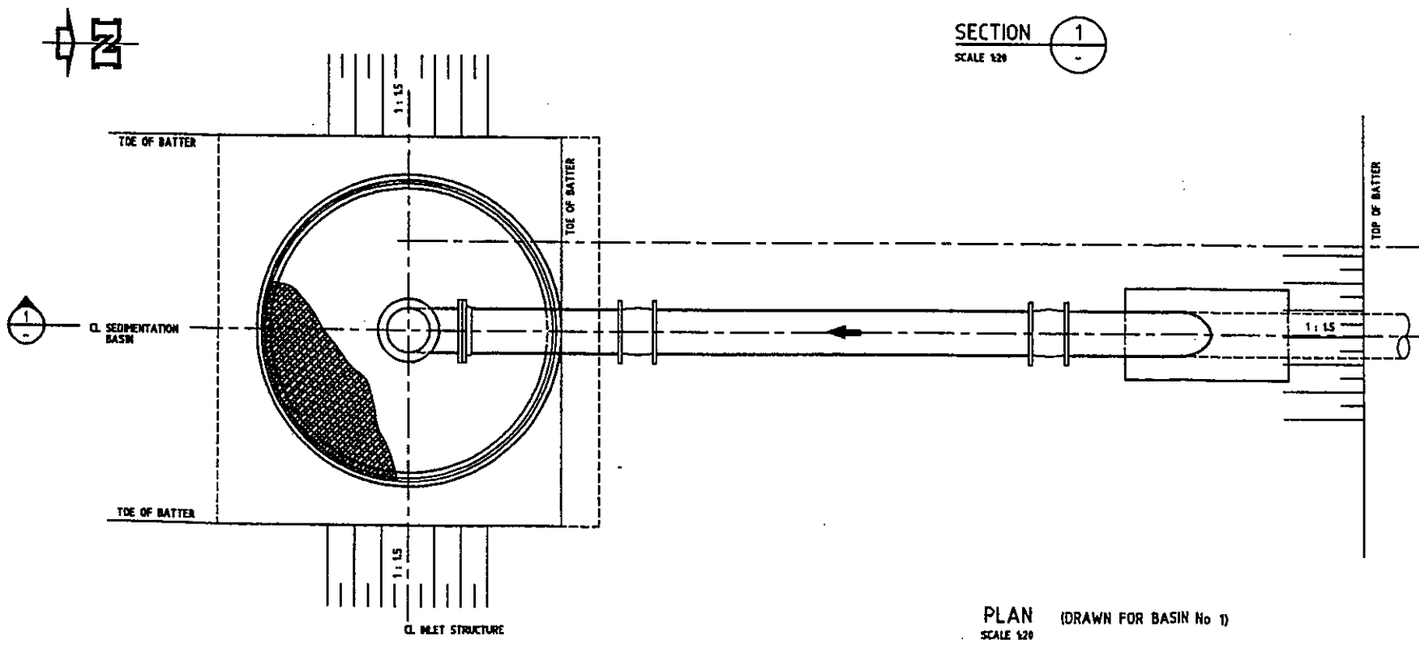
MASTER PLAN – AREA 2
PERMANENT SEDIMENTATION BASINS
GENERAL ARRANGEMENT & SECTIONS

Project No	
58G011B	
Drawing No	Revision
M11	A

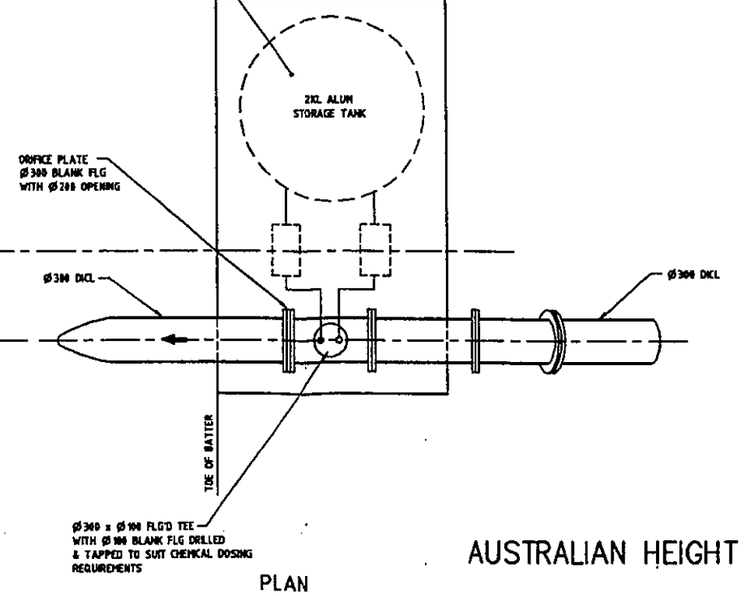


ALL LEVELS RELATIVE TO ARBITRARY DATUM RL 0.00 AT ACCESS ROAD LEVEL AROUND BASIN

SECTION 1
SCALE 1:20



PLAN (DRAWN FOR BASIN No 1)
SCALE 1:20



PLAN
ALUM DOSING STATION
SCALE 1:20

AUSTRALIAN HEIGHT DATUM

1:20 0 400 800 1200 1600 2000mm
400

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

Designed	GC
Design Check	JMcN
Drawn	GCS
Drawing Check	GC
Project Approval	RC
Cad Reference	58G11M12
Document No	58G011B.DM12 REV A
Scale	AS SHOWN

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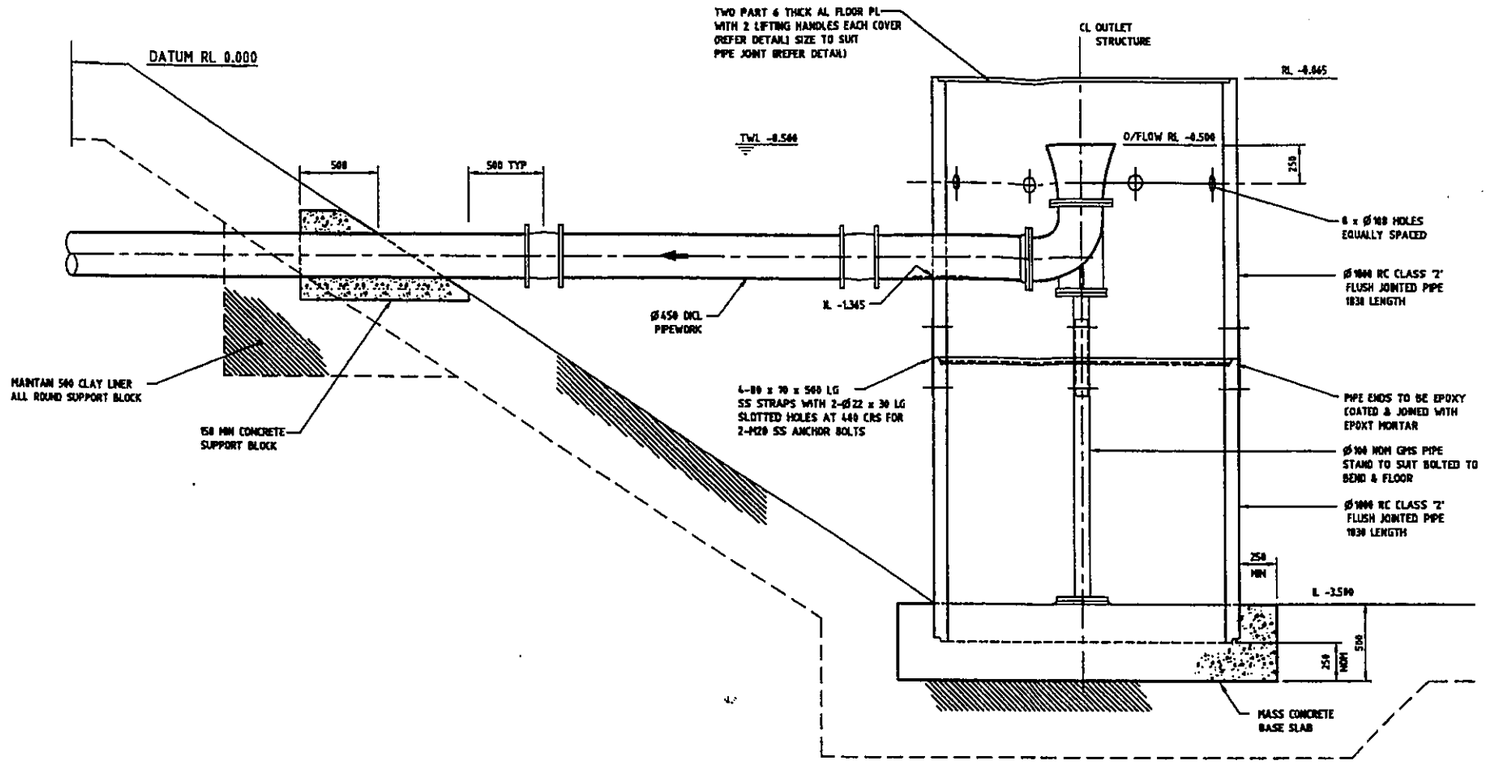
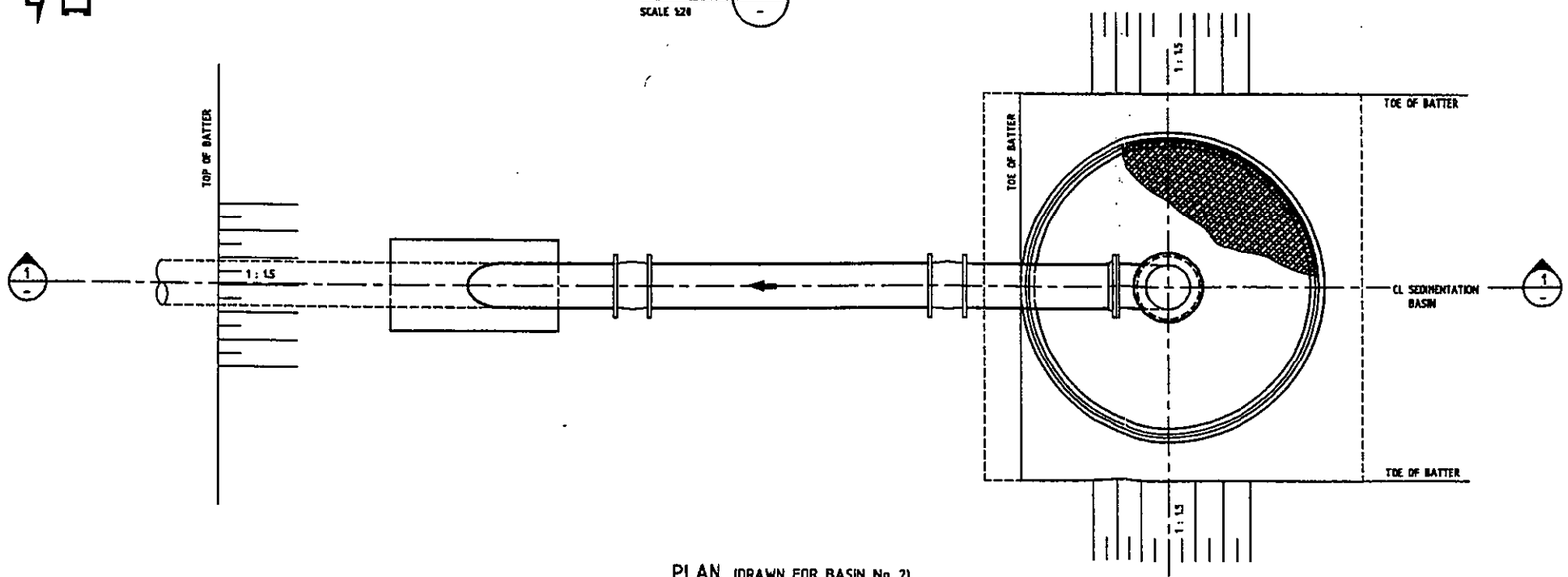
SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
PERMANENT SEDIMENTATION BASINS
INLET STRUCTURE AND DOSING STATION DETAILS

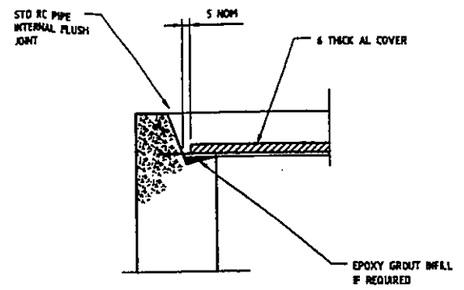
Project No	
58G011B	
Drawing No	Revision
M12	A



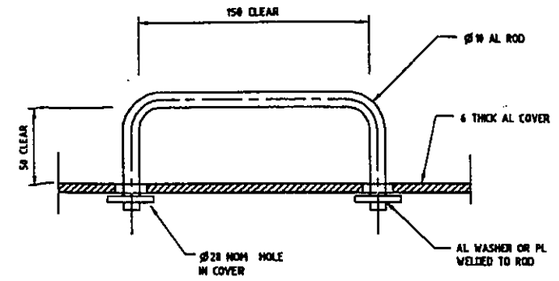
SECTION 1 / - SCALE 1:20



PLAN (DRAWN FOR BASIN No 2) SCALE 1:20



COVER REBATE ARRANGEMENT
SCALE 1:2



LIFTING HANDLE DETAIL
SCALE 1:2

ALL LEVELS RELATIVE TO ARBITRARY DATUM RL 0.00 AT ACCESS ROAD LEVEL AROUND BASIN

AUSTRALIAN HEIGHT DATUM

1:2 0 40 80 120 160 200mm 40

1:20 0 400 800 1200 1600 2000mm 400

Amendment	Description	Date	Approved
A	ISSUED TO CLIENT	21/07/95	

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G11M13
Drawn: GCS	Document No: 58G011B.DM13 REV A
Drawing Check: GC	Scale: AS SHOWN

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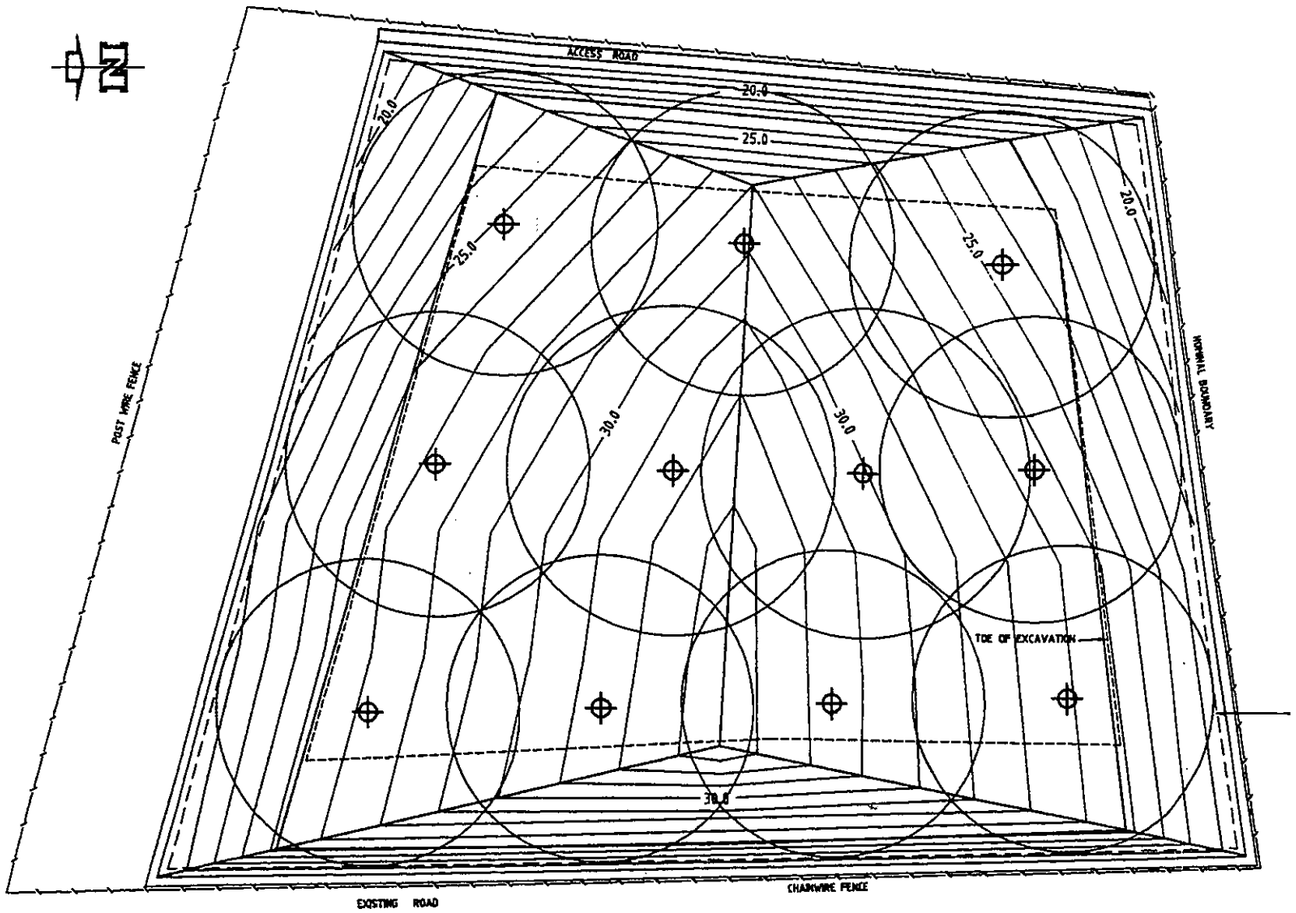
SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2
PERMANENT SEDIMENTATION BASINS
OUTLET STRUCTURE DETAILS

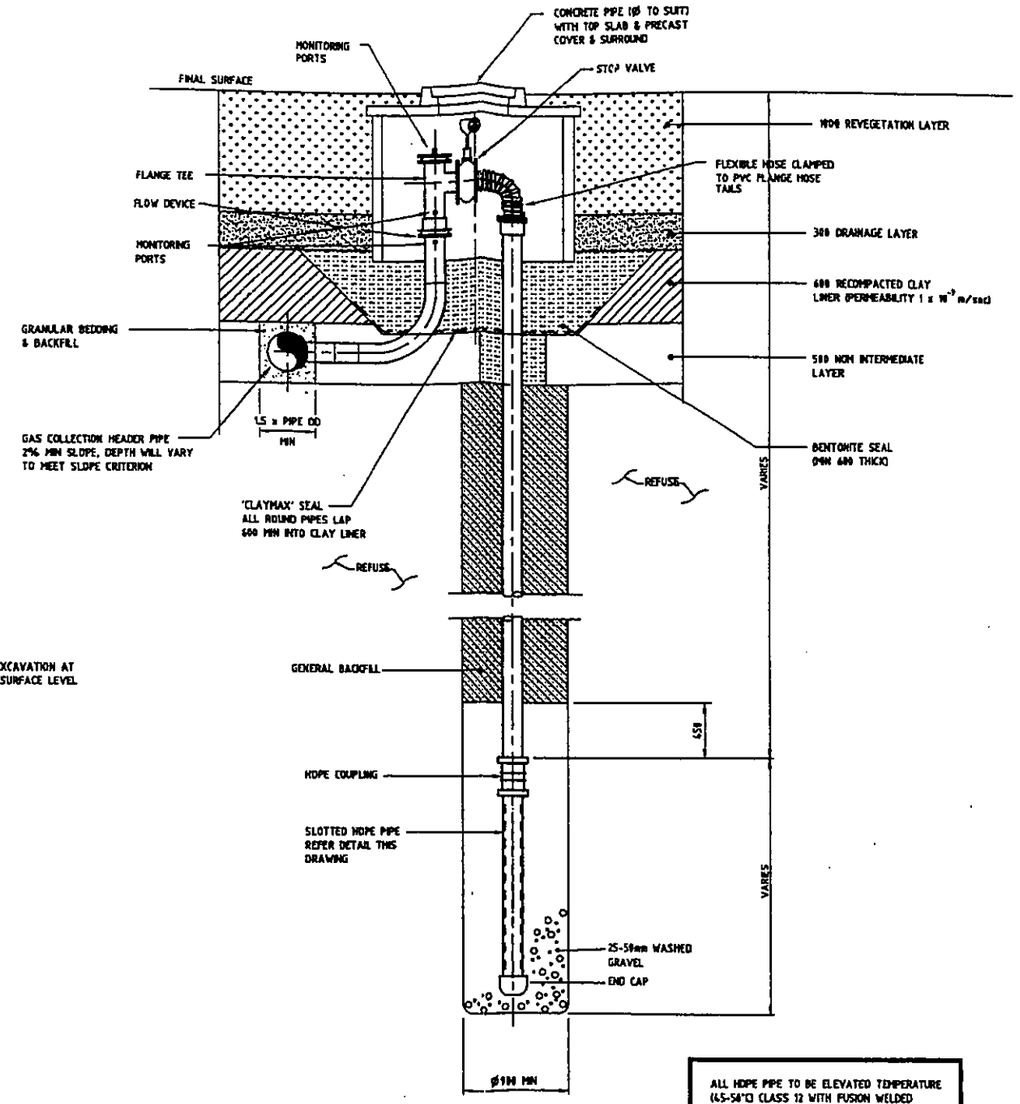
Project No	
58G011B	
Drawing No	Revision
M13	A



PLAN

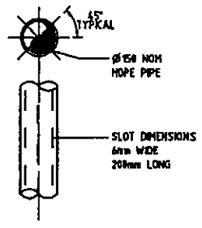
CONCEPT WELL LAYOUT

SCALE 1:1000



WELL HEAD ASSEMBLY

NTS



SLOTTED HDPE PIPE

NTS

AUSTRALIAN HEIGHT DATUM

1:1000 0 20 40 60 80 100 m

20

Amendment	Description	Date	Approved

Designed: GC	Project Approval: RC
Design Check: JMcN	Cad Reference: 58G11M14
Drawn: GCS	Document No: 58G011B.M14 REV A
Drawing Check: GC	Scale: AS SHOWN

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SOUTH WINDSOR WASTE DEPOT

MASTER PLAN – AREA 2

GAS EXTRACTION CONCEPT PLAN AND DETAILS

Project No	
58G011B	
Drawing No	Revision
M14	A

Appendix 2-1

Construction Specifications Landfill
Soil Liner

South Windsor Waste Depot

Construction Specification
Landfill Soil Liner

Hawkesbury City Council

RUST PPK Pty Ltd
Environment & Infrastructure

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Rhodes NSW 2138
PO Box 248
Concord West NSW 2138
Australia
Telephone: (61 2) 743 0333
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A NATA Certified Quality Company

August 1995
58G011B Syd/131

Contents

Appendices

1. Introduction

This construction specification addresses the selection, treatment, placement and conformance testing required in the construction of the compacted soil liner at Hawkesbury City Council's (HCC) South Windsor Waste Depot. This construction specification is applicable for the lining system incorporating the base and sidewall liner. The specification details special construction procedures required to reduce the risk of non-compliance with the design requirements.

This document must be read in conjunction with "HCC's QA/QC Procedures"[1], included for reference in Appendix A.

The design details for the South Windsor Waste Depot soil liner system specify that the constructed base and wall liner shall comprise a compacted soil layer of 900mm minimum thickness with a (saturated) hydraulic conductivity of $1x10^{-9}$ metres per second or less.

Where referenced in this specification the **site engineer** refers to the Council's engineer or nominated consultant/representative. The site engineer must be an experienced geotechnical engineer capable of ensuring that the requirements of this construction specification and the QA/QC procedures are met.

---

1 Hawkesbury City Council's *QA/QC Procedures and Construction Methods for Landfill Soil Liner Systems* (RUST PPK 58G011A.131, June 1995).

2. Soil Liner Materials

2.1 Material Sources

The soil liner material shall consist generally of cohesive soils derived from the on-site cell excavations with a low hydraulic conductivity and shall comprise clean, select material, free of debris, excessive coarse particles and other deleterious matter. Suitable material from off site can be imported to supplement soil liner requirements.

2.2 Acceptance Criteria

The suitability of proposed liner material (from on-site or off-site sources) must be assessed and approved by the site engineer prior to use within the soil liner system. The following acceptance criteria (refer Table 1) will be used to assess the material suitability.

Table 1: Acceptance Criteria for Selection of a Suitable Liner Material

Material Property	Acceptance Criteria
Liquid Limit (LL)	>20
Plasticity Index (PI)	>10
% Fines (<0.075mm)	>30
% Clay (<0.002mm)	>15
% Gravel	<10 (Refer note 2)
Particle Size	≤50mm
% Organic Content	<2
Activity (PI/Clay content)	>0.3

Notes:

1. Acceptance criteria based on Benson et al (1994)[2] and United States EPA recommendations. Most conservative requirements have been adopted in each case. The material property values in Table 1 are recommended minimum values if a mean hydraulic conductivity of 1×10^{-9} m/sec or less is to be achieved.

2. Gravel content can be greater than 10% providing appropriate hydraulic conductivity tests indicate that a conductivity of 1×10^{-9} m/sec or less can be achieved.

---

[2] Benson, C; Zhai, H; and Wang, X (1994). *Estimating Hydraulic Conductivity of Compacted Clay Liners*. J. Geotech. Engrg, ASCE, 120(2), 366-387.

[3] EPA (United States) (1989) *Requirements for Hazardous Waste Landfill Design, Construction and Closure.*

2.3 Conformance Testing

Once proposed material has been sourced, validation and routine conformance testing is required as detailed in 'HCC's QA/QC Procedures' - Section 3b Conformance Testing.

This conformance testing must be carried out for all soil liner materials and results must satisfy the acceptance criteria.

3. Treatment of Materials Prior to Placement

3.1 Site Stockpiles

Approved soil liner material is to be placed in on-site stockpiles located in designated stockpile zones. Precautions are to be taken to avoid degradation and contamination of stockpiled material. The following stockpile procedures shall be adopted:

1. Smooth rolling of stockpile surfaces (by means of track loader or smooth drum roller) shall be carried out to minimise effects of exposure including rainfall and runoff infiltration and excessive drying due to direct sunlight and wind conditions.

2. Suitable stormwater diversion from stockpiles shall be implemented to minimise effects of ponding and erosion at stockpile working faces and toe of batters.

3. Stockpile batters shall not exceed 3(H):1(V) and overall stockpile heights shall remain within site compliance regulations.

4. Visual assessment of stockpiled material shall be made as required in 'HCC's QA/QC Procedures' - Section 3a Visual Assessment of Stockpiled Material. This assessment shall be combined with regular inspections of liner material stockpiles to note any zones of high or low moisture, or excessive gravel content or size which may cause non-compliance with the materials acceptance criteria. Any remediation work undertaken as a result of these visual inspections must be noted accordingly.

3.2 Mixing

The stockpiled material shall be thoroughly mixed to achieve homogeneity. Contamination of the soil liner material shall be prevented during the mixing process.

Material preparation/mixing for the liner base and initial sidewall liner construction may be undertaken at the stockpile zone or proposed placement area. Material preparation/mixing for subsequent wall liner construction must be carried out at the stockpile zone to avoid liner material contamination with waste material.

Excessive mixing and handling of the soil liner material should be avoided wherever possible to minimise the resulting moisture loss.

3.3 Moisture Conditioning

Prior to placement of the soil liner material the moisture content shall be wet of Standard optimum (AS 1289 5.1.1). When initial mixing has been undertaken, an assessment of the moisture content and uniformity of moisture within the material shall be made by the site engineer, who shall direct any further moisture conditioning required.

Appendix 3-1

Hawkesbury City Council Recycling Specifications

Hawkesbury City Council Recycling Specification

Green Waste

Green waste and suitable timber products are to be received and directed to a designated area for recycling. Green waste to be processed through a tub grinder to achieve a size reduction (otherwise known as shredding) of between 20-150mm each month in accordance with AS4454-1999. To be windrowed to a maximum height of 2-3m with a maximum base width of 3m, be approximately 50m in length and contain approximately 150 cubic metres of green waste.

It is expected that the pasteurisation process will require a minimum of 3 weeks and a maximum of 6 weeks per batch. Windrows to be turned weekly to ensure the cooler outer zones of the pile are turned into the centre of the pile and exposed to pasteurisation temperatures.

Bag mulch for resale in recycled produce bags. In addition other woods products (other than trees, leaves and grass) which are not ideally suited fir mulching shall be put aside as other timber products and chipped and formed into windrows the same as mulch. This material is not for resale, does not require pasteurisation and to used on the premises. Cut and stack reusable timber fir firewood resale. Fulltime supervisor must be assigned to the green waste processing and drop off area to effect some form of quality control. The maximum amount of unprocessed vegetation to be stockpiled at the premises must be limited to 4000 cubic metres. Final product is owned by the Council. Within the first week of each month the tonnage dockets of all processed material is to be directed to Council and all monies to remain Councils.

Waste Oil

The waste oil facility that has been supplied by Council is pumped out monthly or as required by National Wide Oil Recycling. Contact the recycling company for collection if necessary. Area to be kept in a clean and tidy manner. All oil containers once discarded are to be placed in the garbage bins provided and put out for collection by Council's garbage truck as required. Within the first week of each month the tonnage dockets of all processed material is to be directed to Council and all monies to remain Councils.

Metal – White Goods

All white goods (fridge, freezers, stoves, dryers and hot water systems) accepted by Council is to be collected and placed within a designated area, partially crushed and placed within the recycling skip bin, contact the recycling company for collection. Within the first week of each month the tonnage dockets of all processed material is to be directed to Council and all monies to remain Councils.

Metal - Black

All metal other than white goods accepted by Council is to be collected and placed within a designated area, partially crushed and placed within the recycling skip bin. Contact the recycling company for collection. Within the first week of each month the

tonnage dockets of all processed material are to be directed to Council and all monies to remain Councils.

Bricks and Concrete

Bricks and concrete is to be received and directed to a designated area for recycling, Contact the recycling company. Primary and secondary crushers may be required for over 0.5m^2 slabs. Material to be screen to –20mm-50mm as required and placed in separate stockpiles. Within the first week of each month the tonnage dockets of processed material is to be directed to Council and all monies to remain Councils.

Soil

Soil suitable for recycling is to be received and directed to a designated area. Material to be screened and blended if required in accordance to Australian Standard AS4419 Interium-1996 "Soils for landscaping and garden use". Within the first week of each month the tonnage dockets of processed material is be directed to Council and all monies to remain Councils.

Tyres

Tyres are to be received in accordance to the current EPA license and directed to a designated area for recycling to be placed within the recycling receptacle, contact the recycling company for collection. Within the first week of each month the tonnage dockets of processed material is to be directed to Council and all monies to remain Councils.

Paper

Paper and cardboard is to be received and directed to a designated area for recycling. The paper and cardboard is to be squashed into the recycling skip bin. Contact the recycling company for collection. Within the first week of each month the tonnage dockets are to be directed to Council and all monies to remain Councils.

Kerbside

Maintain and keep clean the area currently occupied by JJ Richards. Council's kerbside collection contractor.

Batteries

Batteries are to received and directed to a designated area for recycling. The area is to be maintained in a clean and tidy manner. Prepare for transport and contact the recycling company for collection. Within the first week of each month the tonnage dockets are to be directed to Council and all monies to remain Councils.

Agricultural Chemical Drums

Approximately 5,500-10,000. 20L drums will annually be received in a container (non returnable rigid metal or plastic container above 1L/Kg in declared content used in the returnable rigid metal or plastic container above 1L/kg in declared content used

in the packaging of crop protection and animal health products used for agricultural and livestock production, industrial and recreational pest and weed control, forestry, household pest control operation but does not include containers used for stock feed supplements, disinfectants and animal nutritional products. Users of crop protection and animal health chemicals are responsible for correctly cleaning the empty containers with flushing, pressure rinsing, mechanical rinsing or triple rinsing. They then bring the empty, clean containers to the waste management facility. Inspection of containers at collection points is necessary to ensure that containers can be safely reused, recycled or disposed of at authorised landfills.

There must be no product residue on the inside or the outside of the container. Evidence of rinsing includes, puncture holes from pressure rinsing tools, cuts or puncture holes after rinsing and a singed statement by the farmer or applicator that the container be rinsed. The cap and the threads of the container opening must be free of residues. The container should have the labels on to provide inspector with positive identification of material being handled. Engage collection agencies.

Wash Bay

Maintain wash bay in a clean and tidy manner. Council's road sweeper sucks out the separator each day. Council's garbage trucks four in total wash the outside and wheels daily.

Effluent Sludge Receival

EPA trial maybe permanent. Effluent sludge tankers are to be received and directed to a designated area for recycling. The area is to be maintained in a clean and tidy manner. 200 tonnes of green waste mulch is to be transported to this area each week. Trucks are to be directed to the green waste and once a week for approximately 2-3 hours a front end loader is required to mix and place into a pile. Alternatively a designated area is to be made available for the received effluent sludge.

Appendix 4-1

Summary of Monitoring Requirements

Hawkesbury City Council Monitoring

Analyte	Frequency Surface Water	Groundwater & Leachate	Landfill Gas	Dust	Noise
Physical Parameters					
Electrical Conductivity	quarterly	quarterly	-	-	-
pH	quarterly	quarterly	-	-	-
Redox Potential	quarterly	quarterly	-	-	-
Salinity	quarterly	quarterly	-	-	-
Turbidity	quarterly	quarterly	-	-	-
TDS	quarterly	quarterly	-	-	-
Dissolved Oxygen	quarterly	quarterly	-	-	-
Temperature	quarterly	quarterly	-	-	-
Suspended Solids	quarterly	-	-	-	-
Inorganic Non-metallic					
Alkalinity	-	quarterly	-	-	-
Chloride	-	quarterly	-	-	-
Fluoride	-	quarterly	-	-	-
Iron	-	quarterly	-	-	-
Ammonia	quarterly	quarterly	-	-	-
Nitrate	quarterly	quarterly	-	-	-
Nitrite	quarterly	quarterly	-	-	-
Total Nitrogen	quarterly	quarterly	-	-	-
Total Phosphorous	quarterly	quarterly	-	-	-
Major Cations					
Total Sodium	-	quarterly	-	-	-
Total Calcium	-	quarterly	-	-	-
Total Magnesium	-	quarterly	-	-	-
Total Potassium	-	quarterly	-	-	-
Aggregate organics					
TOC	-	quarterly	-	-	-
Microbiological					
Faecal coliforms	quarterly	-	-	-	-
Organics					
BOD	quarterly	quarterly	-	-	-
Total Phenolics	quarterly	quarterly	-	-	-
TPH C6 - C9	-	quarterly	-	-	-
TPH C10-C14	-	quarterly	-	-	-
TPH C15-C28	-	quarterly	-	-	-
TPH C29 - C36	-	quarterly	-	-	-
Other					
Methane	-	-	quarterly	-	-
Carbon Dioxide	-	-	quarterly	-	-
Oxygen	-	-	quarterly	-	-
Dust	-	-	-	monthly	-
Noise	-	-	-	-	monthly

Appendix 4-2

Environmental Monitoring
Procedures Manual

Hawkesbury City Council

Draft
Environmental Monitoring
Procedures Manual

South Windsor
Waste Depot

Rust PPK Pty Ltd
Environment, Engineering and Business Consultants
9 Blaxland Road
Rhodes NSW 2138

Syd/117

58G011A
August 1995

Table of Contents

Table of Contents (cont'd)

LIST OF APPENDICES:

1. Introduction

This procedures manual forms the Rust PPK quality assurance document relating to the Environmental Monitoring at the South Windsor Waste Depot, South Windsor, NSW, carried out on behalf of Hawkesbury City Council (HCC).

2. Communications

2.1 Correspondence

The following should be identified on all correspondence to the laboratory or the client.

Client	:	Hawkesbury City Council
Project	:	South Windsor Waste Depot
Location	:	South Windsor
Job No.	:	
Date	:	
Rust PPK Contact Person	:	

Other relevant data, such as sample information, should also be included.

2.2 Contact List

	:		Tel: (02) 743 0333
HCC			
	:	Michelle McLennan	Tel: (045) 60 4

Site

Gate House	:	Hughes Waste Management	Tel: 045-725 489

3. Sampling Locations and Frequency

The sampling locations have been established in terms of the Environmental Monitoring Plan, in conjunction with Hawkesbury City Council. Reference should be made to location plans in Appendix A and the schedule of analytes in Appendix B. Appendix D contains examples of Sample Handling and Recording Sheets.

4. Surface Water

4.1 Sampling Procedures

4.1.1 Testing and Sampling Equipment

- Calibrated Field Testing Meters with Log Book
- Decontamination Buchete
- Sulphuric Acid (industrial detergent) solution
- Bottles (see Section 4.1.2)
- 3 large eskies with ice bricks
- Disposable powderless rubber gloves
- 1 large plastic bag and plastic kitchen liner bags
- Milk crate to carry sample bottles
- Distilled water and wash bottle
- Chain of custody form
- Camera
- Surface water field form
- Sample register log book and labels
- Teflon beaker
- Thermometer.

4.1.2 Preparation

Before sampling can occur certain arrangements must be made, ideally this preparation should be completed 2-3 days prior to sampling.

- Contact HCC to ensure desired sampling day is suitable.

- Contact the laboratory and arrange for sample container delivery. Appendix B contains a list of necessary analytes and their respective detection limits which should be submitted to the laboratory thus allowing the laboratory to organise the correct number of properly prepared containers which will be necessary. The laboratory shall provide the correct number of prepared containers. Sample

laboratory shall provide the correct number of prepared containers. Sample containers should be obtained at least one day prior to sampling. The eskies and ice bricks which will be necessary to contain all the sample containers should also be obtained. Place the ice bricks in a freezer on the night before sampling is to occur. Arrange for the laboratory to deliver at least one **extra** set of sample containers.

- Rust PPK labels listing sample ID, Date, Time and Name of Sampler must be prepared before entering the field. The sample ID numbers can be obtained from the Sample Register for Environmental Monitoring at South Windsor Waste Depot.

- Calibrate the field testing metres following the procedure manual. The Calibration Log Book must then be completed.

- Appendix C contains a checklist which must be completed before field work can commence.

- On the day of sampling place containers in the eskies with ice bricks to allow for pre-cooling.

4.1.3 Location and Collection

4.1.3.1 Sampling Locations

A permanent mark has been set up at each sample point. Any deterioration of the location identifier should be noted and brought to the attention of HCC rectification as soon as possible.

The sample is taken in line with the permanent marker and perpendicular to the creek or dam shoreline. The sample ideally should be taken midstream or in the centre of the dam at mid-depth, but as close to the locations as is practical and safe is acceptable.

4.1.3.2 Field Tests

Rinse the teflon sampling beaker and measure the conductivity using a blank sample of distilled water - do not proceed to test the field sample until a zero conductivity is obtained for the blank. Then rinse the teflon beaker twice with sample water. Fill the sample beaker half full with sample water and measure the field parameters. Measure pH, conductivity and dissolved oxygen four times. Between each measurement rinse the probe with distilled water, then flick dry. Draw a new beaker of water each time the measurements are repeated. Dissolved oxygen should be tested immediately upon drawing the sample. All results must be documented on the Surface Water Field Form.

If these results vary significantly from the previous sampling period repeat the tests using another Surface Water Field Form. Table 2 sets the criteria for repeat testing.

Table 2 - Variance Criteria

Test	Variance Requiring Repeat
pH	0.5
Conductivity	500 μS/cm
Dissolved Oxygen	0.5 ppm
Include	

If the results are consistent salinity, Eh and temperature can be entered on Surface Water Field Form.

4.1.3.3 Sampling for Laboratory Tests

Use the teflon beaker to collect the sample which will be sent for analysis. At each sampling point, first rinse the beaker with distilled water, then rinse it downstream of the sampling point two or three times (American Public Health Association, 17th edition: 130). Place the beaker in the water with the mouth facing the direction of flow at mid stream and mid depth (American Public Health Association, 17th edition: 131).

Disposable PVC or latex powderless gloves must be worn. New gloves must be worn at each sampling point or more frequently if torn or dirty.

Fill all supplied bottles 99% full to allow for thermal expansion before they reach the lab ("Standard Methods for the Examination of Water and Wastewater", American Public Health Association, 17th edition: 130). Do not let the bottles overflow while being filled because most have preservatives which may be diluted through overflows. The sample bottles should be filled with a minimal amount of air contact, and without allowing the sampling equipment or personnel to contact the inside of the bottles. Never place caps on the ground. Replace caps tightly. The caps of the bacteriological samples should always be held with internal surface facing downward.

Sample bottles or caps which fall on the ground before filling, should be thoroughly rinsed with sample water before being used. If a bottle with preservative is contaminated in anyway, a new sample bottle and sample is to be taken. All circumstances regarding dropped caps or bottles, and their subsequent rinsing and use, must be noted on the chain of custody form. Never rinse a bacteriological bottle cap - use a fresh sample bottle.

4.1.3.4 Documentation

Complete the other details required on the surface water testing form. Field comments should include: sampler type, sampler material, sample composited, sample date, start time, sample appearance, weather conditions, comments on conditions upstream and at sampling point, and depths:

- Sample appearance - odour, colour, turbidity

Odour: Rotten eggs, earthy, strong, moderate, slight, metallic

Colour: Hold the sample up to the light and describe the colour as well as possible. Observations may include: no colour (clear), brown, grey, yellow, etc.

Turbidity: Non-turbid - sample is clear; Trace - stream sediment only slightly clouds or colours the sample - stream sediment does not accumulate at bottom of bottle; Moderate - define cloudiness/colour - stream sediment accumulates at bottom of sample bottle; High - muddy appearance.

- Weather conditions - wind direction and speed, upwind activities, rain, temperature, cloud cover.

Using small labels, label each bottle making sure to include the following:

- sample ID number from Sample Register logbook
- date
- time, and
- name of sampling officer.

(Use black ball point pen only. Pencils/felt-tip pens should not be used).

4.1.3.5 Sample Handling

Samples need to be placed in the esky as soon as possible making sure to keep the esky sealed as much as possible. Record the temperature inside the esky each time it is opened.

Chain of Custody forms must be completed and a signed copy must be received from the laboratory. Samples should be delivered, with the Chain of Custody to the laboratory as soon as possible. Record the temperature in the esky at the time of handing samples over to a third party (eg. courier or laboratory).

5. Groundwater

Groundwater is to be sampled from the six nominated boreholes. An existing steel casing has been installed and is fitted with a lockable steel cap. A 50mm diameter, PVC standpipe is contained within the steel casing from which water is to be purged and sampled.

Purging is to be undertaken within a few days (maximum one week) prior to sampling. Purging and water level measurements will be carried out by HCC in accordance with Procedures for Purging and Sampling.

5.1 Sampling Procedure

5.1.1 Purging and Sampling Equipment

- Field Testing Meters with Log Books
- Decontamination Buckets
- Sulphamic Acid (industrial detergent) Solution
- Distilled Water
- Plastic Drop Sheet
- Bottles (see note below)
- Disposable Medical Powderless Gloves
- Small plastic bag to contain used gloves
- Ground Water Field Form
- Sample Register Log Book and Labels
- Chain of Custody
- Black pens (ball point)
- 2 x 10 litre bucket
- Paper towels
- Teflon bailer
- Rope to secure bailer.

Note: Sample containers, eskies, ice bricks, labels, sample register, calibration and checklist requirements for groundwater are the same as for surface water in Section 4.1.2.

5.1.2 Location and Collection (see Appendix A)

Any deterioration of the groundwater standpipe should be noted and rectified as soon as possible.

5.1.3 Air Compressor Preparation

The air compressor pump is obtained from the maintenance shed and the following checks must be completed:

- Check pump housing, engine, air filters, hoses, hose connections and control panel for damage.
- If equipment is in order or equipment is superficially damaged, comment on condition of equipment in equipment logbook; if damage is serious report damage to engineer.
- Check fuel and oil level, if either requires replenishing use the oil and fuel supplied.
- Connect the black compressor hose to the "Pump Pressure Inlet" on the control panel inside the suitcase.
- Turn the engine fuel switch to open.
- Turn the choke on and open the fuel throttle slightly.
- Turn the ignition on.
- Pull starter pull-cord to start, re-adjust choke and fuel throttle.
- Idle engine for one minute.
- If engine will not start, report to the project engineer.
- If the engine runs smoothly, switch off, disconnect black air hose and load pump onto ute.

5.1.4 Air Compressor Set-Up and Sample Collection

- At the well, inspect the housing for damage, if undamaged unlock the cap, if the casing is damaged or appears to have been interfered with, report to the project engineer.
- Position pump down-wind of sampling location, place buckets and teflon beaker etc next to well head on plastic drop sheet, and remove well cap.
- Open control case and connect black compressor air hose to "Pump Pressure Inlet".

- Connect red compressed air supply hose to "Pump Supply" outlet.
- Start the pump by following the above Preparation steps.
- Prepare three containers for cleaning the water level meter, teflon beaker, bailer, bailer cord and inlet and outlet connections to the well:

  - Pre-rinse tap water
  - Sulphamic acid solution
  - Post-rinse distilled water.

- Put on a clean pair of gloves and remove well hose protection caps.
- Connect appropriate "well-dedicated" flexible water sample hose to well and position a bucket under the outlet.
- Connect red air supply hose to well.
- Set "Flow Throttle", "Discharge" and "Refill" toggles to the appropriate positions listed below:

WELL	FLOW THROTTLE	DISCHARGE	REFILL
G7	5&1/2 Rev's Clockwise	D	B
G6	5&1/2 Rev's Clockwise	D	B
G5	5&1/2 Rev's Clockwise	D	B
G4A	5&1/2 Rev's Clockwise	D	B
G3A	5&1/2 Rev's Clockwise	D	B
G1A	5&1/2 Rev's Clockwise	D	B

(5&1/2 Rev's Clockwise, means turn the Flow Throttle from the closed position, five and one-half turns in the clockwise direction).

- Every fifteen minutes depress the "Moisture Vent" button on the control panel until no moisture is emitted from the vent.
- After purging at least one well volume into the bucket, field tests can commence.
- The groundwater collected in the bucket should be pouted out at least 5m down gradient of the borehole.
- Between wells the teflon beaker needs to be:

  - Pre-rinsed with tap water
  - Washed with Sulphamic acid solution
  - Rinsed with distilled water

- Rinsed twice with the new well's groundwater before field paramaters are tested or samples taken.

- Rinse the teflon sampling beaker with distilled water then twice with sample water. Fill the sample beaker half full with sample water and measure the field parameters. Measure pH, conductivity, dissolved oxygen four times. Between each measurement rinse the probe with distilled water, then flick dry. Draw a new beaker of water each time the measurements are repeated. Dissolved oxygen should be tested immediately upon drawing the sample. All results must be documented on the Ground Water Field Form.

  If these results vary significantly from the previous sampling period repeat the tests using another Ground Water Field Form. Refer to Table 2 on page 5. Document these results on the field groundwater testing form. Either these results are consistent salinity, Eh and temperature can be measured and recorded.

- Note sample appearance and weather conditions on the field testing form.

- Complete labels for the sample containers, and fill in sample register.

- Before taking all samples be conscious that:

  - There should be a minimal amount of air contact.
  - Sampling equipment and people should not contact the inside of the container.
  - Caps should never be placed on the ground.
  - Caps should be replaced tightly.
  - If sample containers are contaminated in any way, spares carried with testing personnel are to be used. A new sample is to be taken.
  - All circumstances regarding dropped caps or containers, and their subsequent rinsing and use, must be noted on the field testing form.
  - Completed labels need to be taped with clear tape onto relevant containers.
  - Samples need to be placed in the relevant esky as soon as possible.

For all samples (except for Volatile Organic Compounds (VOCs)):

- The sample container should be 99% filled.

- The container should not be allowed to overflow. (Preservatives would be diluted).

For Metals:

- Make sure sample is filtered using in-line filter.

For VOCs (40 mL vial):

- If it is windy, turn your back on the wind to protect the sampling process from turbulent conditions.
- Keep exposure time to an absolute minimum (VOCs volatilise upon exposure to air).
- Slowly pour two or three volumes into the vial. This is to ensure there are no air bubbles in the vial.
- Gently replace the cap.
- Invert the vial. Flick the side of the vial sharply with a finger. Check no air bubbles rise.
- If any air bubbles appear, open the vial, add more water, and repeat this process until there are no air bubbles. **Do not empty the vial and refill.**
- Lock the well.

Laboratory:

- Complete copy of "To lab" chain of custody forms for each esky.
- Check the hardness of the icebricks. Replace if necessary. Add a further three bricks if space permits.
- Put on the lid.
- Hand deliver to reach the laboratories (different laboratory for split sample) before 4.30 pm on the sampling day. Ensure receiving laboratory signs chain of custody form - take copy of form.
- Rinse field lab probes with distilled water. Flick dry. Wipe the field lab case dry.
- Clean other equipment if necessary and put away in their correct places.
- Gather and organise used chain of custody forms "from lab", field testing forms, and "to lab" chain of custody forms.

6. Dust

Dust will be collected at the five nominated locations which can be found on the site plan found in Appendix A.

The ten jars used for collection are prepared in the following manner:

- Rinse each jar with distilled water.
- 10 mL of copper sulphate solution shall be placed in each bottle (dissolve 7.8g of $CuS0_4.5H_20$ in 1L of distilled water).

These freshly prepared jars are then swapped with the previous month's jars. Any deposited dust which remains on the funnel from the jars which have been used in collection must be rinsed into the jar using no more than 50 ml of distilled water. The gauge will overflow if more than 250mm of rain falls; if this should occur the results should be neglected. The period of exposure shall be 30 $\pm$ 2 days.

At the end of the sampling period, new jars are replaced with old and the old jars are transported to the laboratory after sealing. When the funnel is inserted in the newly prepared jar ensure that the aperture plane is horizontal.

The following information needs to be recorded and sent to the laboratory with the sample and chain of custody

- Job
- Job No
- Date/outline
- Name of sampler
- Sample Identification
- Period of exposure
- Funnel diameter.

Samples should be delivered to the laboratory as soon as possible.

7. Noise

Noise is monitored at three locations.

7.1 Equipment Required for Monthly Noise Monitoring

- Bruel & Kjoer (Type 1613) Precision Integrating Sound Level Meter.
- Wet and Dry Bulb Thermometers.
- Barometer.
- Compass.
- Airflow LCA 6000 Wind Speed Measurement Device.
- Noise Survey Worksheets.

7.2 Use of Noise Measurement Equipment

7.2.1 Temperature Measurement and Relative Humidity

Temperature measurement is accomplished by the use of wet and dry bulb thermometers. Place water within the wet bulb cavity and spin thermometers for approximately 15 - 20 seconds. Immediately read off temperatures and record on worksheet.

To calculate relative humidity, set slide rule `setting line' at dry bulb temperature. Relative humidity (%) can then be read off slide using wet bulb temperature.

7.2.2 Atmospheric Pressure

Atmospheric pressure is measured using the barometer. The pressure in millibars is required.

7.2.3 Wind Direction and Speed

Wind direction is achieved through the use of a compass. Set arrow into wind and read off direction relative to north.

Wind speed is measured using the Airflow LCA 6000. Position measuring device above head within the airflow, ensuring direction arrow points directly into the wind. Depress the button on the side and hold in this position. This will measure the maximum wind speed achieved during this period. Once a consistent value (maximum value) has been obtained, the windspeed can be recorded simply by reading off the speed from the LCD on the device. The button can then be released.

Wind speed and direction measurements must be taken both at the start and finish of noise measurements.

7.2.4 Noise Level Meter

1. Remove main section from case.
2. Screw microphone extension into place.
3. Carefully remove microphone from case and screw into position atop extension.
4. Remove microphone protective cap.
5. Switch on main section.
6. Place calibrator on microphone and depress calibrator activation button.
7. Meter should register 93.8 dB if correctly calibrated. If not, adjust using screwdriver to appropriate level. Note any calibration performed!
8. Once calibrated, reset noise level meter and recheck calibration.
9. Once satisfied calibration correct, switch main unit to low range and 25-105 dB range.
10. The meter dynamic characteristic must be always on 'fast'.
11. All measurements taken are read from the analogue gauge and not the LCD display. The gauge gives instantaneous readings, while the LCD display gives only averages over certain time periods (a lag is involved).
12. Ensure that foam wind barrier is in place over microphone to minimise wind noise influencing readings.

Ensure that all readings are entered on the Noise Survey Worksheet.

References:

i) Australian Standard AS1055.1-1989: Acoustics - Description and Measurement of environmental noise.

ii) Australian Pollution Law, Schedule 7-1990: General testing procedures for measuring the noise level of a noise source other than vibration.

8. Weather

On the day before weather data is to be collected the computer used for storing the information from the data logger must be recharged. This involves plugging the computer into a power outlet on the afternoon before data is to be collected.

8.1 Procedure

8.1.1 Equipment

- Fully recharged Samsung NoteMaster 386S/20 laptop computer.
- Extension lead to connect laptop to the data logger.
- Clean formatted 3½" disk.
- Umbrella in case there is inclement weather.

8.1.2 Data Collection

The following procedures should be followed when collecting weather data from the data logger. If it is raining at the time of data collection make sure that the laptop computer and connections is kept dry, ie., use the umbrella. Weather data will be collected monthly.

- Turn the laptop on.
- When a flashing cursor appears next to C:\> type in ***cd\58G011A.*** and hit enter.
- A flashing cursor should appear in front of the prompt ***C:\58G011A>***, then type ***cd logger*** and hit enter.

- A flashing cursor should appear in front of the prompt ***C:\58G011A\LOGGER>*** then type start and hit enter.

- The program will then tell you the current date, if this is correct hit enter. If the current data is incorrect type in the correct date using the format ***(mm-dd-yy)*** eg. April 16, 1995) would be entered (04-16-95) then hit enter.

- When the correct date is entered the program will then show the current Time, if this is correct hit enter. If the current Time is incorrect type in the correct time, using 24 hour time format, and hit enter.

- The program will then enter into the Main Menu for Logger Utilities V1.5. Make sure ***Logger Utilities*** is highlighted then press enter.

- The program will then enter into the Logger Utilities Menu. Make sure ***Read Stored Data*** is highlighted then press enter.

- The computer will then ask what file name you want the stored data on the logger to be stored under on the computer; ie. enter name of Output Data File ***[.DAT]:*** will appear on the screen.

  At this point the date will be entered, ie. if data is being collected on April 16, 1995 the file name will be ***16APR95,*** this should be typed in then hit enter.

- The computer will then come up with the prompt -

  Limit Data by #DAYS (D) OR #LINES (L) ? (< CR> for all data): at this point hit enter.

- The computer will then ask for the laptop to be connected to the data logger. Once the serial ports are connected via the cord any key can be pressed to continue.

- The program will then go into transfer mode. The transfer for one months data usually takes 50 minutes. When transfer is complete the screen will read, ***Readout Complete - press any key to continue ....***

- Press any key and the Loggers Utility Menu will appear. At this point hit the escape key to return to the main menu and press escape again and at the bottom of the screen a line ***Exit to DOS? (Y/N)*** will appear. ***Press Y.***

- The prompt ***C:\58G011A\LOGGER>*** will appear on the screen. Type in ***XTG.*** Make sure that logger is highlighted then press enter. At this point the highlight cursor should be in the ***Logger Directory.***

- Use the arrow keys to highlight the file which has just been recorded, the file name will have the extension ***.DAT*** eg. for April 16, 1995 the Filename will be ***16APR95.DAT***. If the file does not appear then the data transfer did not occur and the entire process will have to be repeated.

- Place the clean formatted disk into the disk drive.

- Once the respective file is highlighted press ***C*** to initiate copying from the computer memory to a 3½" disk. The screen will then display ***COPY File:16APR95.DAT*** as, press enter at this command.

- The computer will then display - ***to:*** , press the down arrow key and a display of destination paths will appear. Highlight to the ***A:*** display by using the arrow keys, then press enter.

- The display will now read - ***to: A:***, press enter.

  There should now be a copy of the weather information on the computer and a copy on the 3½" disk.

- Press Q to exit X-Tree and the prompt ***C:\58G011A\LOGGER>*** will appear, type in start and press return. Then follow the original start up procedure until the Logger Utilities Menu appears on screen.

- Highlight Reset Logger using the arrow keys and press enter. The screen will then read ***Connect Logger Communications Cable.*** These cables should already be connected so press any key to continue.

- The screen will read ***Reset Logger Data .... Save? (Y/N)*** press ***Y***. The data logger will then reset itself so that the following month's data can be logged and the screen will return to the ***Logger Utilities Menu.***

- Press Escape ***(Esc)*** to return to the Main Menu.

- Press Escape ***(Esc)*** and ***Exit to DOS? (Y/N)*** will appear on the screen.

- Press ***Y*** and then the computer can be switched off. Disconnect all cables and store the disk in a safe place.

9. Quality Control

9.1 Surface Water and Groundwater

For both surface water and groundwater one location will be selected to take duplicate samples. The duplicate sample will be sent to another NATA registered laboratory as an internal check.

In addition to this check, blank and spiked samples will be tested. The blank samples will consist of distilled water. One blank sample and spiked sample will be sent for each groundwater and surface water test method used at South Windsor Waste Depot. The spiked sample will be made up from known solutions of contaminants, which will be obtained from a laboratory.

These quality assurance samples will be sent with the monitoring samples and the results will be included in the report. Testing should be undertaken according to the plan in the next section.

9.2 Laboratories

The plan for the use of testing laboratories is to be defined in conjunction with the client.

10. Assessment

This section is subject to client requirements.

10.1 Updating Database

As soon as possible, update the database with the field data which has just been obtained. View all relevant graphs, make sure all measurements fall within the acceptance criteria.

As laboratory results are returned enter these into the database again making sure all results fall within the acceptance criteria.

If any results should exceed the acceptance criteria, the Action Plan should be instigated immediately.

10.2 Draft Report

Once all field and lab results have been entered onto the database the draft report can be prepared. All assessments at whatever stage must be overseen by the relevant specialists.

10.2.1 Action Plan

If any results are outside the acceptance criteria or the quality assurance checks show suspect variations a review of testing procedures will be carried out. This review will include looking at old testing results, interviewing the lab to check on correctness of analyses, noting any outside influences, eg. chemical spills or drastic weather variances; damage or disturbances to sampling locations and accuracy of logged information from the field.

Further action will depend on the findings from this review and the decision will be made by relevant personnel.

10.3 Report

Reports must contain all pertinent data collected on site, test results from laboratory analyses and any unusual deviations from previous results or results exceeding acceptance criteria will be commented on. Draft reports, after assessment by relevant specialists, must be finalised, with appropriate quality checks, and issued as promptly as possible.

APPENDIX A

Environmental Monitoring Location Plan

APPENDIX B

Monitoring Schedule

APPENDIX C

Site Visit Equipment Checklist

SURFACE WATER MONITORING CHECKLIST

Hawkesbury City Council
SOUTH WINDSOR WASTE DEPOT

Date: _____

1. PRE FIELD

- ☐ Calibrate Field Meters
- ☐ Call Laboratory and arrange bottles, preservatives, eskies, and ice bricks.
- ☐ Pre-print labels
- ☐ Place ice bricks in freezer
- ☐ Put field metres on charge or ensure batteries are fresh

2. EQUIPMENT

- ☐ Calibrated Field Meters with Log Books
- ☐ Sample Bottles with Preservatives, Eskies, Ice Bricks and Labels
- ☐ Sample Register Log Book
- ☐ Disposable Powderless Gloves
- ☐ Plastic Bag for Garbage
- ☐ Milk Crate
- ☐ Decontamination Equipment
- ☐ Plastic Drop Sheet
- ☐ Camera
- ☐ Teflon Beaker
- ☐ Thermometer
- ☐ Surface Water Field Form
- ☐ Chain of Custody
- ☐ Keys
- ☐ PPK Procedures Manual

GROUNDWATER MONITORING CHECKLIST

Hawkesbury City Council
SOUTH WINDSOR WASTE DEPOT

Date: _____

1. PRE FIELD

- ☐ Calibrate Field Meters
- ☐ Call Laboratory and arrange bottles, preservatives, eskies, and ice bricks.
- ☐ Pre-print labels
- ☐ Place ice bricks in freezer
- ☐ Put field metres on charge or ensure batteries are fresh

2. EQUIPMENT

- ☐ Calibrated Field Meters with Log Books
- ☐ Sample Bottles with Preservatives, Eskies, Ice Bricks and Labels
- ☐ Sample Register Log Book
- ☐ Disposable Powderless Gloves
- ☐ Plastic Bag for Garbage
- ☐ Milk Crate
- ☐ Decontamination Equipment
- ☐ Plastic Drop Sheet
- ☐ Camera
- ☐ Teflon Beaker
- ☐ Thermometer
- ☐ Surface Water Field Form
- ☐ Chain of Custody
- ☐ Keys
- ☐ PPK Procedures Manual

Hawkesbury City Council
SOUTH WINDSOR WASTE DEPOT

Date: _____

1. GENERAL

☐ Ensure Testing Occurs Within 30 (± 2) days of previous month

☐ Keys

2. NOISE

Equipment

☐ Noise Survey Worksheets (15)

☐ Bruel & Kjoer (Type 1613) Precision Integrating Sound Level Meter with Charged batteries

☐ Wet and Dry Bulb Thermometers

☐ Barometer

☐ Compass

☐ Anemo Wind Speed Indicator

3. DUST

Equipment

☐ Call Lab and arrange for pick-up of nine prepared jars

☐ Dust Sampling Sheets, and Chain of Custody

☐ Distilled Water and Wash bottle

4. WEATHER STATION

☐ Connection Cable

☐ **Fully charged** Samsung Notemaster

☐ Clean Formatted 3½" disk

APPENDIX D

Sample Handling and Recording Sheets

CLIENT:	DATE:
PROJECT:	TESTED BY:
JOB No:	SHEET 1 OF 2

NOISE SURVEY WORKSHEET

SITE:

WEATHER:

HUMIDITY: DRY BULB — START TIME:

WET BULB — FINISH TIME:

RELATIVE HUMIDITY

ATMOSPHERIC PRESSURE:

WIND SPEED: (START) (FINISH)

WIND DIRECTION: (START) (FINISH)

TIME	NOISE LEVEL dB(A)	COMMENTS	TIME	NOISE LEVEL dB(A)	COMMENTS
0			6'00		
10			10		
20			20		
30			30		
40			40		
50			50		
1'00			7'00		
10			10		
20			20		
30			30		
40			40		
50			50		
2'00			8'00		
10			10		
20			20		
30			30		
40			40		
50			50		
3'00			9'00		
10			10		
20			20		
30			30		
40			40		
50			50		
4'00			10'00		
10			10		
20			20		
30			30		
40			40		
50			50		
5'00			11'00		
10			10		
20			20		
30			30		
40			40		
50			50		

COMMENTS:

L(A10%,20 mins)	
L(A90%,20 mins)	
L(Aeq,20 mins)	

RUST PPK

CLIENT:	DATE:
PROJECT:	TESTED BY:
JOB No:	SHEET 2 OF 2

NOISE SURVEY WORKSHEET

SITE:

WEATHER:

HUMIDITY: DRY BULB

WET BULB

RELATIVE HUMIDITY

ATMOSPHERIC PRESSURE:

WIND SPEED: (START) (FINISH)

WIND DIRECTION: (START) (FINISH)

TIME	NOISE LEVEL dB(A)	COMMENTS	TIME	NOISE LEVEL dB(A)	COMMENTS
12'00			18'00		
10			10		
20			20		
30			30		
40			40		
50			50		
13'00			19'00		
10			10		
20			20		
30			30		
40			40		
50			50		
14'00			20'00		
10					
20					
30					
40					
50					
15'00					
10					
20					
30					
40					
50					
16'00					
10					
20					
30					
40					
50					
17'00					
10					
20					
30					
40					
50					

COMMENTS:

RUST PPK

CLIENT:	DATE:
PROJECT:	TIME:
JOB No:	

SURFACE WATER FIELD FORM

	TEMP	WIND	GENERAL
WEATHER			

	ODOUR	COLOUR	TURBIDITY
SAMPLE APPEARANCE			

	pH	COND.	D.O.	SAL.	TEMP.	Eh
TEST 1						
TEST 2						
TEST 3						
TEST 4						

OTHER COMMENTS AND OBSERVATIONS:

SAMPLER'S NAME	
DATE AND SIGNATURE	

PPK CONSULTANTS PTY LTD
PPK HOUSE, 9 BLAXLAND ROAD
RHODES, NSW 2138
ENVIRONMENTAL AND GEOTECHNICAL SERVICES

CLIENT:	DATE:
PROJECT:	WELL I.D.:
JOB No:	

GROUND WATER FIELD FORM

R.L. to T.O.C. (m)		WELL DEPTH to T.O.C.(m)	
T.O.C. to GROUNDWATER (m)		T.O.C. to GROUNDWATER (m)	
GROUNDWATER R.L. (m)		DEPTH FOR PURGING (m)	

PURGING INFORMATION

METHOD / PUMP TYPE				TUBING MATERIAL		
PURGE DATE				START TIME		
ONE PURGE VOLUME =				FINISH TIME		
No. TIMES PURGED						
COND. of BLANK						

	pH	COND.	SAL.	D.O.	TEMP.	Eh
PURGE VOL. 1.						
PURGE VOL. 2						
PURGE VOL. 3						

SAMPLING INFORMATION

METHOD / PUMP TYPE				SAMPLE DATE	
SAMPLER MATERIAL				START TIME	
SAMPLE COMPOSITED (Y/N)				FINISH TIME	

	TEMP	WIND	GENERAL
WEATHER			

	ODOUR	COLOUR	TURBIDITY
SAMPLE APPEARANCE			

	pH	COND.	D.O.	SAL.	TEMP.	Eh
TEST 1						
TEST 2						
TEST 3						
TEST 4						

OTHER COMMENTS AND OBSERVATIONS:

PURGER'S NAME	
DATE AND SIGNATURE	
SAMPLER'S NAME	
DATE AND SIGNATURE	

PPK CONSULTANTS PTY LTD
PPK HOUSE, 9 BLAXLAND ROAD
RHODES, NSW 2138
ENVIRONMENTAL AND GEOTECHNICAL SERVICES

CLIENT:	DATE:
PROJECT:	
JOB No:	

DUST FIELD FORM

LOCATION	START DATE / TIME	FINISH DATE / TIME	COMMENTS

PPK CONSULTANTS PTY LTD
PPK HOUSE, 9 BLAXLAND ROAD
RHODES, NSW 2138
ENVIRONMENTAL AND GEOTECHNICAL SERVICES

CHAIN-OF-CUSTODY

Laboratory Name:	
Address:	
Fax Number:	
Phone Number:	
Contact Name:	

RUST PPK Job No. (Quote on all correspondence)

Results Expected By/On:	
Fax Results To:	
Fax Number:	
Phone Number:	

Invoice To:	

Date Sampled	Time	Sample I.D	Container Size	Sample Location	Medium *	Preservative Type	Filtered (x)	No. of Containers	Analysis Required						Sampled By	Company	Signature	Remarks

Relinquished By (Name):		Received By (Name):		Relinquished By (Name):		Received By (Name):	
Date:		Date:		Date:		Date:	
Company:		Company:		Company:		Company:	
On Behalf Of:		On Behalf Of:		On Behalf Of:		On Behalf Of:	
Signature:		Signature:		Signature:		Signature:	

RUST PPK Pty Ltd
9 Blaxland Road,
RHODES NSW 2138.
Environmental and Geotechnical Services

Comments: _____

_____

* Legend: S = Soil, W = Water, F = Filter
T = Tube

Appendix 4-3

ANZECC & Dutch Guidelines

	ANALYTE / CONTAMINANT	SOIL				GROUNDWATER	
		ANZECC 1992		Dutch 1994		Dutch 1994	
		A	B	Target Value	Intervention Value	Target Value	Intervention Value
		mg/kg	mg/kg	mg/kg	mg/kg	ug/L	ug/L
I	**Metals**						
	Antimony	4 - 44	20				
	Arsenic	0.2 - 30	20	29	55	10	60
	Barium	20 - 200		200	625	50	625
	Beryllium						
	Cadmium	0.04 - 2	3	0.8	12	0.4	6
	Chromium	0.5 - 110	50	100	380	1	30
	Cobolt	2 - 170		20	240	20	100
	Copper	1 - 190	60	36	190	15	75
	Lead	<2 - 200	300	85	530	15	75
	Manganese	4 - 12600	500				
	Mercury	0.001 - 0.1	1	0.3	10	0.05	0.3
	Molybdenum	<1 - 20		10	200	5	300
	Nickel	2 - 400	60	35	210	15	75
	Selenium						
	Tin	1 - 25	50	20		10	
	Zinc	2 - 180	200	140	720	65	800
II	**Inorganic Pollutants**						
	Ammonia (as N)						
	Ammonium Compounds						
	Boron	1 - 75				2 - 1000	3000
	Bromide (total)			20	300	300	2000
	Chlorine					100000	
	Cyanide (total free)			1	20	10	1500
	Cyanide (total complex pH < 5)			5	650		
	Cyanide (total complex pH > or = 5)			5	50		
	Fluoride (total)			500	2000	500	4000
	Nitrate					5600	
	Phosphate					400 / 3000	700
	Sulfate	35 - 1000	2000			150000	
	pH	6 - 8					
III	**Monocyclic Aromatic Hydrocarbons (non-halogenated)**						
	Aromatic Hydrocarbons (total)						
	Aniline						
	Benzene	0.05 - 1	1	0.05	1	0.2	30
	Catechol				20		1250
	Cresols				5		200
	Ethylbenzene			0.05	50	0.2	150
	Hydroquinone				10		800
	Phenols (non-halogenated)	0.03 - 0.5		0.05	40	0.2	2000
	Phthalates/ Phthalate Esters (total)			0.1	60	0.5	5
	Pyridine			0.1	1	0.5	3
	Resorcinol				10		600
	Styrene			0.1	100	0.5	300
	Toluene	0.1 - 1		0.05	130	0.2	1000
	Xylenes			0.05	25	0.2	70

	ANALYTE / CONTAMINANT	SOIL				GROUNDWATER	
		ANZECC 1992		Dutch 1994		Dutch 1994	
		A mg/kg	B mg/kg	Target Value mg/kg	Intervention Value mg/kg	Target Value ug/L	Intervention Value ug/L
IV	**Monocyclic Aromatic Hydrocarbons (halogenated)**						
	Chlorobenzenes (total)				30		
	Monochlorobenzene					0.01	180
	Dichlorobenzene			0.01		0.01	50
	Trichlorobenzenes			0.01		0.01	10
	Tetrachlorobenzenes			0.01		0.01	2.5
	Pentachlorobenzenes			0.0025		0.01	1
	Hexachlorobenzene			0.0025		0.01	0.5
	Chlorophenols (total)				10		
	Monochlorophenols			0.0025		0.25	100
	Dichlorophenols			0.003		0.08	30
	Trichlorophenols			0.001		0.025	10
	Tetrachlorophenol			0.001		0.01	10
	Pentachlorophenol			0.002	5	0.02	3
	Chloranilines						
	Chloronitrobenzenes			0.01			
	a-Chlorotoluene						
	Monochlorotoluene						
V	**Polycyclic Aromatic Hydrocarbons**						
	PAHs (total)	0.95 - 5		1	40		
	Total of 6 Borneff PAHs						
	Anthracene			0.05		0.02	5
	Benzo (a) anthracene			0.02		0.002	0.5
	Benzo (a) pyrene			0.025		0.001	0.05
	Benzo (b) fluoranthene						
	Benzo (ghi) perylene			0.02		0.0002	0.05
	Benzo (k) fluoranthene			0.025		0.001	0.05
	Chrysene			0.02		0.002	0.05
	Fenanthrene			0.045		0.02	5
	Fluoranthrene			0.015		0.0004	1
	Indenol (1,2,3-cd) pyrene			0.025		0.0004	0.05
	Napthalene			0.015		0.1	70
	Chlorinated PAHs (total)						
	Chloronaphthalene				10		6
	Oxodised PAHs (total)			1	2000	0.2	400
I	**Other Halogenated Aromatic Compounds**						
	Polychlorobiphenyls (total)	0.02 - 0.1	1			0.01	
	Sigma-6 PCBs 28, 52, 101, 138, 153, 180			0.02		0.01	
	Sigma-7 PCBs 28, 52, 101, 118, 138, 153, 180				1		0.01
	PCBs 28 and 52 (individual)			0.001			
	PCBs 101, 138, 153, and 180 (individual)			0.004			
	Polychlorodibenzo-p-dioxins						
	Polychlorodibenzofurans						
	Polychloroterphenyls						

	ANALYTE / CONTAMINANT	SOIL				GROUNDWATER	
		ANZECC 1992		Dutch 1994		Dutch 1994	
		A	B	Target Value	Intervention Value	Target Value	Intervention Value
		mg/kg	mg/kg	mg/kg	mg/kg	ug/L	ug/L
VII	**Aliphatic Hydrocarbons (non-halogenated)**						
	Acrolein						
	Acrylonitrile						
	Cyclohexanone			0.1	270	0.5	15000
	Ethylene						
	Ethyleneoxide						
	Fuel						
	Formaldehyde						
	Mineral Oil			50	5000	50	600
	Propyleneoxide						
	Tetrahydrofuran			0.1	0.4	0.5	1
	Tetrahydrothiofene			0.1	90	0.5	30
VIII	**Chlorinated Aliphatic Hydrocarbons**						
	Chlorinated Aliphatic Hydrocarbons (indiv.) + (total)				50	0.01 (indiv.)	
	Chlorofluorocarbons						
	Extractable Organic Chlorine (EOCl) (total)			0.1		1	
	Dichloromethane			50 ng/kg	20	0.01	1000
	Trichloromethane			0.001	10	0.01	400
	Tetrachloromethane			0.001	1	0.01	10
	1,1-Dichloroethane				50		
	1,2-Dichloroethane				4		400
	1,1,1-Trichloroethane			0.001	50	0.01	
	1,1,2-Trichloroethane			0.001	50	0.01	
	1,1,2,2-Tetrachloroethane			0.001	50	0.01	
	1,1-Dichloroethene				50		
	1,2-Dichloroethene				50		
	Trichloroethene			0.001	60	0.01	500
	Tetrachloroethene			0.01	4	0.01	40
	1-Chlorine-2,3-epoxypropane				50	0.01	
	2-Chlorine-1,3-butadiene			0.01	50	0.01	
	Hexachloroethane			0.01	50	0.01	
	Vinylchloride				0.1	0.01	0.7
IX	**Organochloropesticides**						
	Organochloropesticides (total)						
	Organochloropesticides (individual)				5	1 / 0.01	
	Aldrin	<0.001 - <0.05		0.0025	4		0.1
	Chlordane			0.01	5		
	Dieldrin	<0.001 - <0.05		0.0005	4	0.02 ng/L	0.1
	Dichlorodiphenyl-dichloroethanes (DDD)			0.0025	4		0.01
	Dichlorodiphenyl-dichloroethenes (DDE)			0.0025	4		0.01
	Dichlorodiphenyl-trichloroethanes (DDT)	<0.001 - 0.97		0.0025	4		0.01
	Endrin			0.001	4		0.1
	Endosulfan			0.0025	5		
	Hexachlorobutadiene			0.0025	5		
	Hexachlorocyclohexane			0.00005	2	0.0002	1
	Heptachlor(epoxide)			0.0025	5		
	Methoxychlor				5	1 / 0.01	
	Pentachloronitrobenzene				5	1 / 0.01	
	Toxaphene				5	1 / 0.01	

	ANALYTE / CONTAMINANT	SOIL				GROUNDWATER	
		ANZECC 1992		Dutch 1994		Dutch 1994	
		A	B	Target Value	Intervention Value	Target Value	Intervention Value
		mg/kg	mg/kg	mg/kg	mg/kg	ug/L	ug/L
X	**Other Pesticides**						
	Pesticides (total)						
	Nonchlorinated Pesticides (individual) + (total)				10	1 / 0.01 (indiv.)	
	Organophosphate Pesticides						
	Cholinesterase Inhibitors				10		
	Azinphos-ethyl			0.01	10		
	Azinphos-methyl			60 ng/kg	10	0.7 ng/L	
	Cumafos				5		
	Demeton				10		
	Diazinon			70 ng/kg	10	0.9 ng/L	
	Dichlorovos				5		
	Dimethoate				10		
	Disulfoton			0.01	10		
	Fenitrothion			0.01	10		
	Fenthion				10		
	Foxim				10		
	Malathion			20 ng/kg	10	0.04 ng/L	
	Mevinfos				10		
	Oxydemethon-methyl				10		
	Parathion-ethyl			40 ng/kg	10	0.05 ng/L	
	Parathion-methyl			0.01	10		
	Pyrazophos				10		
	Triazofor			0.01	10		
	Trichlorofon				5		
	Carbamates						
	Aldicarb				10		
	Carbaryl				5		0.1
	Carbendazim				10		
	Carbofuran				2		0.1
	Oxamil				10		
	Triazines						
	Atrazine			0.05 ug/kg	6	7.5 ng/L	150
	Simazine				5		
	Carboximides						
	Captafol				10		
	Captan				5		
	Chlorophenoxacetic Acid Herbicides						
	2,4-Dichlorophenoxyacetic acid				5		
	2,4,5-Trichlorophenoxyacetic Acid				5		
	2-Methyl-4-chlorophenoxyacetic acid (MCPA)				5		
	Mecoprop				5		

ANALYTE / CONTAMINANT	SOIL				GROUNDWATER	
	ANZECC 1992		Dutch 1994		Dutch 1994	
	A mg/kg	B mg/kg	Target Value mg/kg	Intervention Value mg/kg	Target Value ug/L	Intervention Value ug/L
Halogenated Aliphatic Pesicides						
1,2-Dibromoethane				10		
1,2-Dichloropropane				5		
1,3-Dichloropropene				5	1 / 0.01	
Methylbromide				10		
Phenol Herbicides						
4,6-Dinitro-o-cresol (DNOC)				10		
Dionseb				10		
Aromatic Chloramines						
3,3-Dichlorobenzidine				5		
Linuron				5		
Dithiocarbamates						
Maneb				35		0.1
Methan-Sodium				10		
Thiram				10		
Zineb				10		
Organotin Compounds						
Tributyltin Compounds						
Triphenyltin Compounds						
Tributyltinoxide (TBTO)			0.0001	10	0.0001	
Halogenated Aromatic Nitrocompounds						
Trifluralin			0.01	10	1 / 0.01	
Pyrethroids						
Bifenthrin				10		
Cypermethrin				10		
Deltamethrin				10		
Permethrin				10		
Anilides						
Propachlor				5		

Info from Michelle + Marty - Parks.

9. Shale Hills Woodland

Sample Sites: (61) CAD01LUM, CAD02LUM, CAD14PNU, CAD15PNU, CAD17PNM, CAD35BTF, CAD36LUU, CAD37LUM, CAM03BTU, CAM04BTV, CAM05BTL, CAM06BTV, CAM14BTL, CAM15BTL, CAM20BTM, CAM23BTV, CAM24BTC, CAM25BTL, CAM33BTL, CAM34LUL, CAM35BTL, CAM36BTL, LIV06LUM, LIV07LUL, LIV28SCF, LIV34BTF, LIV37SCF, LIV47BTS, LIV51LUM, LIV52BTC, PEN02LUU, PEN03LUU, PEN04LUM, PEN05LUL, PEN06LUV, PEN07LUM, PEN11BTU, PEN17BTM, PEN20SCF, PIC02BTF, PIC06PNM, PIC07PNU, PIC08PNM, PIC10LUM, PIC23PNL, PIC28PNU, PIC30TPM, PIC31MKF, PRO24BTL, PRO25BTM, PRO26BTM, PRO28BTU, PRO29LUU, PRO31BTU, WAR02LUM, WAR03LUV, WAR04BTV, WAR05LUF, WAR09LUL, WAR10LUU, WAR31LUL

Community Examples on Public Land (tenure): Mulgoa Nature Reserve (NPWS); Mount Annan Royal Botanic Gardens (RBG)

Area (ha 1750/1997): 38271/4309
Proportion Extant: 11.3%
No. Taxa (total/unique): 258/13
No. Taxa per Plot (±sd): 36.9 (7.2)

Map Unit 9 is dominated by *Eucalyptus moluccana* and *E. tereticornis* with *E. crebra* occurring less frequently. A small tree stratum is often present and most frequently includes *Acacia implexa* together with a variety of the commonly occurring *Eucalyptus* species. Map Unit 9 typically has a shrub stratum dominated by *Bursaria spinosa*, and more rarely includes other species such as *A. falcata, Breynia oblongifolia, Indigophera australis* and *Dodonea viscosa subsp. cuneata*. The ground stratum is variable in cover. Often there is a good cover of grass and herb species, but this become quite sparse under a dense shrub stratum of *B. spinosa* or the exotic species *Olea europea subsp. africana*. Species include *Dichondra repens, Brunoniella australis, Aristida ramosa, Desmodium varians, Microlaena stipoides var. stipoides, Themeda australis* and *Cheilanthes sieberi spp. sieberi*.

Shale Hills Woodland occurs almost exclusively on soils derived from Wianamatta Shale. Three sample sites (in bold text) were located on soils that were clearly alluvial in nature. This result is difficult to explain and no attempt was made to model the distribution of Map Unit 9 on this soil landscape. Map Unit 9 is closely related to Map Unit 10, Shale Plains Woodland. There is a reasonably clear differentiation between the habitats of the two communities. Map Unit 9 is widely distributed in, and largely confined to, the southern half of the study area, and occurs at higher elevations and on steeper slopes than Map Unit 10. Map Unit 9 most often occurs in undulating country with a relatively high degree of ruggedness and reaches its northern limit at Mulgoa Nature Reserve and Prospect Reservoir. Sample sites at these locations were sometimes difficult to distinguish from Map Unit 10. On very steep, sheltered hillsides Map Unit 9 grades into Map Unit 14, Moist Shale Woodland, although this Map Unit is highly restricted in distribution and poorly surveyed.

Previous Floristic Classifications:

Cumberland Plain Woodland as described by Benson 1992 (Map Units 9b?, 10c and 10d) and as listed under the NSW Threatened Species Act (1995), is herein divided into two separate communities: Map Unit 9 (Shale Hills Woodland) and Map Unit 10 (Shale Plains Woodland). Map Unit 9 includes areas previously recognised as Map Units 9b, 10c and 10d (Benson 1992), but most often corresponds with Map Unit 10d in the southern half of the study area. Although Benson (1992) ascribed vegetation in the north of the study area to Map Unit 10d these areas are included in Map Unit 10 in the present survey.

Habitat:

Parent Geology: Wianamatta Shale (92%), Holocene Alluvium (8%)

	Elevation (m)	Slope (° above horizontal)	Annual Rainfall (mm)	Ruggedness (900m)	Maximum Temperature, January (°C)	Solar Radiation, January
Mean (±sd)	111.5 (68.8)	6.1 (5.3)	811.6 (42.9)	12.1 (7.5)	27.8 (5.9)	214.1 (3.3)
Range	36 – 328	0 – 22.0	722 – 903	1 – 40	26.7 – 28.9	201 – 217

Structure:

Growth Form	Frequency (%)	Mean Height (m) (±sd)	Mean Foliage Cover (%)(±sd)
Tree	100	22.8 (6.1)	18.5 (9.4)
Small Tree	59	10.5 (4.2)	11.1 (11.4)
Shrub	95	3.8 (1.6)	19.6 (13.6)
Forb	100	0.5 (0.5)	43.9 (24.3)

Diagnostic Species:

Stratum	Name	Group score (50 percentile)	Group freq	Non-group score (50 percentile)	Non-group freq	Fidelity class
Tree	Eucalyptus moluccana	4	0.7049	3	0.1729	positive
	Eucalyptus tereticornis	4	0.7049	3	0.2604	positive
	Acacia implexa	2	0.5738	1	0.1072	positive
Shrub	Rhaminus alaternus	1	0.01639	0	0	positive
	Bursaria spinosa	4	0.918	3	0.5339	constant
Ground	Dichondra repens	3	0.9672	3	0.4967	positive
	Brunoniella australis	3	0.8525	3	0.3611	positive
	Aristida ramosa	3	0.8361	2	0.1729	positive
	Desmodium varians	3	0.8197	2	0.3611	positive
	Carex inversa	2	0.623	2	0.07002	positive
	Asperula conferta	2	0.6066	2	0.06565	positive
	Dichelachne micrantha	2	0.6066	2	0.3414	positive
	Oxalis perennans	2	0.5246	2	0.3392	positive
	Capillipedium spicigerum	1	0.03279	0	0	positive
	Portulaca oleracea	1	0.03279	0	0	positive
	Alternanthera species A	1	0.01639	0	0	positive
	Chamaesyce dallachyana	1	0.01639	0	0	positive
	Chloris divaricata	1	0.01639	0	0	positive
	Cyperus fulvus	1	0.01639	0	0	positive
	Dactyloctenium radulans	1	0.01639	0	0	positive
	Danthonia racemosa var. obtusata	1	0.01639	0	0	positive
	Oxalis rubens	2	0.01639	0	0	positive
	Sisymbrium irio	1	0.01639	0	0	positive
	Veronica brownii	1	0.01639	0	0	positive
	Lomandra multiflora subsp. multiflora	2	0.2459	2	0.5427	negative
	Aristida vagans	2	0.2295	2	0.5208	negative
	Entolasia stricta	4	0.01639	3	0.5821	negative
	Microlaena stipoides var. stipoides	3	0.7869	3	0.7571	constant
	Themeda australis	4	0.7705	3	0.6018	constant
	Cheilanthes sieberi subsp. sieberi	2	0.6885	2	0.5952	constant
	Glycine tabacina	2	0.5574	2	0.302	positive
Tree	Eucalyptus crebra	4	0.3115	3	0.2035	uninformative
	Eucalyptus eugenioides	3	0.1311	2	0.1488	uninformative
	Eucalyptus amplifolia	4	0.04918	4	0.05908	uninformative

Angophora floribunda	3	0.03279	2	0.1007 uninformative
Corymbia maculata	5	0.03279	4	0.0547 uninformative
Angophora subvelutina	3	0.01639	4	0.03939 uninformative
Eucalyptus fibrosa	1	0.01639	4	0.2013 uninformative

10. Shale Plains Woodland

Sample Sites: (72) LIV59RIS, LIV60RIS, LIV61RIF, CAD03BTF, CAD05BTC, CAD10BTF, CAM10BTU, CAM11BTU, CAM12BTF, CAM17SCU, CAM18BTC, CAM19BTF, CAM30BTU, KUR05LUU, KUR13RIF, KUR14ABL, KUR15BPF, KUR17LUU, KUR18LUM, LIV01BTF, LIV02BTM, LIV05BTM, LIV08BTM, LIV09BTM, LIV11PNL, LIV35BTF, LIV36BTF, LIV38RIS, LIV41RIS, LIV49BTF, LIV50BTF, PEN08BTF, PEN12BTM, PEN13LUU, PEN24LUM, PEN25BTM, PEN27BTU, PEN29BTU, PEN30LUM, PRO01BTU, PRO02BTF, PRO03BTM, PRO06SCF, PRO08BTU, PRO11SCF, PRO12BTF, PRO13BTL, PRO14BTL, PRO15BTF, PRO16BTM, PRO17BTF, PRO22BTU, PRO23SCF, PRO27BTU, PRO30BTU, RIV12BPU, RIV21BTF, RIV24BTF, RIV25BTF, RIV26BTF, SPR14LUU, SPR19LUF, SPR20LUF, SPR21LUM, WAR01BTF, WIL12WLC, WIL14WLM, WIL15UPF, WIL16UPV, WIL17WLM, WIL20LHU, WIL21LHV

Examples on Public Land (tenure): Scheyville National Park (NPWS); The Crest Reserve (Council); Noorumba Nature Reserve (Council)

Area (ha 1750/1997): 87172/6745 **Proportion Extant:** 7.7%
No. Taxa (total/unique): 277/10 **No. Taxa per Plot (±sd):** 43.8 (9.4)

Shale Plains Woodland is dominated by *Eucalyptus moluccana* and *E. tereticornis* with *E. crebra, E. eugenioides* and *Corymbia maculata* occurring less frequently. These species often form a separate small tree stratum, occasionally including other species such as *Exocarpus cupressiformis, Acacia parramattensis subsp. parramattensis* and *Acacia decurrens*. A shrub stratum is usually present and dominated by *Bursaria spinosa*. Common ground stratum species include *Dichondra repens, Aristida vagans, Microlaena stipoides var stipoides, Themeda australis, Brunoniella australis, Desmodium varians, Opercularia diphylla, Wahlenbergia gracilis* and *Dichelachne micrantha.*

Shale Plains Woodland is the most widely distributed community on the Cumberland Plain. It predominantly occurs on soils derived from Wianamatta Shale, but also occurs on holocene alluvium in well drained areas that are infrequently inundated. Isolated patches of Map Unit 10 may be found on soils derived from the Mittagong Formation, but only in the vicinity of outcrops of almost pure shale. Very rarely, it may occur on soils derived from Tertiary Alluvium, but it is more usual for Map Unit 10 to grade into Map Unit 103 (Shale Gravel Transition Forest) near the boundary of Shale and Tertiary Alluvium. Towards the edge of the Cumberland Plain, Map Unit 10 grades into Map Unit 1(Shale Sandstone Transition Forest, Low Sandstone Influence) as the depth of the shale soils decreases and the influence of the underlying sandstone increases. In the southern half of the study area Map Unit 10 grades into Map Unit 9 (Shale Hills Woodland) with increasing elevation and ruggedness. This gradation commences on the gentle rises running south from Prospect Reservoir in the centre of the plain, and south of Mulgoa Nature Reserve on the western boundary of the plain.

Previous Floristic Classifications:
Cumberland Plain Woodland as described by Benson (1992) (Map Units 9b?, 10c and 10d) and as listed under the NSW Threatened Species Act (1995), is herein divided into two separate communities: Map Unit 9 (Shale Hills Woodland) and Map Unit 10 (Shale Plains Woodland). Map Unit 10 includes areas previously recognised as Map Units 9b, 10c and 10d (Benson 1992), but most often corresponds with Map Unit 10c. Although Benson (1992) ascribed vegetation in the north of the study area to Map Unit 10d these areas are included in Map Unit 10 in the present survey.

Habitat:

Parent Geology: Wianamatta Shale (68%), Holocene Alluvium (21%), Mittagong Formation (4%), Tertiary Alluvium (3%), Hawkesbury Sandstone (3%), Aeolian Deposits (1%)

	Elevation (m)	Slope (° above horizontal)	Annual Rainfall (mm)	Ruggedness (900m)	Maximum Temperature, January (°C)	Solar Radiation, January
Mean (±sd)	55.1 (34.0)	2.1 (2.5)	829.0 (38.8)	6.2 (3.5)	28.1 (0.6)	216.5 (2.0)
Range	1 – 167	0 – 17.4	739 – 923	1 – 22	27.0 – 29.1	203 – 219

Structure:

Growth Form	Frequency (%)	Mean Height (m) (±sd)	Mean Foliage Cover (%)(±sd)
Tree	100	20.8 (5.1)	17.2 (9.3)
Small Tree	57	9.8 (3.5)	9.5 (7.3)
Shrub	100	3.1 (1.3)	14.0 (9.6)
Forb	99	0.5 (0.5)	45.1 (19.2)

Diagnostic Species:

Stratum	Name	Group score (50 percentile)	Group freq	Non-group score (50 percentile)	Non-group freq	Fidelity class
Tree	Eucalyptus moluccana	3	0.6528	4	0.1682	positive
	Eucalyptus tereticornis	4	0.6389	3	0.2601	positive
	Bursaria spinosa	4	0.9722	3	0.5157	constant
Ground	Dichondra repens	3	0.9722	3	0.4843	positive
	Aristida vagans	3	0.9167	2	0.417	positive
	Brunoniella australis	3	0.875	3	0.3453	positive
	Desmodium varians	3	0.8611	2	0.343	positive
	Opercularia diphylla	2	0.8056	2	0.3587	positive
	Wahlenbergia gracilis	2	0.7917	2	0.3184	positive
	Dichelachne micrantha	3	0.75	2	0.3117	positive
	Paspalidium distans	3	0.75	2	0.2444	positive
	Eragrostis leptostachya	2	0.6944	2	0.2152	positive
	Lomandra filiformis subsp. Filiformis	3	0.6111	2	0.2713	positive
	Dianella longifolia	2	0.5972	1	0.1749	positive
	Oxalis perennans	3	0.5972	2	0.3229	positive
	Lomandra multiflora subsp. Multiflora	2	0.5694	2	0.4978	positive
	Gnaphalium sphaericum	2	0.5556	1	0.1816	positive
	Goodenia hederacea subsp. Hederacea	2	0.5556	2	0.3229	positive
	Aristida ramosa	2	0.5417	2	0.204	positive
	Arthropodium milleflorum	2	0.5417	2	0.204	positive
	Danthonia tenuior	2	0.5139	2	0.157	positive
	Cymbopogon refractus	2	0.5	2	0.148	positive
	Echinopogon caespitosus var. caespitosus	2	0.5	2	0.2668	positive
	Dichopogon strictus	1	0.04167	0	0	positive
	Ranunculus lappaceus	3	0.02778	0	0	positive
	Brachycome multifida	4	0.01389	0	0	positive
	Calandrinia pickeringii	1	0.01389	0	0	positive
	Danthonia setacea	2	0.01389	0	0	positive
	Pimelea curviflora var. subglabrata	2	0.01389	0	0	positive
	Rorippa laciniata	2	0.01389	0	0	positive
	Wurmbea biglandulosa	1	0.01389	0	0	positive

	Dipodium punctatum	1	0.01389	0	0 positive
	Entolasia stricta	2	0.1806	3	0.5695 negative
	Cheilanthes sieberi subsp. Sieberi	3	0.9444	2	0.5516 constant
	Microlaena stipoides var. stipoides	4	0.9028	3	0.7377 constant
	Themeda australis	4	0.875	3	0.5807 constant
	Glycine tabacina	3	0.6528	2	0.2803 positive
	Glycine clandestina	3	0.5556	2	0.4238 positive
Tree	Eucalyptus crebra	4	0.3056	4	0.2018 uninformative
	Eucalyptus eugenioides	2	0.2361	2	0.1323 uninformative
	Eucalyptus fibrosa	2	0.1667	4	0.1816 uninformative
	Angophora floribunda	1	0.06944	2	0.09641 uninformative
	Angophora subvelutina	4	0.06944	4	0.03139 uninformative
	Corymbia maculata	4	0.06944	4	0.04933 uninformative
	Eucalyptus amplifolia	4	0.06944	4	0.05605 uninformative
	Eucalyptus punctata	3	0.02778	3	0.2937 uninformative
	Eucalyptus baueriana	1	0.01389	4	0.01121 uninformative
	Eucalyptus globoidea	1	0.01389	2	0.07399 Uninformative
	Eucalyptus longifolia	1	0.01389	1	0.0157 Uninformative
	Eucalyptus paniculata	1	0.01389	4	0.01345 Uninformative

Hawkesbury City Council

366 George Street (PO Box 146) Windsor NSW 2756 DX 8601 WINDSOR
Phone: (02) 4560 4444 **Facsimile:** (02) 4560 4400 **Email:** council@hawkesbury.nsw.gov.au

Plant Dispatch Advice (This is not a tax invoice)

Hawkesbury Community Nursery, Mulgrave Road, McGraths Hill

Date: Drivers Licence:

Name:

Postal Address:

Fax: Telephone:

Sales/Description	Quantity	$ Rate	Total Cost
Sub Total			
Tray Fee			
Tray return			
Total Dispatch Cost			

FEES & CHARGES

Pot Size	Prices (GST Inclusive)
Hyco cells 1-40 (each)	$1.10 each (40 tray)
Hyco cells 41 or more (each)	$1.00 each (40 per tray)
Tubestock 1-20 (each)	$2.20 approx size 50mm x 50mm x 120mm
Tubestock 21 or more (each)	$1.65 approx size 50mm x 50mm x 120mm
Super Tube	$2.75 approx size 65mm x 65mm x 160mm
Long stem	$2.75 approx size 50mm x 50mm x 120mm
6" Pot	$6.60
Tray fee	$3.30 per tray. NO CASH REFUNDS FOR TRAY FEE

Note: If the tray is returned within 6 months in a proper condition, HCC staff have the discretion to offset the tray fee from future purchases of either plants or trays.
Cashiers Mnemonic: SaleofPlantsCommNurs

Plants received by: Name Signature Date

Tray return: Name Signature Date

Note: The moisture content must be consistent throughout the material to allow uniform compaction. Mixing must therefore continue until this requirement is met and approved by the site engineer.

Further moisture conditioning may be required following placement of the material (refer Section 6 Defects and Repairs).

4. Placement of Materials

4.1 General

The soil liner system, comprising base, sidewalls, capping shall be constructed to the lines, grades, levels and thicknesses shown on the design drawings. Minimum dimensions specified on the drawings, eg. liner thickness shall be strictly achieved. The soil liner is to be placed in layer thicknesses as directed by the site engineer in accordance with the "HCC QA/QC Procedures".

4.2 Liner Base

The subgrade upon which the liner is to be constructed must be prepared to the approval of the site engineer prior to placement of the initial soil liner layer. The liner base is to be constructed in accordance with "HCC QA/QC Procedures" -Section 4.2a.

4.3 Liner Sidewalls

The liner sidewalls are to be constructed in accordance with 'HCC QA/QC Procedures' - Section 4.2b.

4.4 Specific Procedures

The following procedures shall be implemented in addition to the construction procedures detailed in Section 4.2 of 'HCC QA/QC Procedures'.

a) If liner construction is halted/delayed for any length of time or inclement weather conditions are expected, the existing liner surface is to be smooth-rolled (with track loader or truck) to seal surface from moisture ingress.

b) Where construction of liner is to recommence after a period of delay, the surface of the existing soil layer must be cut back such that the compacted soil exposed complies with the requirements of the specification. Prior to placement of new soil liner layers, the prepared surface is to be inspected and approved by the site engineer.

c) Approximate levels of proposed lifts should be marked on the excavated (natural) wall face in clearly visible paint (or other appropriate system adopted) to ensure the specified maximum lift thicknesses are not exceeded.

d) Once a liner stage has been constructed, moisture content must be stabilised by spraying the surfaces from an on-site water cart as directed by the site engineer.

e) A minimum effective wall liner thickness of 900mm (perpendicular to the excavated face) must be strictly adhered to as shown on the drawings.

f) Where the liner is under construction in a new cell, the successive stages shall be keyed into the previously constructed liner of the adjoining cell. The edges of the existing liner shall be cut back such that the compacted liner material exposed in the face complies with the requirements of this specification. As a minimum requirement the site engineer shall assess the exposed face prior to approving the abutment construction of the new liner.

4.5 Construction Observation

Full time construction supervision by the site engineer or experienced geotechnical engineer is required to ensure QA/QC procedures are adhered to and work meets the required specification. During construction the site engineer shall make visual assessment of the work in progress. General requirements are outlined in `HCC QA/QC Procedures' - Section 3c Construction Observation.

The site engineer shall ensure that the compactive effort is uniform across both the width and length of the soil layer being compacted (ie. number of passes of compactor and even coverage of all areas). Particular attention must be made to ensure that the liner sidewalls are compacted adequately into the adjacent excavated face to remove voids between the two surfaces.

Visual observation of all `field joints' in the soil liner must be made. All `field joints' must be constructed to the satisfaction of the site engineer. As outlined in 'HCC QA/QC procedures' - Section 4.2a Liner Base and Sidewalls.

All leachate sump and drain excavations, leachate line connections and removal of temporary leachate sumps must be observed and approved by the site engineer. This will ensure that the liner is not damaged and the effective thickness or width is not reduced.

Field notes of all construction observations, defects and subsequent remedial action, should be logged in a site diary with all relevant test results. A sample observation report sheet is included in Appendix B.

5. Compaction Specification

5.1 Acceptance Criteria

The compaction specification is based on an acceptance criteria of a minimum dry density ratio and a range of allowable moisture contents. The minimum dry density ratio corresponds to the minimum compaction level that will ensure adequate shear strength and compactive effort to remould soil clods and eliminate voids within the compacted material. The maximum allowable moisture content is specified to minimise and control potential for shrinkage and desiccation.

5.2 Specification Acceptance Parameters

The following acceptance parameters define the specification:

i. Minimum Compaction=100% Standard (Dry Density Ratio)
ii. Allowable Moisture Content, ω : O.M.C. -1% $\leq\omega\leq$ O.M.C.+2%.

Notes: O.M.C. refers to optimum moisture content (Standard compaction AS 1289 5.1.1).

5.3 Compaction Test Methods, Documentation and Reporting

The QA/QC Programme will be controlled by the site engineer in accordance with the guidelines set out in 'HCC QA/QC Procedures' - Section 2. Third party testing will be carried out by a NATA registered materials laboratory.

The following tests and reporting procedures are to be followed with regard to the landfill soil liner:

a) Test Method AS1289 5.7.1 (Hilf Rapid Compaction Method) is to be used for determination of density ratio and moisture variation with results documented on NATA endorsed report sheets (refer example report sheet in Appendix B). Compaction test to field density test ratio shall be 1 to 1 with a minimum of three (3) points per compaction.

b) Test Method AS1289 E8.1 (Nuclear Density Gauge) may be used to determine field wet density, field moisture content and calculation of field dry density. Calibration of the Nuclear Density Gauge shall be carried out at least once each day of testing using the Sand Replacement Method (AS1289 5.3.1). The number of calibration tests is to be increased if gravel content changes visibly (as directed by the site engineer).

c) The field moisture content and moisture content from the lab compactions of all test samples shall be determined overnight by the Oven-Dried Method (AS1289 2.1.1) and the following results shall be submitted for each test location to the site engineer the next morning:

i. Field moisture content;
ii. Field dry density, calculated from field wet density;
iii. Maximum dry density and optimum moisture content (calculated from Hilf compaction curve);
iv. Moisture variation from optimum;
v. Test location and level.

d) Apart from the requirements of a) above, all other test results are not required to be documented on NATA endorsed report sheets. These results shall be reported in a formal manner in a format approved by the site engineer.

5.4 Evaluation of Test Results

a. Initial Result Acceptance

On the basis of the results of Section 5.3a and 5.3b above, the site engineer shall pass or fail the soil layer in question by comparing the results with the requirements of this specification (Section 5.2 above). In the case of a 'borderline result', a decision on acceptance may be postponed to the following morning when the moisture content has been verified by the Oven-Dried Method (AS1289 2.1.1).

b. Final Acceptance/Result Review

On receipt of test results as outlined in Section 5.3c above, test result compliance with all the acceptance criteria can be confirmed.

Test results which fail solely due to moisture content, but meet all other criteria require individual assessment by the site engineer with regard to passing or failing. These results should then be referred by the site engineer to a consultant geotechnical engineer for review.

All other tests which do not meet the specification are recorded as failures - refer Section 6 Defects and Repairs.

5.5 Compaction Test Frequency and Location

Compaction control testing on liner base and sidewalls will be undertaken generally as detailed in 'HCC QA/QC Procedures' - Section 3d . The proposed base of each cell portion will be divided into control areas. Each control area will be approximately 900 square metres.

The base liner is to be tested in lifts not exceeding 225mm compacted thickness. Specified compaction will be tested by means of two (2) density field tests per control area per layer. These tests will be randomly located within each control area. Test location and results must be recorded on the appropriate report sheets. Each density field test is to test the full thickness of each soil layer to ensure uniform compaction and moisture content.

Failure of any field test (wall or base) will require reworking of the entire layer within the particular control area (refer Section 6 Defects and Repairs).

Location of all test results is to be recorded using an appropriate grid coordinate system. Appropriate methods will be used to determine levels of successive soil liner layers, to monitor layer thickness and to ensure maximum thickness is not exceeded. These levels are to be reported with each test result.

6. Defects and Repairs

6.1 Non-Compliance

Quality control test results deemed not to satisfy the compaction specification and/or materials not placed in accordance with Section 4 are classed as being in non-compliance with the construction specification.

Some factors which contribute to non-compliance include:

i. Poor compaction due to inadequate compactive effort;

ii. Placement of fill in too thick layers resulting in inadequate compaction at base of layer and poor interlayer bonding;

iii. Lack of uniformity of compaction over a particular area;

iv. Lack of uniformity in moisture content and other properties of the soil layer prior to compaction;

v. The presence of desiccation cracks due to drying out/shrinkage of clay soils and other construction defects. These defects can take the form of survey stake holes and field density test holes which may act as discrete flow channels/preferred seepage paths through the liner;

vi. Soil liner has been subject to adverse weather conditions;

vii. Incorrect preparation and joining of field joints between old and new liner sections resulting in inadequate layer bonding and preferred leachate paths;

viii. Contamination of liner material with surrounding waste fill or shale/cover material.

At locations where the testing and visual assessment indicates the requirements of the construction specification are not met, the site engineer shall determine the extent and nature of the defect and implement corrective actions. The site engineer shall record any non-compliance and subsequent remedial action taken.

6.2 Remedial Action

The general requirements for remedial action are outlined in 'HCC QA/QC Procedures' - Section 3f Defects and Repairs.

If a construction specification criteria cannot be met, or unusual weather conditions hinder work, the site engineer may arrange a work deficiency meeting to assess the problem, review alternative solutions and implement an action plan.

Reworking of all control areas must comply with the specification - eg. if a 300mm deep section of sidewall liner requires reworking, the section must be recompacted in the specified 150mm to maximum 225mm thick loose layers.

Documentation of all remedial action shall be included in the site diary for easy reference and confirmation of non-complianced areas being reworked and subsequently passed.

6.3 Retesting

The site engineer shall schedule appropriate retests when the work defect/non-compliance has been corrected. All remedial work must be submitted for retesting. All retests must be carried out in accordance with the specification. The site engineer is to review retest results and verify the defect has been corrected before any additional work is performed in the area of the deficiency.

Appendix A

HCC QA/QC Procedures and Construction Methods for Landfill Soil Liner Systems
58G011B.136/June 1995

QA/QC Procedures and Construction Methods For Landfill Soil Liner Systems

Hawkesbury City Council

RUST PPK Pty Ltd
Environment & Infrastructure

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Australia
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August 1995
58G011B Syd/136

Contents

1. Introduction

This document summarises Hawkesbury City Council's Quality Assurance and Quality Control (QA/QC) procedures and specific construction methods implemented in the construction of landfill soil liner systems.

2. Earthworks Specification and Supervision

The construction of the soil liner system is "controlled" by:

a) A construction specification for the earthworks which details the acceptance criteria for soil materials which can be used; the method of placement and compaction to form the liner base, sidewalls and capping layer; the compaction specification for the soil fill and special construction procedures required to reduce the risk of non-compliance with the design requirements.

b) Full-time supervision of the works by an experienced geotechnical engineer (assisted by regular QC testing by an independent geotechnical consultant). The role of the engineer is to provide visual appraisal, ensure construction methods are in accordance with the specification and to direct and control the quality control testing programme. If required, the engineer will instruct remedial earthworks to be undertaken in the event that the results of the quality control testing indicate non-compliance with the specification.

c) A quality control testing programme, which is coordinated by the site engineer, is detailed in the earthworks specification. This programme (refer Section 3) comprises compaction control (density) tests to be carried out at an appropriate frequency to assess compliance with the construction specification. If the engineer considers that there is significant variation in the type of soil fill materials to be used in the works, then additional material tests, including laboratory permeability, plasticity, particle size distributions and specific gravity determination may be requested by the engineer to assess acceptance of the materials for use in the works.

3. Site QA/QC Procedures

The QA/QC procedures to be implemented at a site can be summarised as follows:

a) Visual assessment of stockpiled material.

b) Conformance Testing.

c) Construction observation.

d) QC/construction testing.

e) Laboratory testing.

f) Defects and repairs.

a) Visual Assessment of Stockpiled Material

The excavated and stockpiled clay materials proposed for liner construction are initially visually assessed for general consistency with the material types previously nominated for use in the works for which the soil classification and hydraulic conductivity characteristics have already been established by laboratory testing.

b) Conformance Testing

Material conformance tests are recommended on the stockpiled clay materials as listed below. The purpose of these tests is to characterise the soil materials and to assess consistency of the properties of the soil from borrow sources.

The frequency of tests will depend on variability of the soil materials and number of borrow sources. Test frequencies may be reduced to a minimum of one per 10,000 m^3 if consistency of materials is established by the conformance tests to-date.

Test Type	Suggested (Nominal) Test Frequency
Particle size distribution	One per 3500 m^3
Moisture Content	One per 3500 m^3
Atterberg Limits	One per 3500 m^3
Specific Gravity	One per 3500 m^3
Laboratory Compaction	One per 3500 m^3
Laboratory hydraulic conductivity at a specified compaction (or over a range of specified dry densities and moisture contents, if required)	One per change of material

c) Construction Observation

Basic construction control is exercised by the site engineer's visual evaluation of the following:

- The uniformity of moisture content and the properties of the soil lift before compaction.
- The thickness of the compacted layers (lifts).
- Type and level of compactive effort, including roller type, roller weight and average number of passes used to compact each lift.
- Action of compaction equipment on the soil surface (sheeps-foot penetration, pumping, cracking etc).
- Maximum clod size and presence of oversize material (ironstone fragments and stones).
- Method and effectiveness of bonding lifts together.
- Areas where post-construction 'damage' may have occurred e.g. drying and desiccation cracking.

d) QC/Construction Testing

To supplement visual evaluation of construction techniques and to provide the engineer with guides to judgement, field tests of material density and moisture content are performed. These tests are also undertaken to assess compliance with the compaction specification. Laboratory hydraulic conductivity and strength tests are not generally used for routine construction control (other than for conformance testing) because their relationship to soil dry density and moisture content has been established prior to construction and is addressed by the type of compaction specification and acceptance criteria adopted for the works.

Routine density tests are undertaken at a nominal frequency of one per 200 m^3 in the liner, and more frequently where a small volume of material will significantly increase the thickness of the liner in a particular area. Testing frequency is substantially increased for the liner sidewalls and capping construction where small volumes of fill result in significant changes in the height of a section.

Record density tests are undertaken at locations of embedded structures (e.g. leachate drains) and/or instrumentation. In addition to the density test, particle size distribution, specific gravity and Atterberg Limit tests are required at these locations.

Notwithstanding the above, the liner area under construction (i.e. the particular area being built up in the one operation) is subdivided into test control areas for the purpose of compaction control and density tests are undertaken in each control area at a frequency of at least one test per lift per control area. Test locations are selected by the site engineer to be representative of a particular control area (based on surface inspection). In any event, at least one density test is made during each shift involving placement of soil fill materials.

An increased frequency of density testing and additional conformance - type tests (as detailed in b) above) are undertaken in areas of suspected 'non-compliance', for example where:

- The degree of compaction and remoulding of the material is doubtful.
- Extensive earth fill operations are concentrated in confined areas.
- Mechanical tamping and rolled earth fill are in contact.
- Rollers turn during rolling operations.
- Lift thickness is greater than specified.
- Dirt-clogged rollers are being used to compact the material.
- Over-sized rock exists in the fill material.
- Compaction is by rollers that may not have used proper ballast.
- Fill materials differ substantially from those specified.

e) Laboratory Testing

Laboratory Hydraulic Conductivity Tests are conducted on 'undisturbed' samples of the completed liner obtained in thin-walled tubes. Samples are usually tested in a triaxial cell with an applied chamber and head back pressure. These tests are required to be undertaken at a nominal frequency of 1 per 5000m^3 or a minimum of 1 per cell.

f) Defects and Repairs

In the event that the site engineer identifies suspect areas in the liner construction and/or if the QC testing indicates 'non-compliance' with the compaction specification, then the engineer instructs additional testing to be undertaken to confirm the nature and extent of the defective area. The engineer then defines an appropriate scope of remedial work to be implemented, which may include reworking or complete removal and replacement of the fill materials. Upon completion of the remedial works the area is retested for compliance.

Any 'holes' which result from insitu density tests and field sampling are either excavated and/or carefully backfilled with compacted clay material during liner construction. Any sampling of the completed liner is not permitted to penetrate more than one half the full liner thickness and sample 'holes' are backfilled with a bentonite/cement mixture and clay plug in accordance with established site procedures.

4. Construction Procedures

4.1 Test Pad Programme

Prior to construction of the liner proper, a test pad may be constructed to identify appropriate placement and compaction procedures to be adopted for the liner to meet the necessary performance standards and project specification requirements.

A test pad programme need not be considered as mandatory but would be prudent if the soil liner materials are expected to have extreme or unusual properties/characteristics.

4.2 Specific Procedures

Specific construction procedures are implemented to reduce the presence of construction defects (e.g. interfaces between fill lifts and desiccation cracks) in the liner system; these are outlined below:

a) Liner Base and Sidewalls

- The liner base and sidewalls are built-up in lifts not exceeding 150 - 225 mm loose thickness. A sheeps-foot roller is used of sufficient weight and adequate pad depth to ensure compaction is achieved through the depth to the fill layer being compacted and to ensure the fill layer is keyed into and bonded to the underlying fill layer, i.e. the feet of the roller penetrate the previous lift. This procedure eliminates the presence of distinct horizontal interfaces between fill lifts which may otherwise provide 'preferred' seepage paths.

- As far as practicable, the full depth of liner is constructed in a continuous operation. The surface of intermediate fill lifts are kept damp to eliminate the risk of desiccation and cracking prior to overlaying the next lift. If drying and/or cracking of the surface occurs, the surface is scarified, moisture-conditioned and re-worked prior to placement of the next lift. The final surface of the liner is wetted and immediately covered by a 300 mm (minimum) thickness layer of drainage material to prevent drying and promote leachate flow across liner surface.

- The liner is constructed in sections (cells). Subject to available areas of operation and other constraints, the liner area to be built up in the one operation is maximised to reduce the requirement for 'construction joints' between abutting sections of liner. Where joints are required between adjacent areas or lift layers, the existing edge/face is trimmed back to remove any desiccated material such that the material exposed in the face complies with the specification. The fill to be placed is then benched into the existing face/edge such that there are no continuous 'vertical' joints through the liner, i.e. the joints between successive fill lifts are staggered throughout the depth of the liner.

b) Capping

To facilitate construction of the capping layer, a layer of intermediate cover material is placed and compacted against and over the waste materials. This intermediate cover may comprise clay materials similar to those used for the liner construction or other suitable material. The intermediate cover layer is constructed with sufficient thickness to act as a 'bridging' layer over the waste material to provide an adequate subgrade for the controlled construction/compaction of the clay capping.

The sloping sides of the capping are constructed progressively commensurate with the build-up of the waste material.

Construction methods used for the capping are similar to those described for the base liner and sidewalls in a) above. The QA/QC procedures implemented for the capping construction are the same as those for the base liner and sidewalls.

Appendix B

Standard Report Forms

HAWKESBURY CITY COUNCIL
SITE ENGINEER'S OBSERVATION RECORD
(REFER TECHNICAL SPECIFICATION SECTION 4.6)
SOUTH WINDSOR WASTE DEPOT : SOIL LINER

Engineer : _____

Technician : _____

GENERAL :

Date & Time of Inspection : _____

Identify Location : Cell : _____ Grid Reference : _____
Approx. RL : _____ Base/Wall/Capping : _____

Check Any Special Requirements : _____

Weather Conditions (wind speed & direction; temperature): _____

Equipment In Use : _____

SOIL LINER :

	Spec. Requirements	
	Yes	No
Previous Soil Layer Preparation		
Contamination of Material to be Placed		
Material Consistency & Moisture Conditioning		
Even Compaction		
Layer Thickness		
Interlayer Bonding		
Field Joint Preparation		

REMEDIATION WORK REQUIRED

Details of Non-compliance : _____

Remediation Action Instructed : _____

REMEDIAL WORK INSPECTED & APPROVED BY : _____

Other Comments / Observations : _____

Prepared By :	Checked By :	Approved By :

2-2 Materials Specification for Leachate Collection Drain and Drainage Blanket Filter Materials

South Windsor Waste Depot Material Specification for Leachate Collection Drain and Drainage Blanket Filter Materials

Hawkesbury City Council

Rust PPK Pty Ltd
Environment & Infrastructure

9 Blaxland Road
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A NATA Certified Quality Company

August 1995
58G011B Syd/138

Contents

1. Introduction

This material specification addresses the selection criteria and conformance testing required in the construction of the leachate collection drain and drainage blanket at Hawkesbury City Council (HCC) South Windsor Waste Depot.

This document must be read in conjunction with construction drawings.

Where referenced in this specification, the site engineer refers to HCC's engineer or nominated representative. The site engineer must be an experienced geotechnical engineer capable of ensuring that the requirements of this material specification and the QA/QC procedures are met.

2. Collection Drain Filter Material

2.1 Material Description

Collection drain filter material shall consist of clean, durable, gravel, sand, rock or other approved material. The grading of the filter material shall not deviate by more than 10% from the particle size distribution for the sample supplied to the site engineer. The filter material shall be free from dust, clay, organic matter and other deleterious materials.

The filter material is to be of high permeability for use in leachate collection drains.

2.2 Material Properties

Prior to construction of the leachate drains, source evaluation tests shall be performed to confirm adequacy of the materials. All required testing shall be performed by a NATA registered laboratory approved by the site engineer. The material shall be accepted or rejected by the site engineer on the basis of these results.

The filter material shall have the following properties:

(a) Particle size distribution (AS1289 C6.1)

A S Sieve Size (mm)	Percentage Passing (by mass)
26.5	100
19.0	85 - 100
9.5	20 - 60
4.75	0 - 5

(b) Less than 15% Calcium Carbonate by volume. (Test method - Rapid Titration Method specified in "Soil and Plant Analysis" by C S Piper).

(c) Permeability not less than 1×10^{-3} m/s. (Test method AS1289 F7.1 "Determination of Permeability of a Soil - Constant Head Method". Material compacted to density index 70%).

(d) Less than 1% organic material. (Test method AS1289 D1.1).

(e) Less than 5% increase in percentage passing each sieve size after sample is compacted with two (2) cycles of compaction specified for AS1289 E1.1. (Test method AS1289 C6.1).

2.3 Conformance Testing

Conformance testing of filter material shall be performed to ensure the consistency of the drainage material properties. Particle size tests (AS1289 C6.1) shall be performed at a frequency of one (1) test per 2,500 m^3 of material, or upon visually observable changes in material type.

2.4 Construction Observation

The site engineer shall observe the procedures used by the earthworks contractor during placement of the collection drain filter material to ensure that the materials meet the project specification.

Depth of cover, liner condition prior and following material placement and material consistency must satisfy the design drawings and specification.

All remedial work is to be undertaken where required under the direction and approval of the site engineer. Record of all construction observations is to be on appropriate daily reports.

3. Granular Drainage Blanket

3.1 Material Description

The granular drainage blanket shall consist of clean, durable gravel, sand, rock or other approved materials. It shall be free of organic matter, lumps of clay or other deleterious material and be free of fine grained material which may reduce transmissivity over time.

The blanket performs both the role of improving leachate drainage characteristics and protection of the components of the soil liner system. This material prevents direct contact between the soil liner system and the refuse and between the leachate collection drain system and the refuse. The drainage blanket material shall not contain aggregate, rubble or other particles of a size or shape which may damage the underlying soil liner.

3.2 Material Properties

Prior to construction of the granular drainage blanket, source evaluation tests shall be performed to confirm the adequacy of the material. All required testing shall be performed by a NATA registered laboratory approved by the site engineer. The material shall be accepted or rejected by the site engineer on the basis of the test results.

The drainage blanket shall have the following properties:

(a) 100% passing A S Sieve 19 mm.

(b) Permeability greater than 1×10^{-4} m/s. (Test method - AS1289 F7.1 - Determination of Permeability of a Soil - Constant Head Method, compacted at density index of 70%).

(c) The percentage passing each of the following sieve sizes shall not be greater than the percentage passing that same sieve size for samples complying with (b) above. Sieve sizes - 9.5 mm, 4.75 mm, 2.36 mm, 0.425 mm, 0.075 mm.

(d) Less than 15% Calcium Carbonate by volume. (Test method - Rapid Titration Method Specific in "Soil and Plant Analysis" by C S Piper).

(e) Less than 1% organic material. (Test method - AS1289 D1.1).

(f) Less than 5% increase in percentage passing each sieve size after sample is compacted with two (2) cycles of compaction specified in AS1289 E1.1. (Test method AS1289 C6.1).

3.3 Conformance Testing

Conformance testing of drainage blanket shall be performed to ensure consistency of properties of material. The site engineer will direct particle size test (AS1289 C6.1) at a frequency of one (1) per 3,500 m^3 at NATA approved testing laboratory. If source of drainage material changes, all material property tests outlined in Section 3.2 must be undertaken and results assessed accordingly by the site engineer.

3.4 Construction Observation

The site engineer shall verify the granular drainage blanket thickness by spot checks and direct measurements after placement. The site engineer shall ensure that construction methods adopted by contractor for materials placement do not damage the soil liner system during or following placement. All construction observations are to be recorded on appropriate daily reports.

4. Defects and Repairs

If a defect is identified in the filter material or granular drainage blanket, the site engineer shall determine the extent and nature of the defect and instruct the appropriate remedial works to be undertaken.

All remedial work carried out must be inspected and approved by the site engineer. Record of all remedial work undertaken is to be made on appropriate daily reports.

Appendix 2-2

Materials Specifications for Leachate Collection Drain & Drainage Blanket Filter Materials

South Windsor Waste Depot Material Specification for Leachate Collection Drain and Drainage Blanket Filter Materials

Hawkesbury City Council

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The filter material is to be of high permeability for use in leachate collection drains.

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The site engineer shall observe the procedures used by the earthworks contractor during placement of the collection drain filter material to ensure that the materials meet the project specification.

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3.2 Material Properties

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The site engineer shall verify the granular drainage blanket thickness by spot checks and direct measurements after placement. The site engineer shall ensure that construction methods adopted by contractor for materials placement do not damage the soil liner system during or following placement. All construction observations are to be recorded on appropriate daily reports.

4. Defects and Repairs

If a defect is identified in the filter material or granular drainage blanket, the site engineer shall determine the extent and nature of the defect and instruct the appropriate remedial works to be undertaken.

All remedial work carried out must be inspected and approved by the site engineer. Record of all remedial work undertaken is to be made on appropriate daily reports.