MINERAL RESOURCES TASMANIA

Tasmania

DEPARTMENT *of* INFRASTRUCTURE, ENERGY *and* RESOURCES

NHT Funded Project
NLP 13188

AUSTRALIA
Natural Heritage Trust
Helping Communities Helping Australia

The effects of waste disposal on groundwater quality in Tasmania

Port Latta waste depot

Tasmanian Geological Survey Record 2002/07

Tasmania
DEPARTMENT of INFRASTRUCTURE, ENERGY and RESOURCES

Mineral Resources Tasmania
Tasmanian Geological Survey
Record 2002/07

Natural Heritage Trust
Helping Communities Helping Australia

Groundwater quality investigations at the Port Latta waste depot

A. R. Ezzy

Abstract

The Port Latta waste depot is a disposal site for general and hazardous waste materials. The local groundwater table slopes away from the site north towards Bass Strait. The regolith profile and related engineering grades of the clay material affects recharge to the fractured bedrock aquifer. Groundwater quality in the area of the leachate ponds is degraded. Ongoing monitoring and changes in the engineering design (i.e. filling sequence, surface water controls and leachate pond infrastructure) are regarded as high priorities at the site.

INTRODUCTION

Mineral Resources Tasmania (MRT) initiated a project to investigate the effects of waste disposal on groundwater quality in Tasmania. The project was funded by MRT and the Natural Heritage Trust (NHT) and included a number of sites for detailed study. The waste depot at Port Latta was one of these sites.

The objectives of the investigations at the Port Latta waste depot were to:

- Determine the geological nature of the host materials;
- Identify the depth of the water table;
- Examine the quality of the groundwater; and
- Identify if a potential hydraulic connection exists between the waste fill materials and the local hydrological system.

Hazardous waste (including medical waste) and general municipal waste are disposed of at the site. Australian Bulk Minerals (ABM) currently uses groundwater extracted from two water bores on the Pipeline Track approximately two kilometres to the southwest. The water is used at the Port Latta pelletising plant for processing and office needs.

SITE DESCRIPTION

The Port Latta waste depot is located approximately 500 metres south of the Bass Highway at Port Latta (362 300 mE, 5 475 300 mN) (fig. 1) and began operation in 1994. The Department of Primary Industries, Water and Environment (DPIWE) currently licenses the facility.

Site history and waste management

The site was a greenfield site at the time of construction. An engineered surface water system, filling sequence, landfill liner and leachate collection system have been constructed at the site. The filling sequence has occurred as a series of bench lifts over a clay liner of various thicknesses. The leachate collection system is constructed of PVC pipe surrounded by crushed rock on the top of the clay

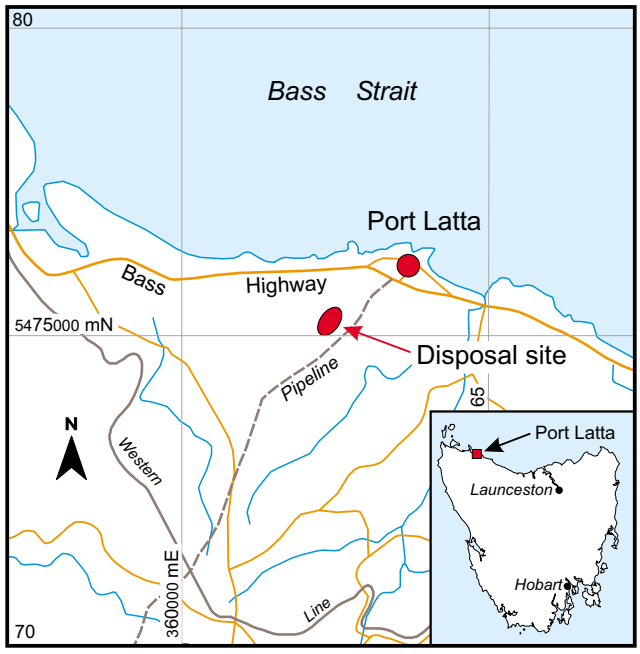


Figure 1. *Location of the Port Latta waste depot.*

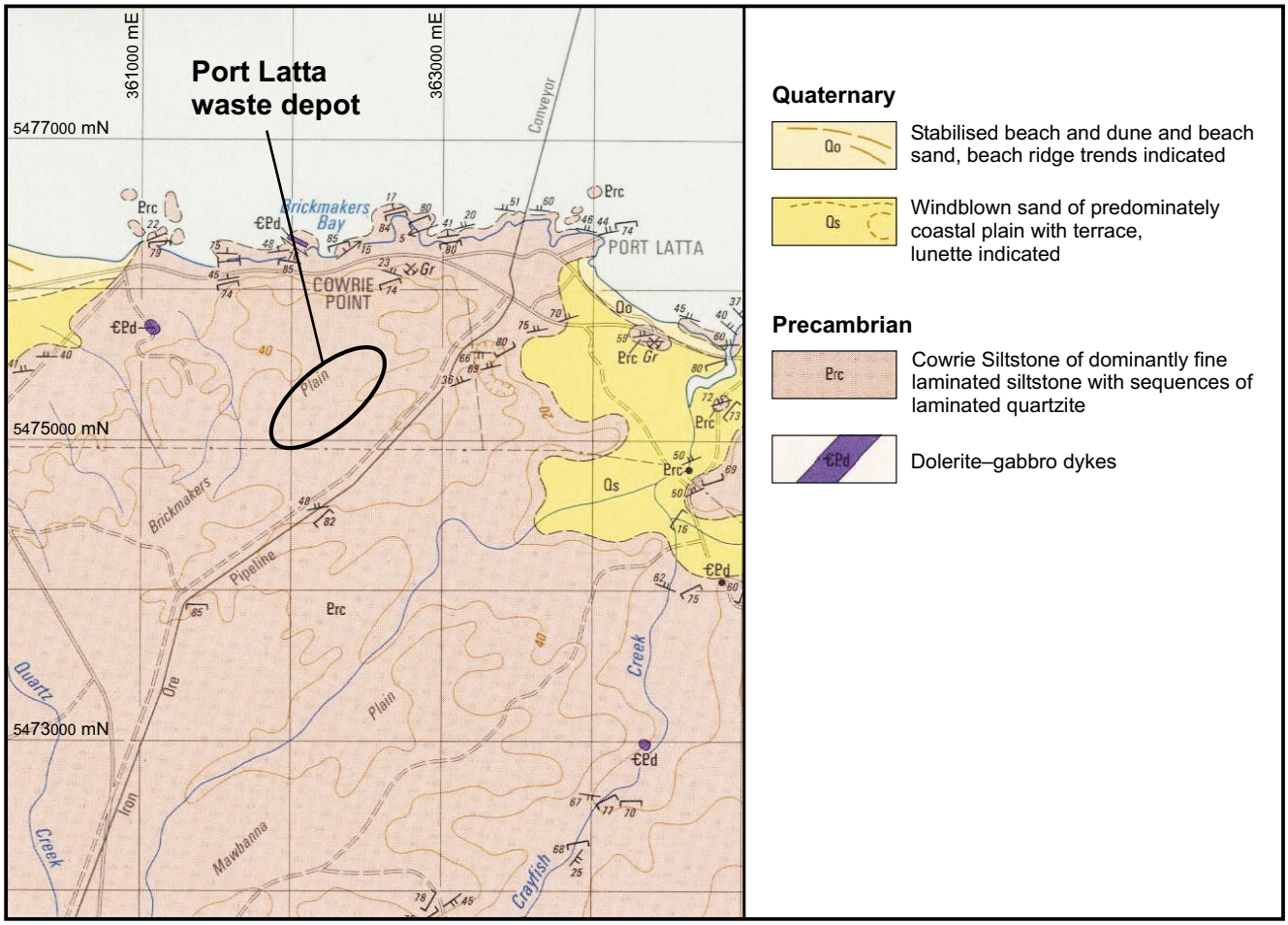


Figure 2

Extract from Smithton geological map (Lennox et al., 1982) of the local area and related geology.

liner. Because groundwater was intercepted during various stages of development, sections of the landfill liner are underlain by a sub-liner which discharges to the surface water system. The sub-liner collection system is constructed of PVC pipe surrounded by crushed rock on weathered bedrock. Plate 1 shows a discharge point of one of these sub liners to the surface water system.

All disposal sites are located in clay deposits related to Precambrian sediments. Plate 2 shows cement tanks used to store soil contaminated by polychlorinated biphenyls (PCB's), while Plate 3 shows an active medical waste trench in clay materials typical of the site. Plate 4 shows cracking in the clays and related slumping above the most recent trenches.

Geology

The Tasmania Department of Mines 1:50 000 scale geological map of the area (Lennox *et al.*, 1982) indicates that the waste disposal area is underlain by Precambrian Cowrie Siltstone (fig. 2). This consists of finely laminated siltstone with sequences of laminated quartzite.

Geological mapping during the present study indicated that two types of clay deposits dominate the site. The first is material related to *in situ* weathering of the Cowrie Siltstone, forming a regolith profile. The second material lies within a palaeochannel located within the regolith profile and the weathered Cowrie Siltstone (Plate 5). Both materials overly the Precambrian Cowrie Siltstone with a transitional zone from the regolith profile to the bedrock. This transitional contact is exposed at the western end of the Stage 2 filling area (Plate 6).

The regolith profile controls the engineering behaviour of the respective grades within the profile. The uppermost section of the profile (0 to approximately 6 m) consists of grade IV to VI (Dearman and Fookes, 1974) material. Material beneath approximately six metres progressively grades from III to II.

Grade II Cowrie Siltstone crops out on the coastline to the north of the landfill. Complex folding and faulting are evident within the outcrops, with fold axes ranging in length from 0.4 to over 15 metres (Plate 7) within the coastal exposures. Pyrite, as pods up to 160 mm in diameter (Plate 8) and cubes up to 3 mm, was identified in the outcrops. The Cowrie Siltstone outcrops are heavily fractured, with secondary minerals (limonite) forming on some of the joint planes (Plate 9).

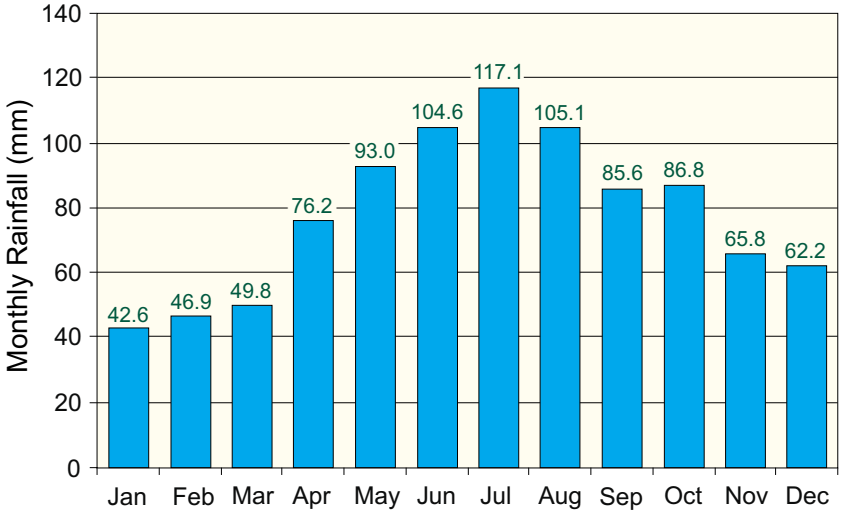


Figure 3
Average monthly rainfall for Australian Bureau of Meteorology rainfall station 091094, Stanley (Post Office).

Hydrology

The landfill footprint is located within the catchment area of Stinking Creek, which discharges into Bass Strait on the eastern side on of the ABM pelletising plant. Stinking Creek has a total catchment area of approximately two square kilometres. Stormwater runoff from the site is directed into stormwater settling ponds before discharging into Stinking Creek.

Australian Bureau of Meteorology rainfall station 091094 at Stanley (Post Office) is the closest rainfall station to the site. The rainfall chart of average monthly recorded rainfall (fig. 3) shows that the annual average rainfall for the station is 935.7 mm.

INVESTIGATION METHODS

Borehole drilling and installation

Nine 120 mm diameter monitoring bores were auger drilled between 22 and 24 August 2000 for this project (fig. 4). Fifty millimetre PVC casing was installed in eight of the bores, with slotted screens with bentonite seals being installed in each hole. Borehole PL2000/1 was drilled as a background hole approximately 500 m south of the landfill footprint. Borehole PL2000/7 intercepted medical waste and was backfilled with bentonite for occupational health and safety reasons. All bores were logged in accordance with AS1726-1993; engineering logs are presented in Appendix 1.

Groundwater was encountered across the site in close proximity to the overburden/bedrock interface. Flow during drilling indicated that the groundwater in the bedrock was being confined to some degree by the overlying clay materials. Figure 5 shows a southwest to northeast cross-section of the site and related standing water levels on 11 August 2001 for boreholes PL2000/3, 4, 5, 6 and 8.

The unsaturated zone consists of heterogenous medium to high plasticity mottled clays. In boreholes PL2000/2, PL2000/3, PL2000/4 and PL2000/5 groundwater was located above bedrock (auger refusal) in a low to medium plasticity, dark grey to black clay (base of regolith profile).

HYDROLOGICAL MODEL

Boreholes previously drilled outside the landfill footprint in the general area (e.g. ABM bores on the pipeline track to the east) showed that the main aquifer at the site is located within the fractured Precambrian basement bedrock. The Precambrian rocks contain extensive fractures (jointing) which are associated with the complex folding of the area. Two high-yielding bores (12.6 L/s) drilled within the same rock mass have been reported on farmland approximately three kilometres to the east. No engineering logs exist for these bores, but comments from the drillers indicate that the fracturing system increased storage capacity with depth. Both bores where drilled to approximately 70 metres.

A hydraulic boundary condition appears to exist between the regolith profile and the underlying bedrock. As precipitation exceeds evaporation for about nine months of the year (implying a net recharge to groundwater), a concentration of groundwater develops at the base of the regolith profile. Based on observations of the coastline outcrops and the above, joint cementation must be occurring in the upper section of the fractured bedrock aquifer. This has increased the saturation of the regolith materials overlying the low permeability Precambrian bedrock surface.

Groundwater discharges as springs on several beaches approximately one kilometre north of the landfill footprint (Plate 10). Other springs in this area discharge at the interface between bedrock and unconsolidated overburden. Some of these springs discharge discoloured water (Plate 11).

Figure 6 illustrates an interpretation of the piezometric surface based on surveyed heights and groundwater depths of the boreholes in the area of the landfill. The cross-section (fig. 5) and piezometric surface outlined in Figure 6 indicate that the water table at the base of

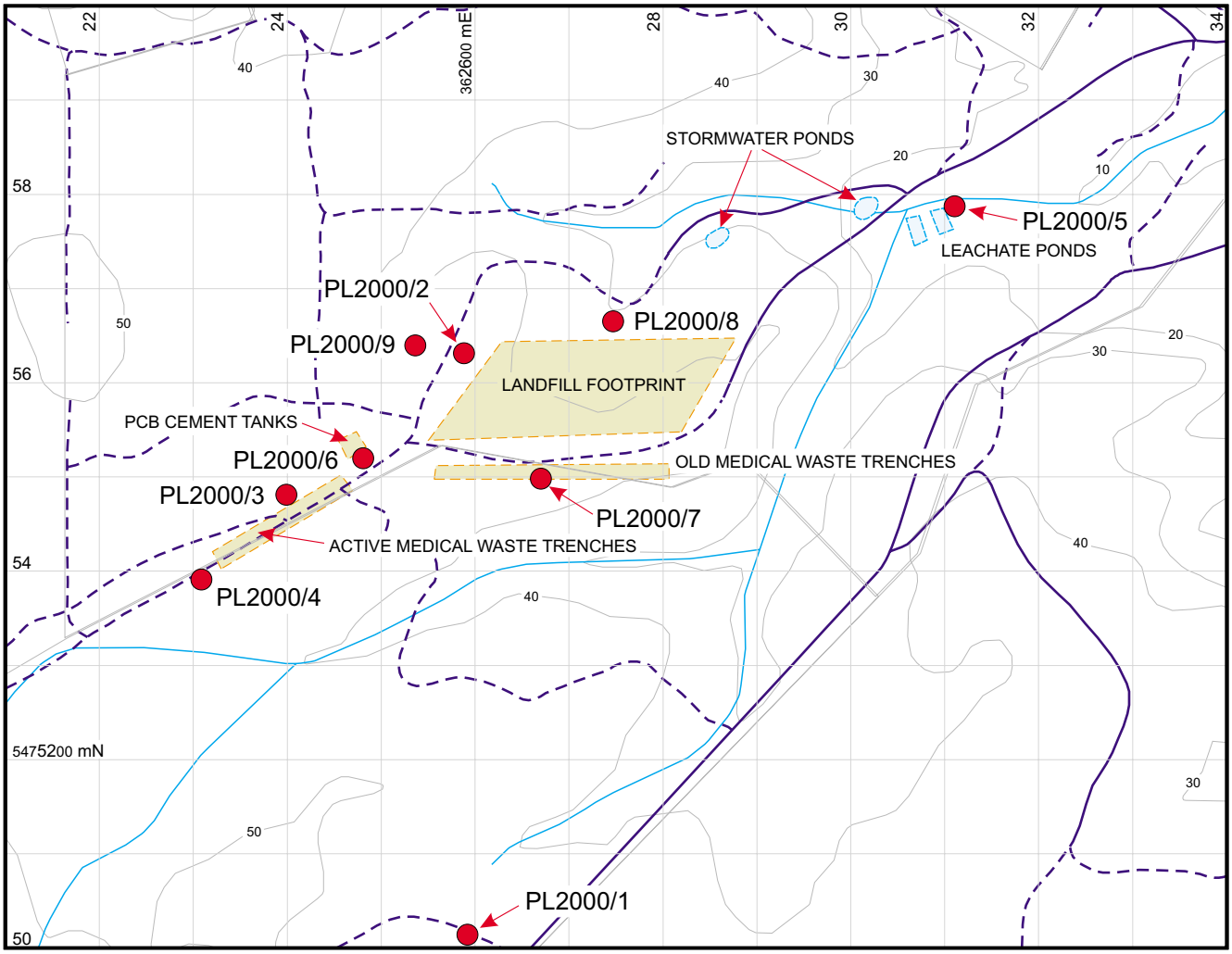


Figure 4

Locations of the nine environmental monitoring bores drilled at the Port Latta waste depot. Note: no casing was installed in PL2000/7.

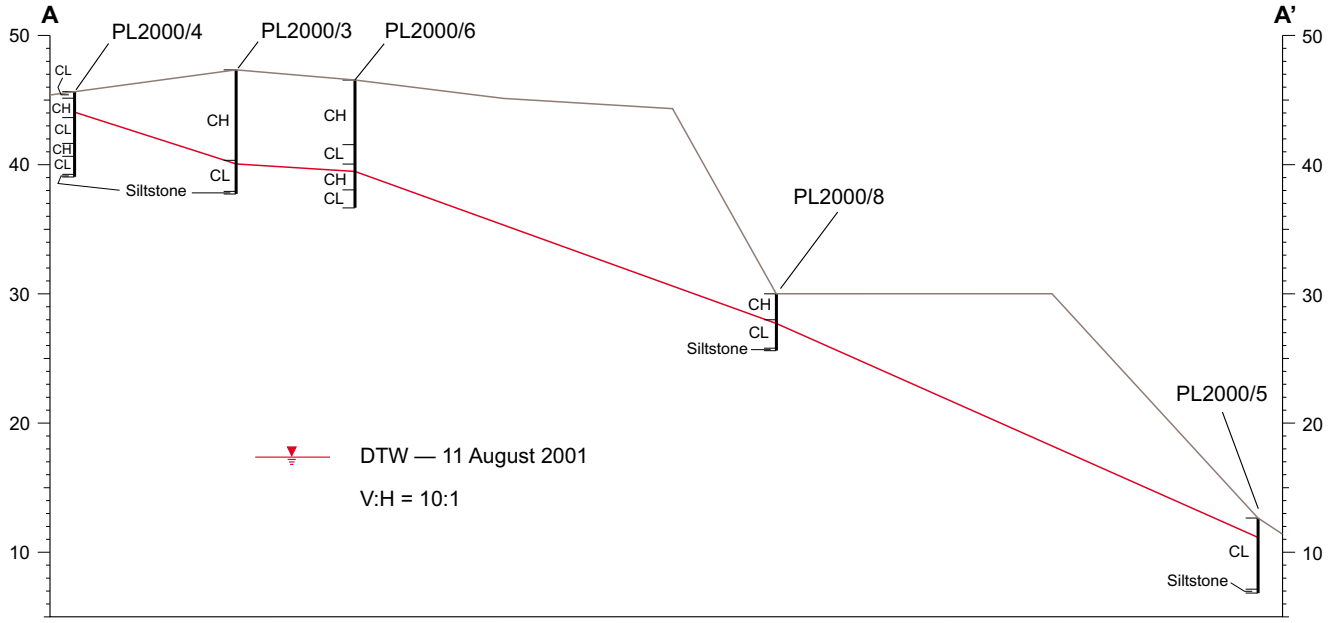


Figure 5

Southwest to northeast cross-section of the site and related standing water levels on 11 August 2001 for boreholes PL2000/3, 4, 5, 6 and 8.

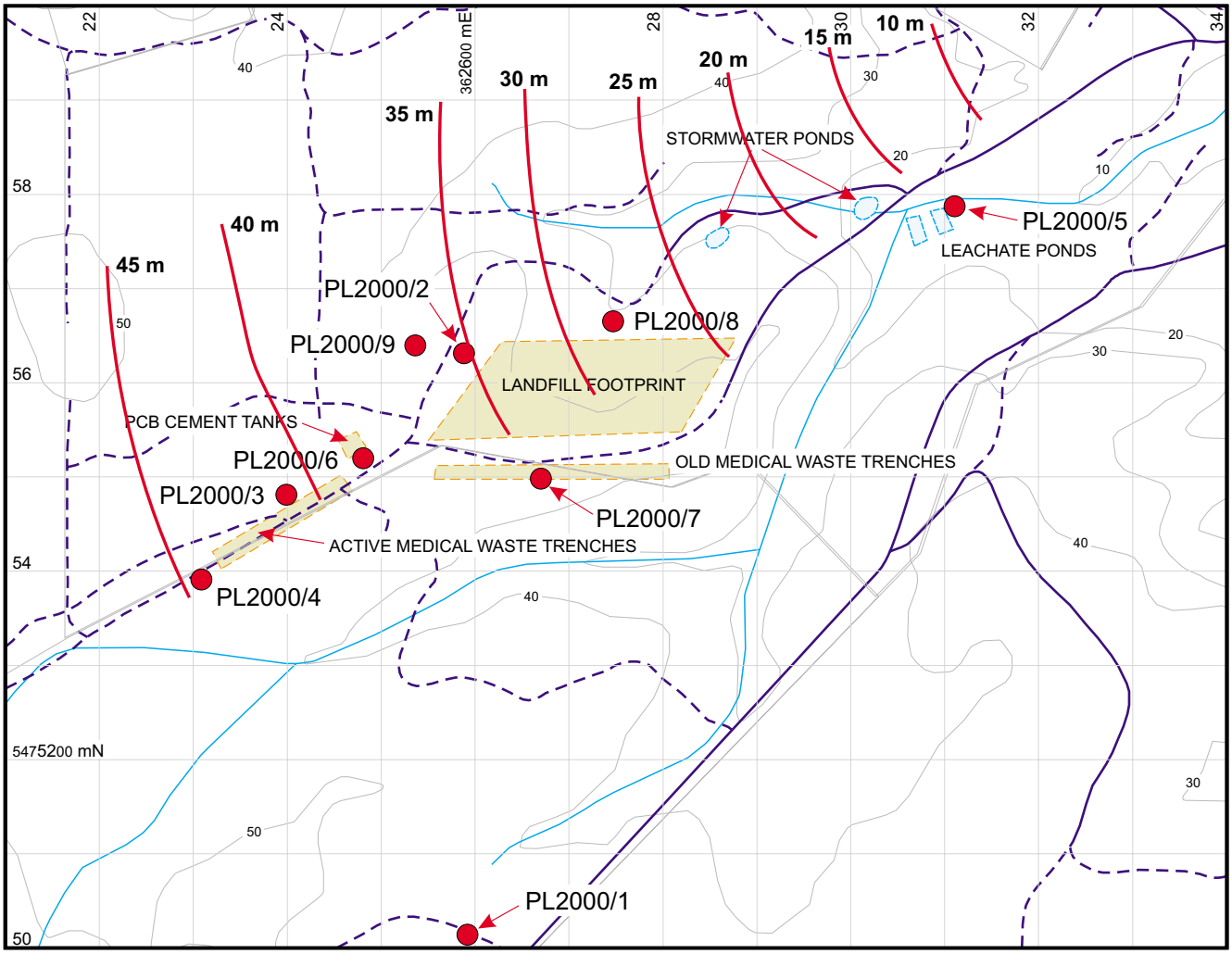


Figure 6

Interpretation of the piezometric surface based on surveyed heights and groundwater depths of the boreholes (RL water surface contours).

the regolith profile slopes towards the coastline to the north. This is consistent with spring discharges observed on the beaches along the coastline.

The removal of the clay overburden and associated well-established vegetation (including many large trees) has promoted groundwater discharge from the interface between the regolith profile and the underlying bedrock. Inflows occur in excavations within this zone and some appear to also have a hydraulic connection to the unconfined (confined?) water within the fractured bedrock aquifer.

In summary, groundwater is perched on the bedrock interface with a deeper fractured aquifer within the bedrock itself. Groundwater flow is towards the coast line to the north of the site. Groundwater gradients appear to increase in the area of the leachate and stormwater ponds. When leachate is pumped from the leachate ponds (and irrigated over the landfill site) the water level in the stormwater ponds also decreases, implying a hydraulic connection between the two systems.

GROUNDWATER CHEMISTRY

All cased bores were sampled on 31 October 2000 in accordance with Australian/New Zealand Standard AS/NZS 5667.11:1998. Analytical Services Tasmania, in accordance with relevant Australian and international standards, carried out laboratory testing of the groundwater samples (Appendix 2). Groundwater values for pH ranged from 5.2 to 7.2, with conductivity values ranging between 180 and 675 µS/cm. Analytical results for groundwater samples are presented on site maps in Appendix 3. Figure 7 is an anion Ternary plot for the results of the groundwater samples, while Tables 1 and 2 compare the analytical results against international standards where a guideline/emission value is stated by the relevant standard.

Iron and manganese are elevated in the background bore. Limonite and other secondary minerals, which occur in fractures on the coastline, imply that iron and manganese are both naturally occurring within the fractured aquifer cementation processes.

Table 1. *Comparison of analytical results against water quality standards (guideline value listed when stated by a relevant standard). Highlighted values exceed emission limits.*

Parameter	*2000/1*	*2000/2*	*2000/3*	*2000/4*	*2000/5*	*2000/6*	*2000/8*	*2000/9*	*Emission limit*
pH	7.2	6.6	5.9	6.0	6.3	5.2	5.6	6.1	N/A
Conductivity (µS/cm)	645	393	216	180	675	285	277	471	N/A: note average sea water value 36 000
TDS (mg/L)	390	243	142	110	406	161	161	280	N/A
Alkalinity CO_3 (mg/L)	<1	<1	<1	<1	<1	<1	<1	<1	N/A
Alkalinity HCO_3 (mg/L)	167	43	23	31	154	5	24	57	N/A
Chloride (mg/L)	65	76	25	21	110	63	51	90	250* (mg/L)
Fluoride (mg/L)	0.41	0.09	0.06	<0.02	0.11	<0.02	0.04	0.04	1.5* (mg/L)
Sulphate (mg/L)	3.7	11	3.1	9.1	12	14	7.2	23	250* (mg/L)
Ammonia (mg/L)	<0.002	0.008	<0.002	<0.002	0.400	0.003	<0.002	<0.002	0.5* (mg/L) nitrogen (as ammonia)
Nitrate + Nitrite (mg/L)	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.007	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Nitrite (mg/L)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Ortho-P (mg/L)	0.011	0.003	<0.002	<0.002	0.003	0.002	0.003	0.005	2.0* as phosphorus
Aluminium (mg/L)	0.012	0.025	0.011	<0.010	1.370	0.036	0.031	0.752	N/A
Arsenic (mg/L)	0.006	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	0.05* (mg/L)
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01* (mg/L)
Cobalt (mg/L)	0.001	0.002	0.018	0.007	0.014	<0.001	<0.001	0.002	N/A
Chromium (mg/L)	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	0.5* (mg/L)
Copper (mg/L)	<0.001	0.004	<0.001	<0.001	0.041	<0.001	0.006	<0.001	1.0* (mg/L)
Iron (mg/L)	**4.460**	0.029	<0.020	0.094	**1.230**	0.020	<0.020	**1.590**	(Combined iron and manganese
Manganese (mg/L)	**1.980**	0.281	0.693	0.693	**0.288**	0.014	0.107	**0.133**	(total 1.0* (mg/L)
Nickel (mg/L)	<0.001	0.005	<0.001	0.001	0.033	0.002	0.002	0.003	0.1** (mg/L)
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	0.009	0.014	<0.005	<0.005	0.05* (mg/L)
Zinc (mg/L)	0.016	0.018	0.003	0.004	0.319	0.005	0.010	0.006	5.0* (mg/L)

* *Environment Protection (Water Pollution) Regulations 1974*, emission into inland water.
** Australian Water Quality Guidelines for Fresh and Marine Waters 1992.
N/A — no emission limit available.

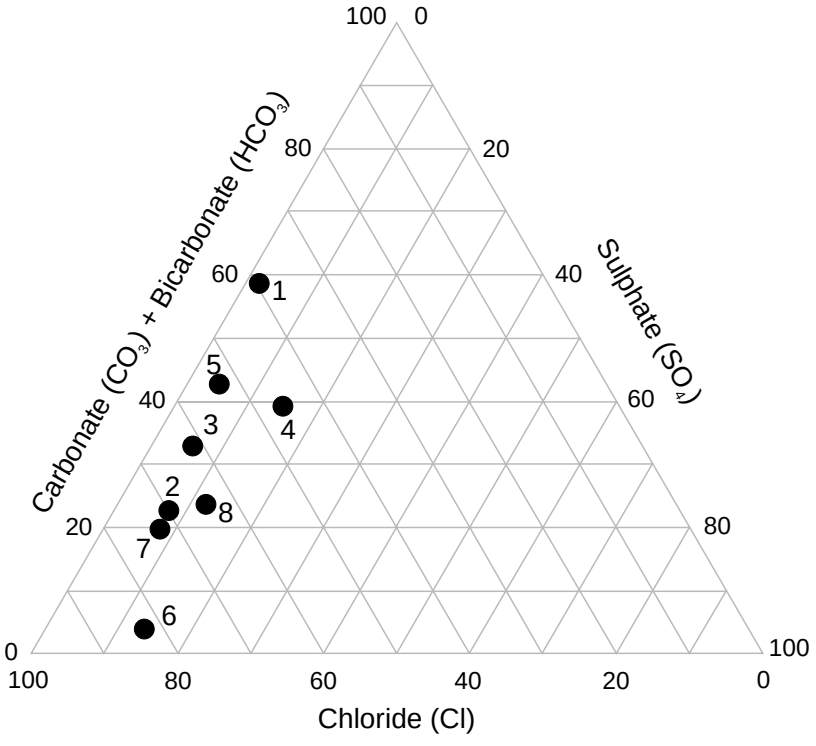


Figure 7
Anion Ternary plot for groundwater bores at the Port Latta waste depot. 1 – PL2000/1; 2 – PL2000/2; 3 – PL000/3; 4 – PL2000/4; 5 – PL2000/5; 6 – PL2000/6; 7 – PL2000/8; 8 – PL2000/9.

Table 2. *Comparison of analytical results against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000.*

	PORT LATTA WASTE DEPOT								ANZECC 2000		
Bore hole number (PL2000/)	1	2	3	4	5	6	8	9	IRRIGATION		LIVESTOCK DRINKING
Analyte									STV (Short-term)	LTV (Long-term)	
Standing Water Level (m)	0.05	13.00	6.10	1.98	1.39	6.02	2.19	5.46			
pH – field (pH Units)	7.3	6.7	6.2	6.1	6.0	5.5	5.7	6.4	**6.0–8.5		
PH – lab (pH Units)	7.2	6.6	5.9	6.0	6.3	5.2	5.6	6.1	**6.0–8.5		
Conductivity – field (µS/cm)	578	384	201	152	570	275	251	410	(1) (Refer Tables 4.2.3 & 4.2.4)		
Conductivity – lab (µS/cm)	645	393	216	180	675	285	277	471			
TDS (mg/L)	390	243	142	110	406	161	161	280			(2) 2,000-10,000 (Refer Table 4.3.1)
Chloride (mg/L)	65	76	25	21	110	63	51	90	(3) MT (Refer Table 4.2.6) MR (Refer Table 4.2.7)		
Fluoride (mg/L)	0.41	0.09	0.06	<0.02	0.11	<0.02	0.04	0.04	4	1	
Sulphate (mg/L)	3.7	11	3.1	9.1	12	14	7.2	23			
NH_3-N (mg/L)	<0.002	0.008	<0.002	<0.002	0.400	0.003	<0.002	<0.002			
(NO_2 + NO_3)-N (mg/L)	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.007			
NO_2-N (mg/L)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003			
PO_4-P (mg/L)	0.011	0.003	<0.002	<0.002	0.003	0.002	0.003	0.005			
Aluminium (µg/L)	12	25	11	<10	1370	36	31	752	20,000	5,000	5,000
Arsenic (µg/L)	6	<5	<5	<5	7	<5	<5	<5	2000	100	500
Cadmium (µg/L)	<1	<1	<1	<1	<1	<1	<1	<1	50	10	10
Cobalt (µg/L)	1	2	18	7	14	<1	<1	2	100	50	1,000
Chromium (µg/L)	<1	<1	<1	<1	4	<1	<1	<1	1,000***	100***	1,000
Copper (µg/L)	<1	4	<1	<1	41	<1	6	<1	5,000	200	400-5,000
Iron (µg/L)	4460	29	<20	94	1230	20	<20	1590	10,000	200	NST
Manganese (µg/L)	1980	281	693	693	288	14	107	133	10,000	200	NST
Nickel (µg/L)	<1	5	<1	1	33	2	2	3	2000	200	1,000
Lead (µg/L)	<5	<5	<5	<5	9	14	<5	<5	5,000	2,000	100
Zinc (µg/L)	16	18	3	4	319	5	10	6	5,000	2,000	20,000

Shaded areas indicate values above relevant guideline levels

Notes:
** set to limit potential for corrosion and fouling of pumping, irrigation and stock watering systems
*** chromium (VI)
(1) Suitability depends on salt tolerance of crop & calculation of ECse, the average root zone salinity. ECse depends on soil type & average root zone leaching fraction
(2) Depending on animal type, within this salinity range may be reluctance to drink or may be some scouring but stock should adapt without loss of production.
(3) ES = Suits extremely sensitive crops
MS = Suits moderately sensitive crops, may affect sensitive crops
MT = Suits moderately tolerant crops
MR = Medium risk of increasing crop cadmium concentrations
MA = may affect crops sensitive to foliar injury through foliar absorption
STV — Short term trigger value for contaminant in irrigation water (<20 years) use
LTV — Long term trigger value for contaminant in irrigation water (100 years) use
NST — Not sufficiently toxic

CONTAMINATION ASSESSMENT

On the premise that PL2000/1 is the control bore, groundwater is slightly more acidic in bores at the landfill site. Conductivity, TDS, and chloride are slightly higher in bore PL2000/5 and aluminium, copper, nickel and zinc are significantly elevated compared to the control bore.

Plate 12 shows soakage observed on the north side of the leachate ponds ten metres west of borehole PL2000/5. The soakage is within ten metres of Stinking Creek, the main surface drainage outlet from the site. Other subsurface leakage from the leachate ponds could inter-react with this surface water system. Data relating to the area in close proximity to the leachate pond demonstrates that groundwater contamination has occurred at this location.

Transportation rates of contaminates within the clay material at the site are expected to be very low. The clay material would also aid in the absorption of metals concentrated within migrating water from either the fill material or any part of the leachate management infrastructure.

Transportation rates of any contaminates within the surface water system could be extremely rapid, depending on residence time for flows in the settling ponds (i.e. hydraulic retention time) and rainfall at the time. Trap efficiency of the surface drainage collection system (in particular during stormwater events) is considered critical to avoid recharge of stormwater into the waste fill materials.

As no hard rock bores exist at the site the quality of the bedrock aquifer in close proximity to the landfill remains unknown. Any contaminates that enter the fractured aquifer are expected to migrate north towards the coast.

PRINCIPAL CONCLUSIONS

This site is an excellent location for a regional waste facility. More efficient management procedures could include the use of natural clay liners, regular cleaning of leachate collection and recirculation infrastructure, quality controlled engineered encapsulation for some materials (i.e. medical waste) and reforestation using appropriate tree and shrub species to control erosion.

Future cells should retain two metres of *in situ* clay material over the bedrock to aid in the prevention of groundwater discharges in the vicinity of the landfill liner and prevent leachate migration into the groundwater. Regular cleaning of the leachate collection system (to prevent calcium carbonate build ups) would also aid in preventing excessive leachate hydraulic heads developing on the landfill liner.

Where groundwater is able to directly recharge waste fill, discharges from the fill material may cause the degradation of surface and groundwater quality within the area of the activity. This site demonstrates the impact groundwater hydraulic pressure may exert on landfill material and related infrastructure. Additional engineering specifications will be required to maintain a standard of best practice environmental management. An integrated site management plan should include long-term monitoring of surface water and groundwater for quality control assessment of the developing engineering design.

FURTHER WORK

Long-term monitoring of groundwater quality would require the drilling of additional boreholes to monitor both groundwater within the regolith profile and the bedrock aquifer. At least one hole could be diamond drilled to assess joint density and cementation at shallow depth within the bedrock aquifer. Bedrock bores should be sited up gradient, within the landfill area, and down gradient of the site. The up-gradient bore may need to be drilled to approximately 70 m to allow for pump testing to gain an understanding of the hydraulic setting within the bedrock aquifer.

Test pitting across the site and the production of related isopach maps would aid in the future management and maximum potential use of clay resources at this site.

REFERENCES

DEARMAN, W. R.; FOOKES, P. G. 1974. Engineering geological mapping for civil engineering practice in the United Kingdom. *Quarterly Journal of Engineering Geology* 7:223–256.

LENNOX, P. G.; CORBETT, K. D.; BAILLIE, P. W.; CORBETT, E. B.; BROWN, A. V. 1982. *Geological Atlas 1:50 000 Series. Sheet 21 (7916S). Smithton*. Department of Mines Tasmania.

[30 May 2002]

Plate 1

Discharge point of one of the sub-liners to the surface water system.

Plate 2

Cement tanks used to store soil contaminated by polychlorinated biphenyls (PCB's).

Plate 3

Active medical waste trench in southern area of the site.

Plate 4

Cracking in the clay and related slumping above a recent medical waste trench.

Plate 5

Palaeochannel located within the weathered Cowrie Siltstone exposed in the northern wall of the Stage 2 filling area.

Plate 6

Precambrian Cowrie Siltstone bedrock exposed on the western end of the Stage 2 filling area.

Plate 7

Tight axial hinge fold in the Precambrian Cowrie Siltstone coastal outcrops.

Plate 8

Pyrite pods in the Precambrian Cowrie Siltstone coastal outcrops.

Plate 9

Limonite on jointing within the heavily fractured Precambrian Cowrie Siltstone in the coastal outcrops.

Plate 10

One of many springs discharging on beaches approximately one kilometre to the north of the landfill footprint.

Plate 11

Spring discharging at the bedrock interface with unconsolidated overburden approximately one kilometre to the north of the landfill footprint. Note discolouration of water.

Plate 12

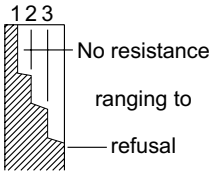
Soakage observed on the north side of the leachate ponds 10 metres west of bore hole PL2000/5.

Appendix 1

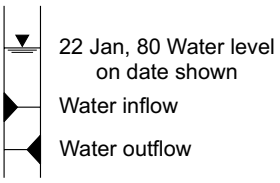
Engineering logs of boreholes

EXPLANATION SHEET FOR ENGINEERING LOGS
Borehole and excavation log

Penetration



Water



Notes — samples and tests

U50	Undisturbed sample 50 mm diameter
D	Disturbed sample
N	Standard penetrometer blow count for 300 mm
N*	SPT + Sample

Material classification

Based on Unified Soil Classification System.

In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

Moisture content

D	Dry, looks and feels dry
M	Moist, no free water on hand when remoulding
W	Wet, free water on hand when remoulding
LL	Liquid limit
PL	Plastic limit
PI	Plasticity index

e.g. M>PL — Moist, moisture content greater than the plastic limit

Consistency

		: hand penetrometer
VS	Very soft	<25 (kPa)
S	Soft	25 – 50
F	Firm	50 – 100
St	Stiff	100 – 200
VSt	Very stiff	200 – 400
H	Hard	>400
Fb	Friable	

Notes: X on log is test result
— is range of results

Density index

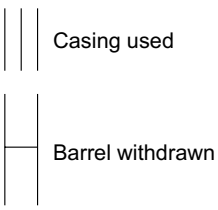
		%
VL	Very loose	0 – 15
L	Loose	15 – 35
MD	Medium dense	35 – 65
D	Dense	65 – 85
VD	Very dense	85 – 100

Fracture description

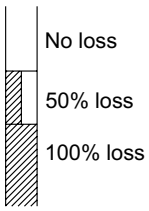
RP	Rough planar
RL	Rough irregular
SP	Smooth planar
SL	Smooth irregular

Cored borehole log

Case - lift



Fluid loss



Lugeons

Lugeon units (uL) are a measure of rock mass permeability. For a 46 to 74 mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of 1 x 10^{-4} mm / sec.

Graphic log

No core

Rock substances represented by clear, contrasting symbols consistent for each project.

Weathering

Fr	Fresh
SW	Slightly weathered
HW	Highly weathered
EW	Extremely weathered

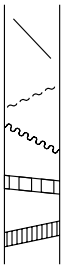
Strength

		point load strength index $I_{s\,(50)}$ (MPa)
EL	Extremely low	< 0.03
VL	Very low	0.03 – 0.1
L	Low	0.1 – 0.3
M	Medium	0.3 – 1
H	High	1 – 3
VH	Very high	3 – 10
EH	Extremely high	>10

Notes: X on log is test result.

Significant defects

Significant defects shown graphically



MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/1**
Sheet 1 of 2

Project: Port Latta waste depot — Location: Brickmakers Plain, Port Latta

Co-ordinates: 55 362592 mE, 5475014 mN
R.L.
Inclination: Vertical
Bearing: -

Drill type: Auger
Drill method: Rotary
Drill fluid: Nil

Hole commenced: 22 August 2000
Hole completed: 22 August 2000
Drilled by: Mr Shane Heawood
Logged by: Mr Andrew Ezzy
Checked by: Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1			CH	CLAY - high plasticity, light brown-grey	M	F	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5		CH	CLAY - high plasticity, light grey	M	S	Tertiary clay overburden
			D Sample ID 3	1.0		CH	CLAY - high plasticity, light grey-green	D	S L	Tertiary clay overburden
			D Sample ID 4	1.5		CH	CLAY - high plasticity, light grey	D	S L	Tertiary clay overburden
	No screen	7 mm Gravel	D Sample ID 5	2.0		CH	CLAY - high plasticity, light grey-green	D	S L	Tertiary clay overburden
			D Sample ID 6	2.5		CH	CLAY - high plasticity, light grey	D	S L	Tertiary clay overburden
			D Sample ID 7	3.0		CH	CLAY - high plasticity, yellow, siltstone chips	D	S L	Tertiary clay overburden
	1.5 metre N.R.F.S. Screen		D Sample ID 8	3.5		CH	CLAY - high plasticity, dark brown, 3% siltstone and mudstone chips	M	F	Tertiary clay overburden
			D Sample ID 9	4.0		CH	CLAY - high plasticity, yellow-brown	W	VL	Tertiary clay overburden
	NS			4.5			* Nylon Rock Fabric Sock			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/1**
Sheet 2 of 2

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 362592 mE 5475014 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	22 August 2000
Inclination	Vertical	Hole completed	22 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	Back in fill	Back in fill	D Sample ID 10		5.5						
			D Sample ID 11		6.0			SILTSTONE - dark grey	W		Bedrock - Precambrian Cowrie Siltstone
			Sample ID numbers refer to samples stored in MRT core shed					End of hole due to auger refusal at 6.2 m			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/2**
Sheet 1 of 3

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 362588 mE 5475631 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 22August 2000
Hole completed 22 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen	Cement	D Sample ID 1			CH	CLAY - high plasticity, red-brown	M	F	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5		CH	CLAY - high plasticity, light red	Vst	D	Tertiary clay overburden
		7mm gravel	D Sample ID 3	1.0		CH	CLAY - high plasticity, red-grey	D	S L	Tertiary clay overburden
			D Sample ID 4	1.5		CH	CLAY - high plasticity, light grey	D	S L	Tertiary clay overburden
			D Sample ID 5	2.0		CH	CLAY - high plasticity, light red, 5% clay grey mottles	D	S L	Tertiary clay overburden
			D Sample ID 6	2.5		CH	CLAY - high plasticity, white-red, 10% clay grey mottles	D	S L	Tertiary clay overburden
			D Sample ID 7	3.0		CH	CLAY - high plasticity, red-brown, clay grey mottles	D	S	Tertiary clay overburden
			D Sample ID 8	3.5		CH	CLAY - high plasticity, light red, clay grey mottles up to 2 mm	D	S L	Tertiary clay overburden
			D Sample ID 9	4.0		CH	CLAY - high plasticity, red- brown, 20% clay light grey mottles	D	S L	Tertiary clay overburden
			D Sample ID 10	4.5		CH	CLAY - high plasticity, red, 5% clay grey mottles	M	S MD	Tertiary clay overburden

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/2**
Sheet 2 of 3

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 362588 mE 5475631 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 22August 2000
Hole completed 22 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen	7mm Gravel	D Sample ID 11			CH	CLAY - high plasticity, red, clay grey mottles	M	L	Tertiary clay overburden
			D Sample ID 12	5.5		CH	CLAY - high plasticity, red, 20% clay grey mottles	M	L	Tertiary clay overburden
			D Sample ID 13	6.0		CL	CLAY - medium plasticity, red, siltstone fragments	M	L	Tertiary clay overburden
			D Sample ID 14	6.5		CL	CLAY - medium plasticity, brown, siltstone fragments	M	S	Tertiary clay overburden
			D Sample ID 15	7.0						
			D Sample ID 16	7.5		CH	CLAY - high plasticity, red, orange siltstone fragments	M	S	Tertiary clay overburden
			D Sample ID 17	8.0						
			D Sample ID 18	8.5						
			D Sample ID 19	9.0		CH	CLAY - high plasticity, red- yellow, various coloured siltstone fragments	M	S L	Tertiary clay overburden
			D Sample ID 20	9.5		CH	CLAY - high plasticity, brown	M	S L	Tertiary clay overburden

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/2**
Sheet 3 of 3

Project: Port Latta waste depot
Location: Brickmakers Plain, Port Latta

Co-ordinates: 55 362588 mE, 5475631 mN
R.L.
Inclination: Vertical
Bearing

Drill type: Auger
Drill method: Rotary
Drill fluid: Nil

Hole commenced: 22 August 2000
Hole completed: 22 August 2000
Drilled by: Mr Shane Heawood
Logged by: Mr Andrew Ezzy
Checked by: Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen					CH	CLAY - high plasticity, red, clay grey mottles	M	S L	Tertiary clay overburden
	2 metre N.R.F.S. Screen	7mm Gravel	D Sample ID 21	10.5		CL	CLAY - medium plasticity, grey-green, black siltstone fragments	M	S L	Tertiary clay overburden
			D Sample ID 22	11.0		CL	CLAY - low plasticity, dark grey, 10% black siltstone fragments	M	F	Tertiary clay overburden
			D Sample ID 23	11.5		CL	CLAY -low plasticity, green-grey, black micaceous siltstone fragments	M	F	Clay overburden transitional zone to Cowrie Siltstone bedrock
	No screen		D Sample ID 24	12.0 12.5 13.0			End of hole due to auger refuse at 13.0 m.			

Sample ID numbers refer to samples stored in MRT core shed

* Nylon Rock Fabric Sock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/3**
Sheet 1 of 2

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 362399 mE 5475481 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	22August 2000
Inclination	Vertical	Hole completed	23 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1			CH	CLAY - high plasticity, red- brown	M	St D	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5						
			D Sample ID 3	1.0		CH	CLAY - high plasticity, light red, clay light grey mottles	M	St D	Tertiary clay overburden
			D Sample ID 4	1.5		CH	CLAY - high plasticity, light grey, clay orange mottles	D	S L	Tertiary clay overburden
	No screen	7 mm Gravel	D Sample ID 5	2.0		CH	CLAY - high plasticity, white	D	S L	Tertiary clay overburden
			D Sample ID 6	2.5		CH	CLAY - high plasticity, light red, 30% clay white mottles	D	S L	Tertiary clay overburden
			D Sample ID 7	3.0		CH	CLAY - high plasticity, light red, 5% clay white mottles	D	S L	Tertiary clay overburden
			D Sample ID 8	3.5		CH	CLAY - high plasticity, red, 5% clay light brown mottles	D	S L	Tertiary clay overburden
			D Sample ID 9	4.0		CH	CLAY - high plasticity, light red, 5% clay white mottles	D	S L	Tertiary clay overburden
				4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/3**
Sheet 2 of 2

Project: Port Latta waste depot — Location: Brickmakers Plain, Port Latta

Co-ordinates: 55 362399 mE, 5475481 mN
R.L.
Inclination: Vertical
Bearing

Drill type: Auger
Drill method: Rotary
Drill fluid: Nil

Hole commenced: 22 August 2000
Hole completed: 23 August 2000
Drilled by: Mr Shane Heawood
Logged by: Mr Andrew Ezzy
Checked by: Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen	7 mm Gravel	D Sample ID 11			CH	CLAY - high plasticity, light red, 20% clay yellow mottles 22/08/00	D	S L	Tertiary clay overburden
			D Sample ID 12	5.5		CH	CLAY - high plasticity, light brown- red 23/08/00	D	S L	Tertiary clay overburden
			D Sample ID 13	6.0						
			D Sample ID 14	6.5						
			D Sample ID 15			CH	CLAY - high plasticity, light brown- red, clay white mottles	D	S L	Tertiary clay overburden
			D Sample ID 16	7.0		CL	CLAY - medium plasticity, light red, siltstone orange rounded fragments	D	L	Clay overburden transitional zone to Cowrie Siltstone bedrock
	2 metre screen - 4 x 150mm spaced 5mm holes with N.R.F.S.		D Sample ID 17	7.5						
			D Sample ID 18	8.0		CL	CLAY - medium plasticity, light red, weathered siltstone various coloured rounded fragments	D	L	Clay overburden transitional zone to Cowrie siltstone bedrock
			D Sample ID 19	8.5		CL	CLAY - low plasticity, black and grey, mottled	W	S	Clay overburden transitional zone to Cowrie siltstone bedrock
	No screen		D Sample ID 20	9.0						
				9.5			SILTSTONE- dark grey			Cowrie siltstone bedrock
	Sample ID numbers refer to samples stored in MRT core shed						End of hole due to auger refusal at 9.7 m * Nylon Rock Fabric Sock			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/4**
Sheet 1 of 2

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 362309 mE
5475391 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 23August 2000
Hole completed 23 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1			CL	CLAY - black-brown	M	F	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5		CH	CLAY - high plasticity, light red	M	F	Tertiary clay overburden
	No screen	7 mm Gravel	D Sample ID 3	1.0		CH	CLAY - high plasticity, red-yellow, 40% clay grey mottles	D	L	Tertiary clay overburden
			D Sample ID 4	1.5						
			D Sample ID 5	2.0		CL	CLAY - medium plasticity, red-yellow, 20% clay grey mottles, strong sulphide odour in returns	D	L	Tertiary clay overburden
			D Sample ID 6	2.5		CL	CLAY - medium plasticity, yellow, clay 10% grey and 5% red mottles	D	L	Tertiary clay overburden
			D Sample ID 7	3.0		CL	CLAY - medium plasticity, light red, siltstone fragments	D	L	Tertiary clay overburden
			D Sample ID 8	3.5						
	Screen		D Sample ID 9	4.0		CH	CLAY - high plasticity, light red, clay 5% white mottles and 10% siltstone fragments	D	L	Tertiary clay overburden
			D Sample ID 10	4.5		CH	CLAY - high plasticity, light red, siltstone chips	M	F	Tertiary clay overburden

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/4**
Sheet 2 of 2

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 362309 mE
5475391 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 22 August 2000
Hole completed 23 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
			D Sample ID 11								
	2 metre N.R.F.S. Screen	7 mm Gravel	D Sample ID 12		5.5		CL	CLAY - medium plasticity, light red, siltstone and mudstone	W	F	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 13		6.0						
	No screen		D Sample ID 14				CL	CLAY - low plasticity, black	M	F	Weathered Cowrie Siltstone
					6.5			SILTSTONE - various colours, mudstone chips			Cowrie Siltstone bedrock
			Sample ID numbers refer to samples stored in MRT core shed					End of hole due to auger refusal at 6.6 m			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/5**
Sheet 1 of 2

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 363111 mE
5475787 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 23August 2000
Hole completed 23 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1			CL	CLAY - medium plasticity, grey, siltstone fragments - cover material	M	F	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5		CL	CLAY - medium plasticity, yellow, siltstone fragments - cover material	M	F	Tertiary clay overburden
	No screen		D Sample ID 3	1.0		CL	CLAY - medium plasticity, black, humic, quartz pebbles	M	S	Tertiary clay overburden
			D Sample ID 4	1.5						
		7 mm Gravel	D Sample ID 5	2.0		CL	CLAY - medium plasticity, light grey, mudstone grey fragments	D	S VL	Tertiary clay overburden
			D Sample ID 6	2.5		CL	CLAY - medium plasticity, dark grey, 5% clay brown mottles	D	S L	Tertiary clay overburden
	3 metre N.R.F.S. Screen with 4 x 150mm spaced 5mm holes		D Sample ID 7	3.0		CL	CLAY - medium plasticity, dark grey, mudstone dark grey fragments	D	S L	Tertiary clay overburden
			D Sample ID 8	3.5						
			D Sample ID 9	4.0		CL	CLAY - medium plasticity, dark grey, mudstone dark grey fragments	D	S L	Tertiary clay overburden
			D Sample ID 10	4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/5**
Sheet 2 of 2

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 363111 mE 5475787 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	22 August 2000
Inclination	Vertical	Hole completed	23 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		7 mm Gravel	D Sample ID 11,12 & 13								
	No screen						CL	CLAY - medium plasticity, dark grey	M	F	Tertiary clay overburden
			D Sample ID 14		5.5			SILTSTONE - dark grey			Cowrie Siltstone bedrock
			Sample ID numbers refer to samples stored in MRT core shed					End of hole due to auger refusal at 5.75 m.			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/6**
Sheet 1 of 2

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 362481 mE 5475520 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	23August 2000
Inclination	Vertical	Hole completed	24 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1			CH	CLAY - high plasticity, red-brown, clay various coloured mottles - cover material	M	F	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5						
				1.0		CH	CLAY - high plasticity, brown, clay various coloured mottles	M	F	Tertiary clay overburden
			D Sample ID 3							
			D Sample ID 4	1.5						
			D Sample ID 5	2.0						
	No screen	7 mm Gravel	D Sample ID 6	2.5		CH	CLAY - high plasticity, light red, 30% clay light grey mottles	D	S L	Tertiary clay overburden
			D Sample ID 7	3.0		CH	CLAY - high plasticity, light red, 20% clay white mottles	D	S L	Tertiary clay overburden
			D Sample ID 8	3.5		CH	CLAY - high plasticity, light red	D	S L	Tertiary clay overburden
			D Sample ID 9	4.0		CH	CLAY - high plasticity, light red, siltstone light red fragments	D	S L	Tertiary clay overburden
			D Sample ID 10	4.5		CH	CLAY - high plasticity, yellow, 5% clay brown mottles and siltstone fragments	D	S L	Tertiary clay overburden

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/6**
Sheet 2 of 2

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 362481 mE 5475520 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	23 August 2000
Inclination	Vertical	Hole completed	24 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen	7 mm Gravel	D Sample ID 11				CL	CLAY - medium plasticity, light brown, siltstone various coloured fragments	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 12		5.5						
			D Sample ID 13		6.0						
			D Sample ID 14		6.5		CH	CLAY - high plasticity, yellow and brown, siltstone fragments	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 15		7.0		CH	CLAY - high plasticity, yellow, siltstone fragments	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
	3 metre N.R.F.S. Screen with 4 x 150mm spaced 5 mm holes		D Sample ID 16		7.5		CH	CLAY - high plasticity, brown-grey, 5% clay various coloured mottles and siltstone chips	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 17		8.0						
			D Sample ID 18		8.5		CL	CLAY - medium plasticity, light brown-grey, siltstone black fragments	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 19		9.0		CL	CLAY - medium plasticity, dark yellow- grey, siltstone fragments	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 20		9.5		CL	CLAY - medium plasticity, yellow-brown, siltstone and quartz fragments	D	S L	
	N/S		D Sample ID 21				CL	CLAY - low plasticity, dark grey, black siltstone	D	S/L	
								End of hole at 9.9 m — Installation 24/08/2000			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/7**
Sheet 1 of 1

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 362670 mE 5475498 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	24 August 2000
Inclination	Vertical	Hole completed	24 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No casing	Bentonite	D Sample ID 1	0.0		CH	CLAY - high plasticity, light red, siltstone fragments	M	F	Cover material - made
			D Sample ID 2	0.5		CH	CLAY - high plasticity, light red, 10% clay various coloured mottles	M	F	Cover material - made
			D Sample ID 3	1.0						
			D Sample ID 4	1.5						
		Back fill of clay returns	D Sample ID 5	2.0		CH	CLAY - high plasticity, white	M	F	Cover material - made
			D Sample ID 6	2.5			WASTE fill - medical waste, clay green			Medical waste
			Sample ID numbers refer to samples stored in MRT core shed	3.0			End of hole at 3.0 m			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/8**
Sheet 1 of 1

Project: Port Latta waste depot
Location: Brickmakers Plain, Port Latta

Co-ordinates: 55 362747 mE, 5475665 mN
R.L.
Inclination: Vertical
Bearing

Drill type: Auger
Drill method: Rotary
Drill fluid: Nil

Hole commenced: 24 August 2000
Hole completed: 24 August 2000
Drilled by: Mr Shane Heawood
Logged by: Mr Andrew Ezzy
Checked by: Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen	Cement	D Sample ID 1			CH	CLAY - high plasticity, light red, siltstone fragments	M	F	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5						
			D Sample ID 3	1.0		CH	CLAY - high plasticity, light red, 10% clay various coloured mottles	M	F	Tertiary clay overburden
			D Sample ID 4	1.5		CH	CLAY - high plasticity, mottled light red and grey, black siltstone fragments	M	F	Clay overburden transitional zone to Cowrie Siltstone bedrock
		7 mm Gravel	D Sample ID 5	2.0		CL	CLAY - low plasticity, black, 10% black siltstone and 5% quartz fragments	M	F	Clay overburden transitional zone to Cowrie Siltstone bedrock
	1.5 m N.R.F.S.* Screen 4x150mm spaced 5mm holes		D Sample ID 6	2.5		CL	CLAY - medium plasticity, dark grey, 10% siltstone dark grey fragments	D	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 7	3.0						
			D Sample ID 8	3.5		CL	CLAY - low plasticity, black, 10% siltstone fragments	M	S L	Clay overburden transitional zone to Cowrie Siltstone bedrock
	No screen		D Sample ID 9 & 10	4.0		CL	CLAY - medium plasticity, mottled grey and yellow	M	F	
							SILTSTONE - Various colours			Cowrie Siltstone

Sample ID numbers refer to samples stored in MRT core shed

End of hole due to auger refusal at 4.3 m.

* Nylon Rock Fabric Sock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/9**
Sheet 1 of 3

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 362536 mE
5475640 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 22August 2000
Hole completed 22 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1			CH	CLAY - high plasticity, light red, 10% siltstone fragments	M	F D	Tertiary clay overburden
		Bentonite	D Sample ID 2	0.5		CH	CLAY - high plasticity, light red, 10% clay white mottles	M	F	Tertiary clay overburden
			D Sample ID 3	1.0		CH	CLAY - high plasticity, light red and grey	M	F	Tertiary clay overburden
			D Sample ID 4	1.5		CH	CLAY - high plasticity, light grey	D	F	Tertiary clay overburden
			D Sample ID 5	2.0		CH	CLAY - high plasticity, red-orange, 30% clay mottles various colours	D	S	Tertiary clay overburden
			D Sample ID 6	2.5		CH	CLAY - high plasticity, light red, 15% clay mottles various colours	D	S	Tertiary clay overburden
			D Sample ID 7	3.0		CH	CLAY - high plasticity, light red-brown, 10% clay mottles white	D	S	Tertiary clay overburden
			D Sample ID 8	3.5		CH	CLAY - high plasticity, light red, 10% clay mottles white	D	S	Tertiary clay overburden
			D Sample ID 9	4.0		CH	CLAY -high plasticity, red-brown, 5% clay mottles various colours	D	F	Tertiary clay overburden
			D Sample ID 10	4.5		CH	CLAY - high plasticity, light red, 5% siltstone various coloured fragments	D	S	Tertiary clay overburden
	No screen	7 mm Gravel								

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/9**
Sheet 2 of 3

Project Port Latta waste depot — Location Brickmakers Plain, Port Latta

Co-ordinates 55 362536 mE
5475640 mN
R.L.
Inclination Vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 24August 2000
Hole completed 24 August 2000
Drilled by Mr Shane Heawood
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
			D Sample ID 11								
			D Sample ID 12	5.5			CH	CLAY - high plasticity, light brown and red, 5% clay mottles various colours	D	S	Tertiary clay overburden
			D Sample ID 13	6.0							
			D Sample ID 14	6.5			CH	CLAY - high plasticity, light brown, siltstone various coloured fragments	D	S	Tertiary clay overburden
			D Sample ID 15	7.0			CH	CLAY - high plasticity, light brown, 10% clay mottles yellow	D	S	Tertiary clay overburden
			D Sample ID 16	7.5			CH	CLAY - high plasticity, light red	D	S	Tertiary clay overburden
			D Sample ID 17	8.0			CH	CLAY - high plasticity, green-grey, green-yellow and brown	D	S	Tertiary clay overburden
			D Sample ID 18	8.5			CH	CLAY - high plasticity, yellow and green-grey, 5% siltstone grey fragments	M	S	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 19	9.0			CL	CLAY - medium plasticity, grey and green-brown, siltstone yellow and grey inter banded (1mm) fragments	D	S	Clay overburden transitional zone to Cowrie Siltstone bedrock
			D Sample ID 20	9.5			CL	CLAY - low plasticity, mottled various colours, siltstone chips * Nylon Rock Fabric Sock	M	F	Clay overburden transitional zone to Cowrie Siltstone bedrock

No screen
7 mm Gravel
No screen 1.5 m
N.R.F.S.* Screen 4x150mm spaced 5mm holes

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **PL2000/9**
Sheet 3 of 3

Project	Port Latta waste depot	Location	Brickmakers Plain, Port Latta
Co-ordinates	55 362536 mE 5475640 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	24 August 2000
Inclination	Vertical	Hole completed	24 August 2000
Bearing		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
			D Sample ID 21								
					10.2			End of hole due to auger refuse at 10.2 m			Auger refusal most likely on Cowrie Siltstone bedrock

Sample ID numbers refer to samples stored in MRT core shed

Appendix 2

Analytical Services Tasmania — laboratory reports

Tasmania

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c|- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005
Telephone: (03) 6226 7175 Fax: (03) 6226 7825
Email: ast.sandybay@dpiwe.tas.gov.au

NATA Accreditation Number: 5589

Laboratory Report

Report No:	13772 *Please quote this number when making enquiries about this report*	
Submitted By:	Andrew Ezzy	
Client:	Mineral Resources Tasmania	
Site Description:	Port Latta Waste Depot	
Received:	03-Nov-00	**Client Order No:**
Report Date:	01-Dec-00	
Report To:	Andrew Ezzy	
Address:	Gordons Hill Rd Rosny TAS 7018	

Test Method(s) :

1001-Water:	pH in Water by APHA Method 4500-H
1002-Water:	Conductivity by APHA Method 2510
1004-Water:	Solids, Total Dissolved by APHA Method 2540C
1101-Water:	Alkalinity by APHA Method 2320/4500-CO2
1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120

Mike Johnson
Manager

Tasmania

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c|- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005

NATA Accreditation Number: 5589

Report No: 13772 **Report Date:** 01-Dec-00

Method	Analyte	Lab.No.: / Sample Id.: / Units / Sampled On :	13081 PL 2000/1 31/10/00 14:50	13082 PL 2000/2 31/10/00 12:50	13083 PL 2000/3 31/10/00 14:35	13084 PL 2000/4 31/10/00 15:20
1001-Water	pH		7.2	6.6	5.9	6.0
1002-Water	Conductivity	µS/cm	645	393	216	180
1004-Water	TDS	mg/L	390	243	142	110
1101-Water	Alkalinity CO3	mg/L CaCO3	<1	<1	<1	<1
	Alkalinity HCO3	mg/L CaCO3	167	43	23	31
1103-Water	Chloride	mg/L	65	76	25	21
	Fluoride	mg/L	0.41	0.09	0.06	<0.02
	Sulphate	mg/L	3.7	11	3.1	9.1
1201-Water	Ammonia	µg-N/L	<2	8	<2	<2
	Nitrate+Nitrite	µg-N/L	5	5	5	5
	Nitrite	µg-N/L	<2	<2	<2	<2
	Ortho-P	µg-P/L	11	3	<2	<2
1301-Water	Al (Dissolved)	µg/L	12	25	11	<10
	As (Dissolved)	µg/L	6	<5	<5	<5
	Cd (Dissolved)	µg/L	<1	<1	<1	<1
	Co (Dissolved)	µg/L	1	2	18	7
	Cr (Dissolved)	µg/L	<1	<1	<1	<1
	Cu (Dissolved)	µg/L	<1	4	<1	<1
	Fe (Dissolved)	µg/L	4460	29	<20	94
	Mn (Dissolved)	µg/L	1980	281	693	693
	Ni (Dissolved)	µg/L	<1	5	<1	1
	Pb (Dissolved)	µg/L	<5	<5	<5	<5
	Zn (Dissolved)	µg/L	16	18	3	4

Tasmania

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c|- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005

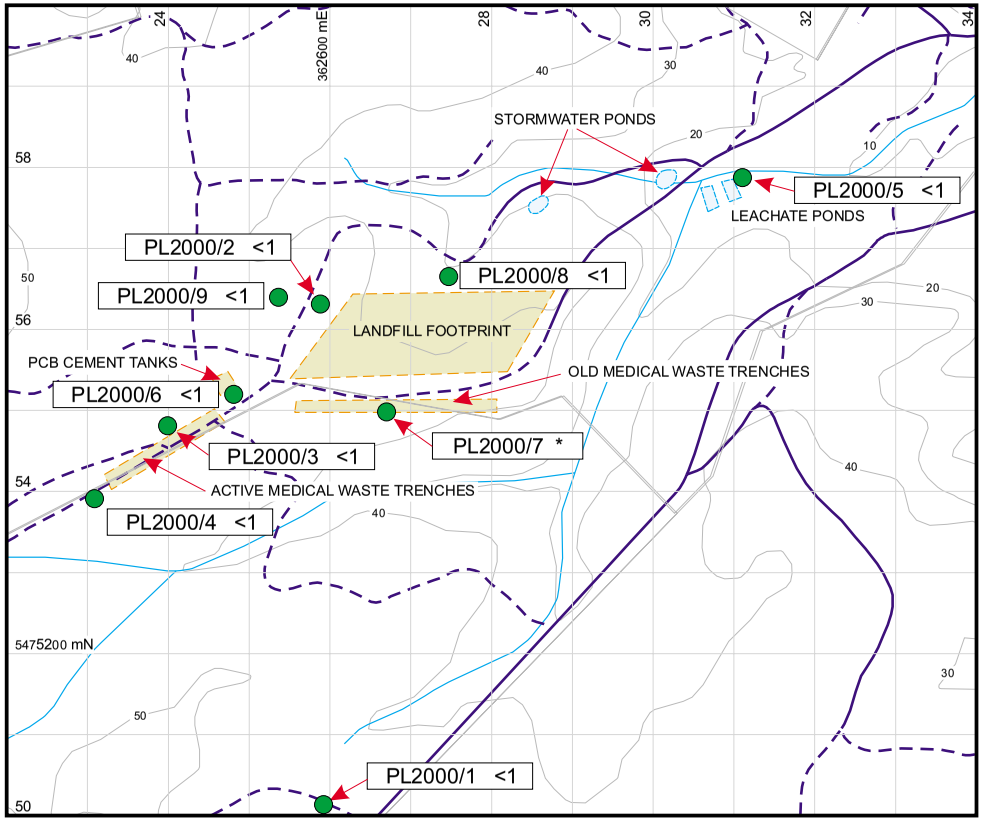
NATA Accreditation Number: 5589

Report No: 13772 **Report Date:** 01-Dec-00

		Lab.No.:	13085	13086	13087	13088
		Sample Id.:	PL 2000/5	PL 2000/6	PL 2000/8	PL 2000/9
Method	Analyte	Units / Sampled On :	31/10/00 11:10	31/10/00 14:20	31/10/00 11:50	31/10/00 13:45
1001-Water	pH		6.3	5.2	5.6	6.1
1002-Water	Conductivity	µS/cm	675	285	277	471
1004-Water	TDS	mg/L	406	161	161	280
1101-Water	Alkalinity CO3	mg/L CaCO3	<1	<1	<1	<1
	Alkalinity HCO3	mg/L CaCO3	154	5	24	57
1103-Water	Chloride	mg/L	110	63	51	90
	Fluoride	mg/L	0.11	<0.02	0.04	0.04
	Sulphate	mg/L	12	14	7.2	23
1201-Water	Ammonia	µg-N/L	400	3	<2	<2
	Nitrate+Nitrite	µg-N/L	5	5	4	7
	Nitrite	µg-N/L	<2	<2	<2	3
	Ortho-P	µg-P/L	3	2	3	5
1301-Water	Al (Dissolved)	µg/L	1370	36	31	752
	As (Dissolved)	µg/L	7	<5	<5	<5
	Cd (Dissolved)	µg/L	<1	<1	<1	<1
	Co (Dissolved)	µg/L	14	<1	<1	2
	Cr (Dissolved)	µg/L	4	<1	<1	<1
	Cu (Dissolved)	µg/L	41	<1	6	<1
	Fe (Dissolved)	µg/L	1230	20	<20	1590
	Mn (Dissolved)	µg/L	288	14	107	133
	Ni (Dissolved)	µg/L	33	2	2	3
	Pb (Dissolved)	µg/L	9	14	<5	<5
	Zn (Dissolved)	µg/L	319	5	10	6

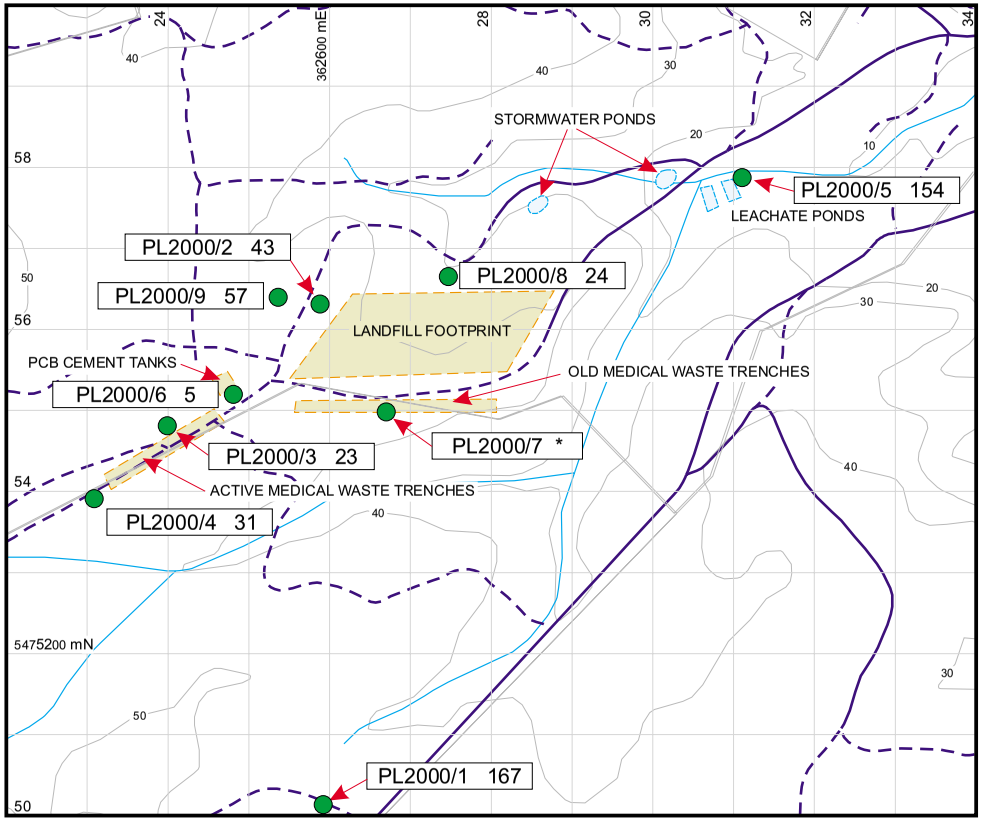
Appendix 3
Analytical results on site maps

Port Latta Waste Depot
October 2000
Alkalinity CO_3 (mg/L $CaCO_3$)



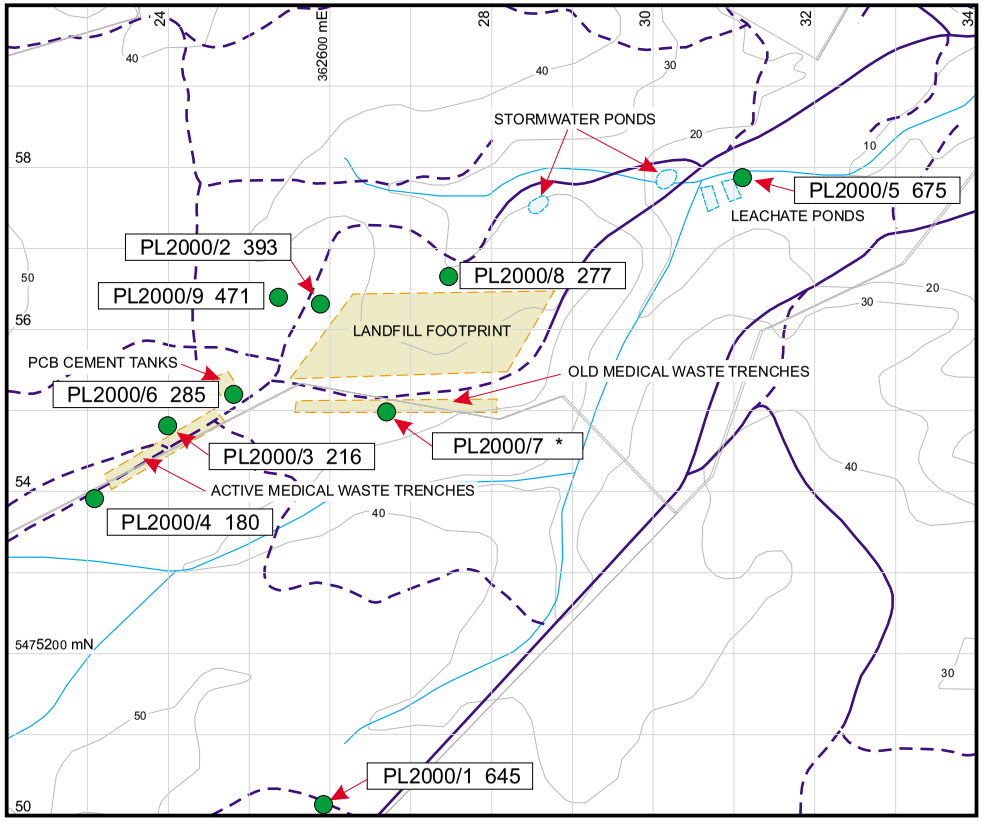
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Alkalinity HCO_3 (mg/L $CaCO_3$)



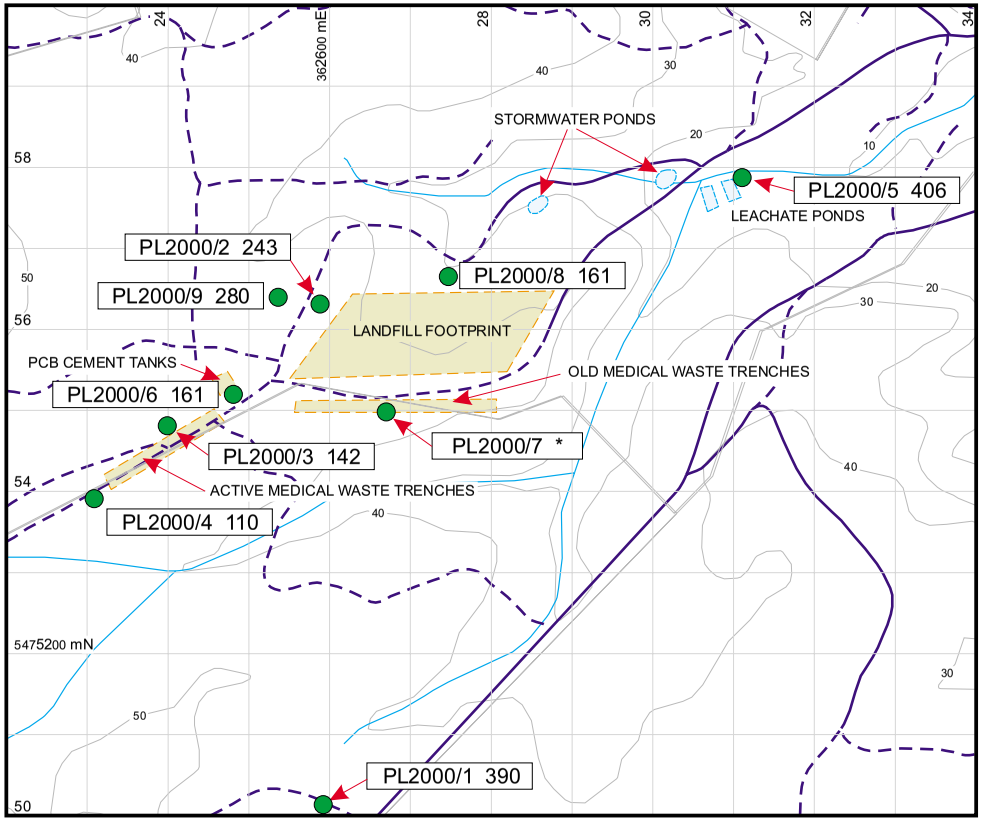
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Conductivity (μS/cm)



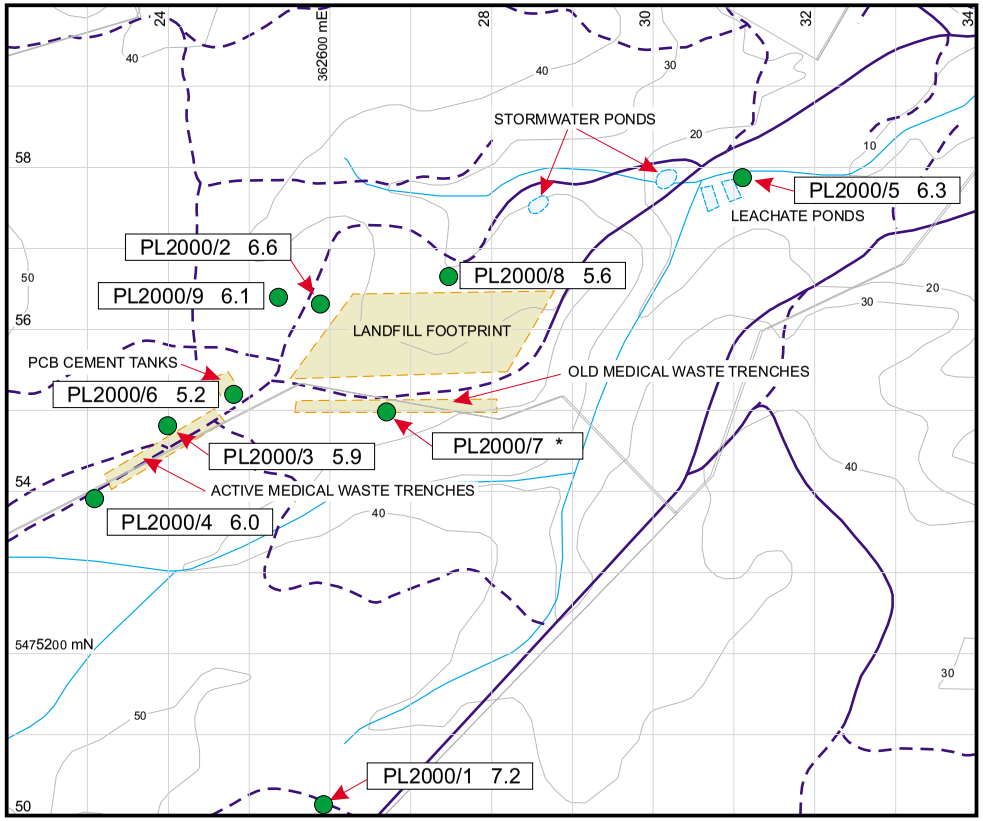
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
TDS (mg/L)



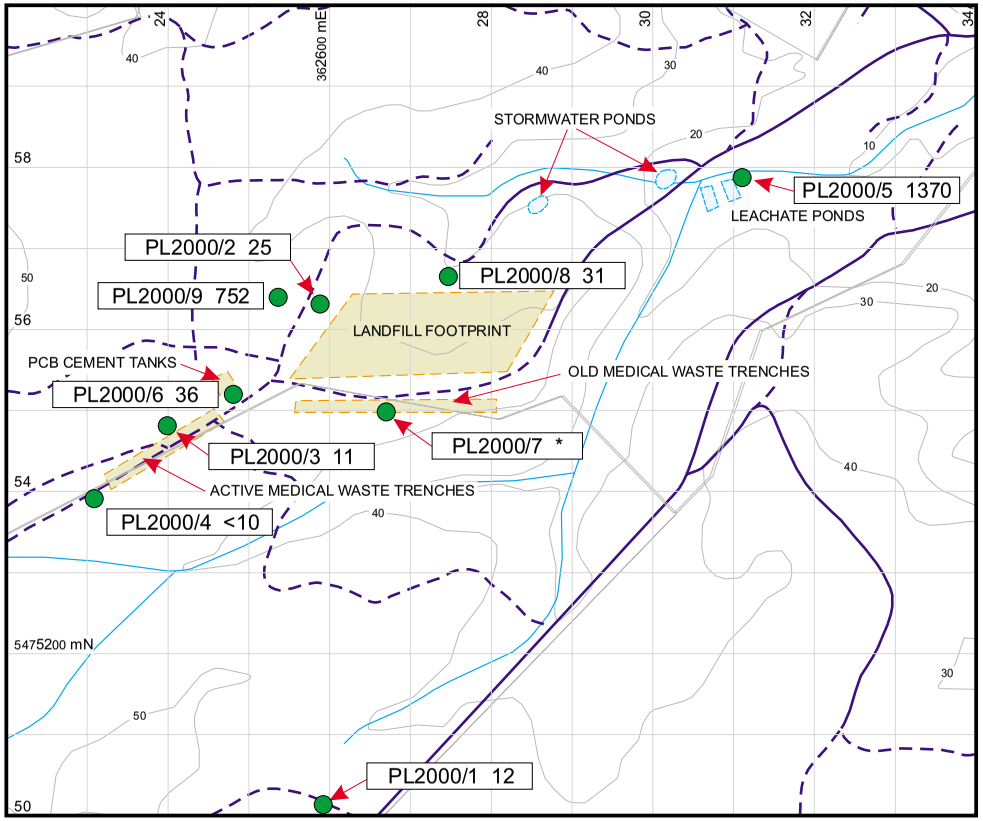
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
pH



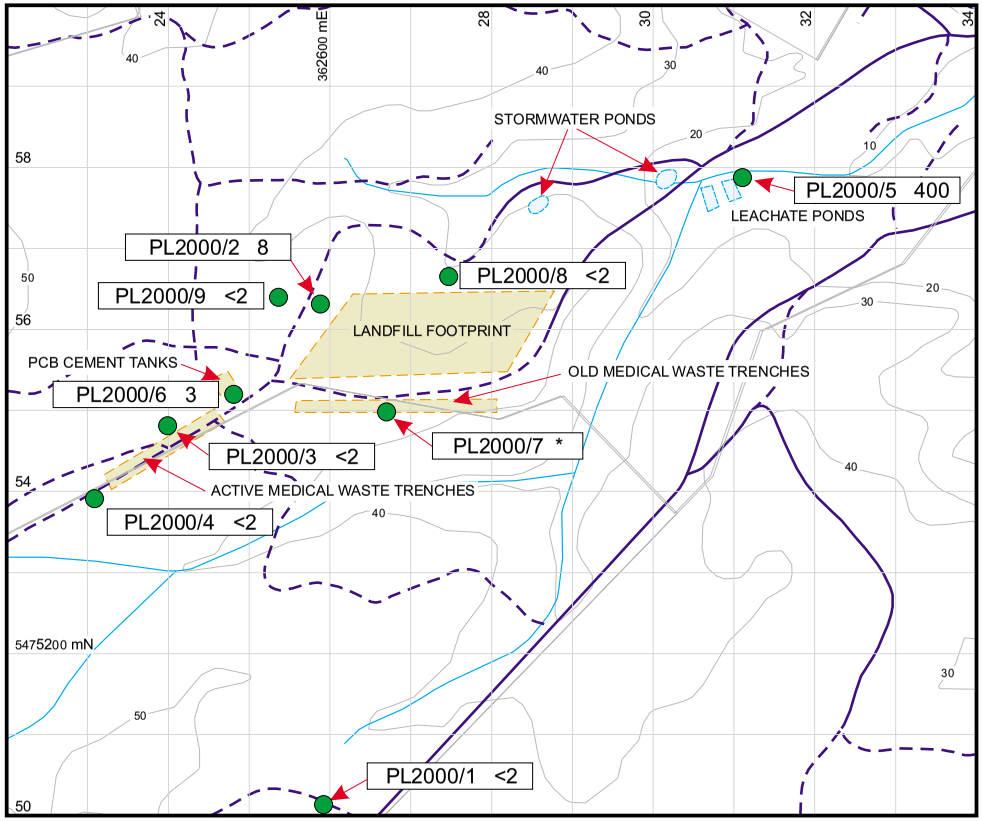
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Al (μg/L)



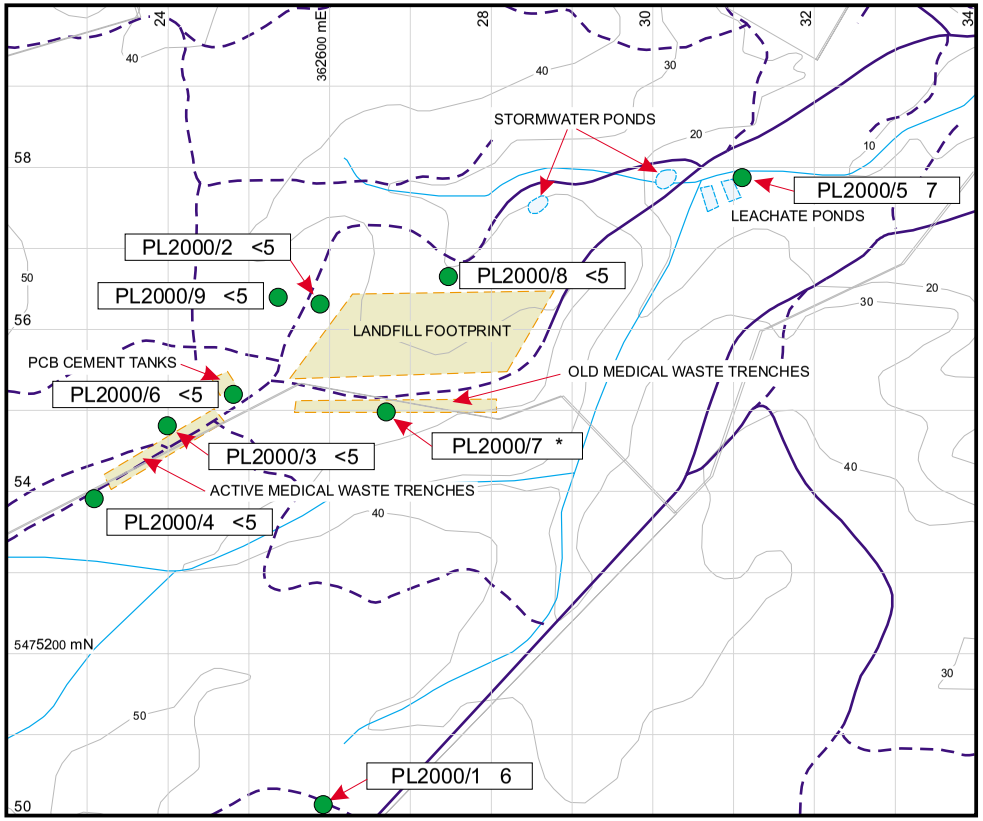
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Ammonia (μg-N/L)



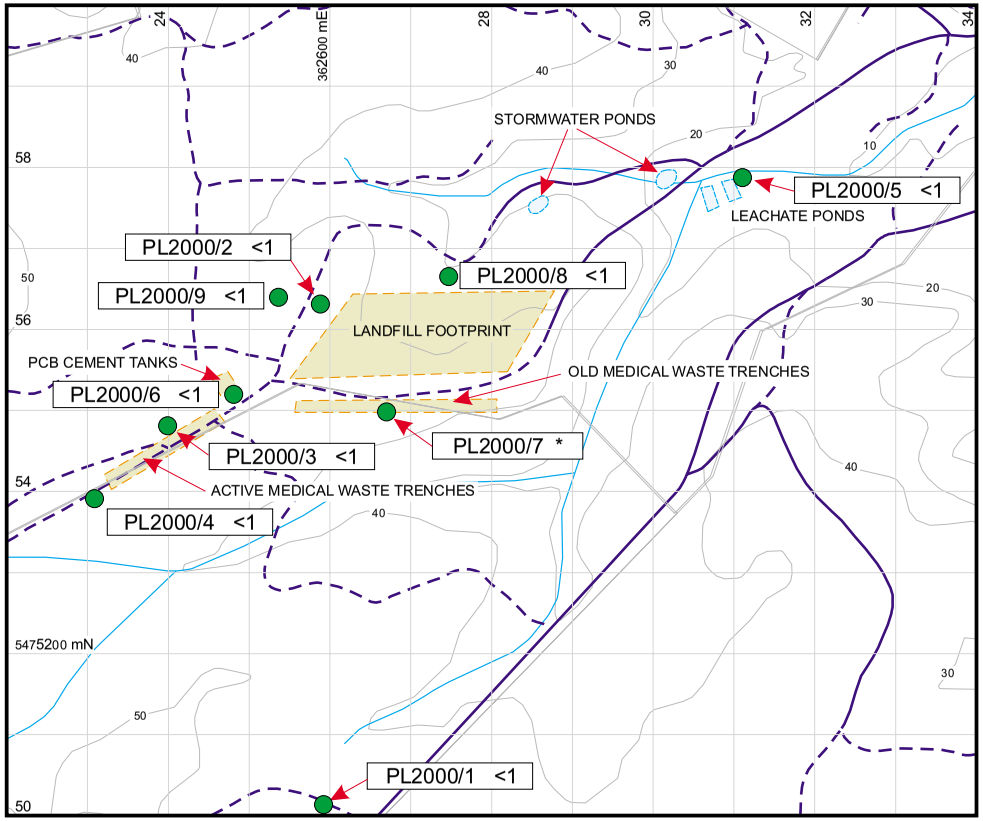
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
As (μg/L)



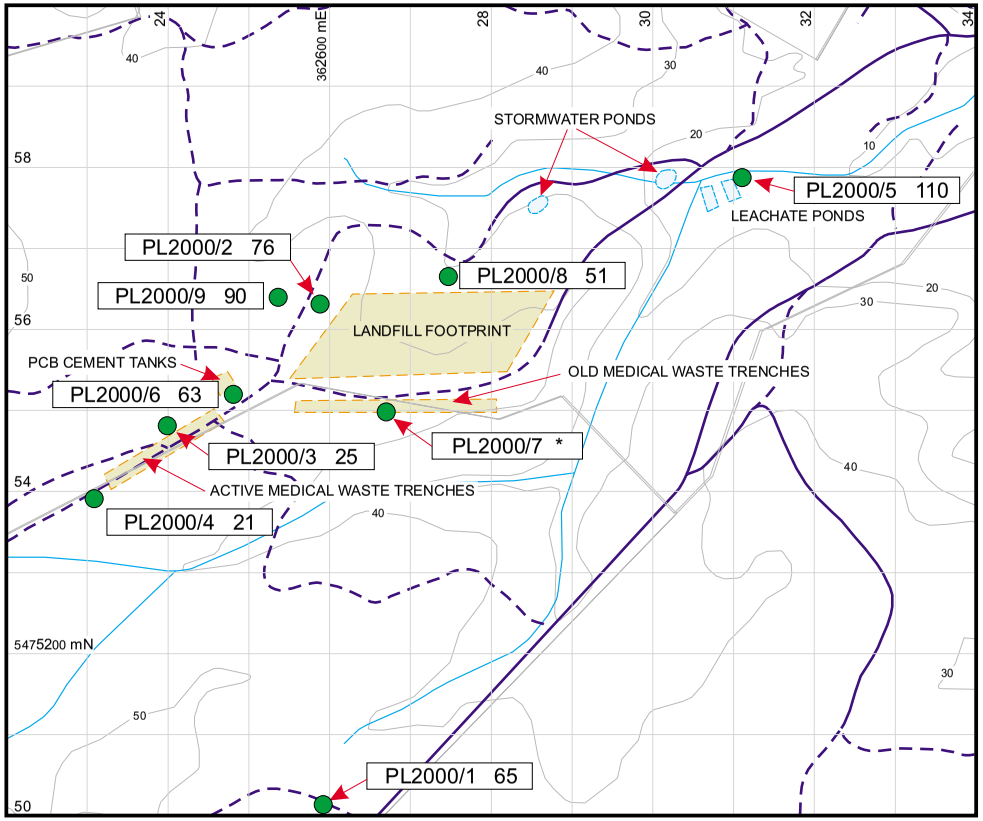
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Cd (µg/L)



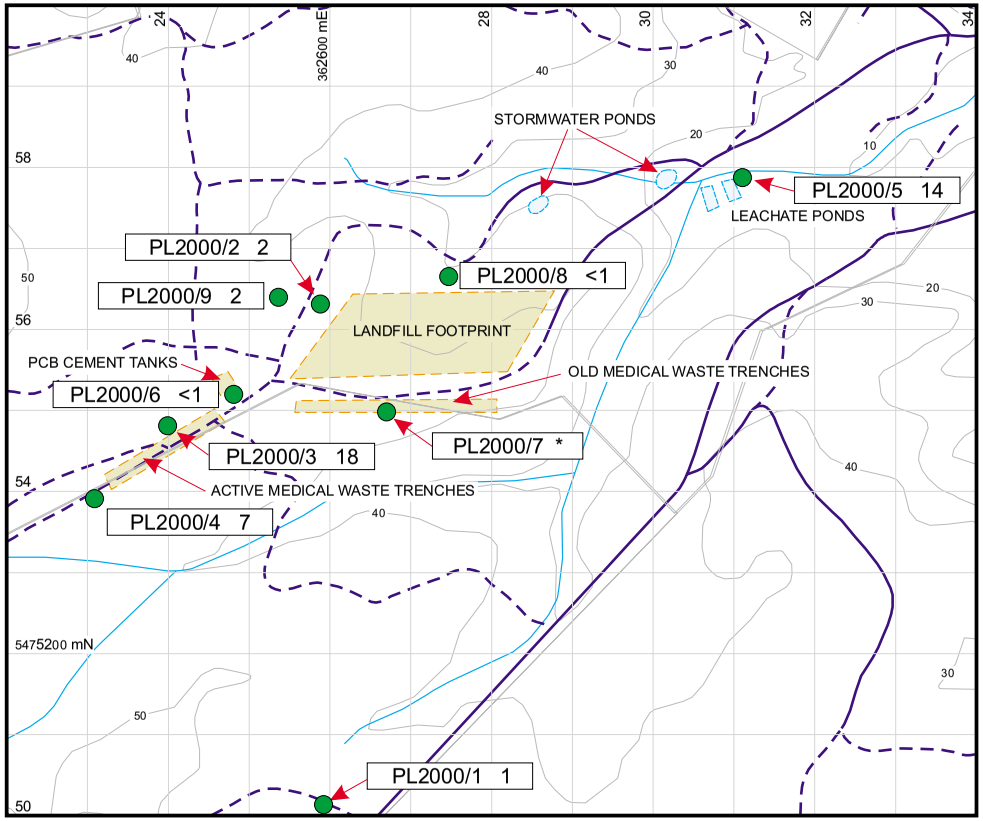
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Chloride (mg/L)



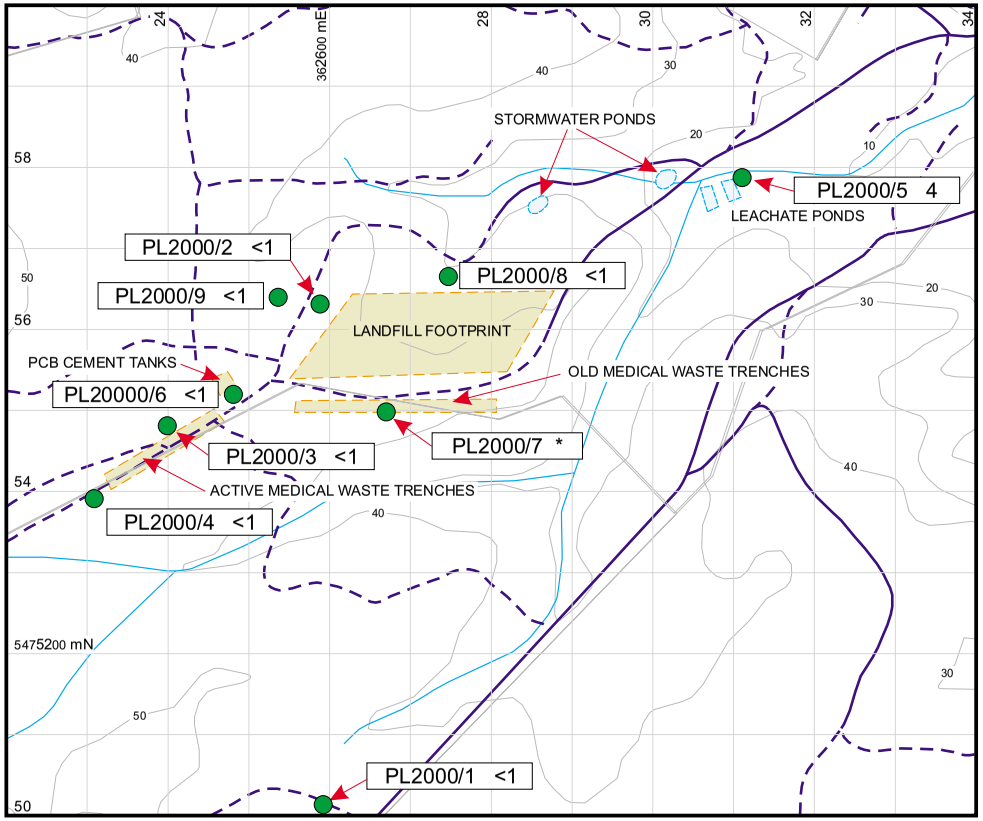
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Co (µg/L)



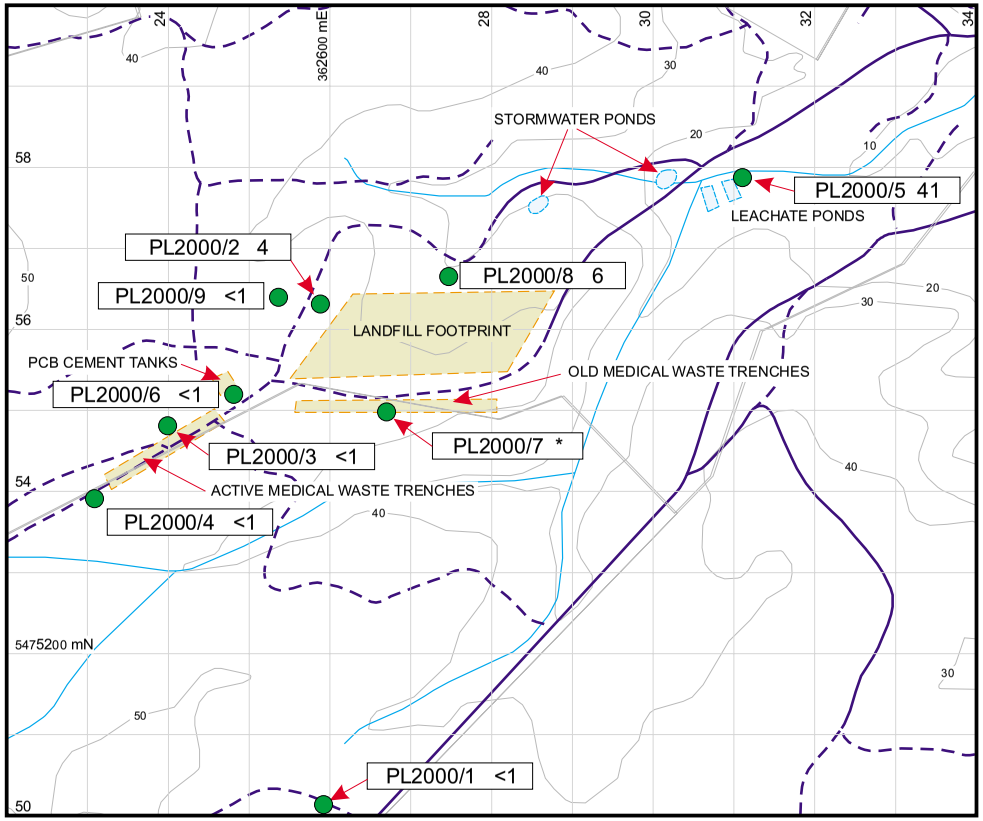
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Cr (µg/L)



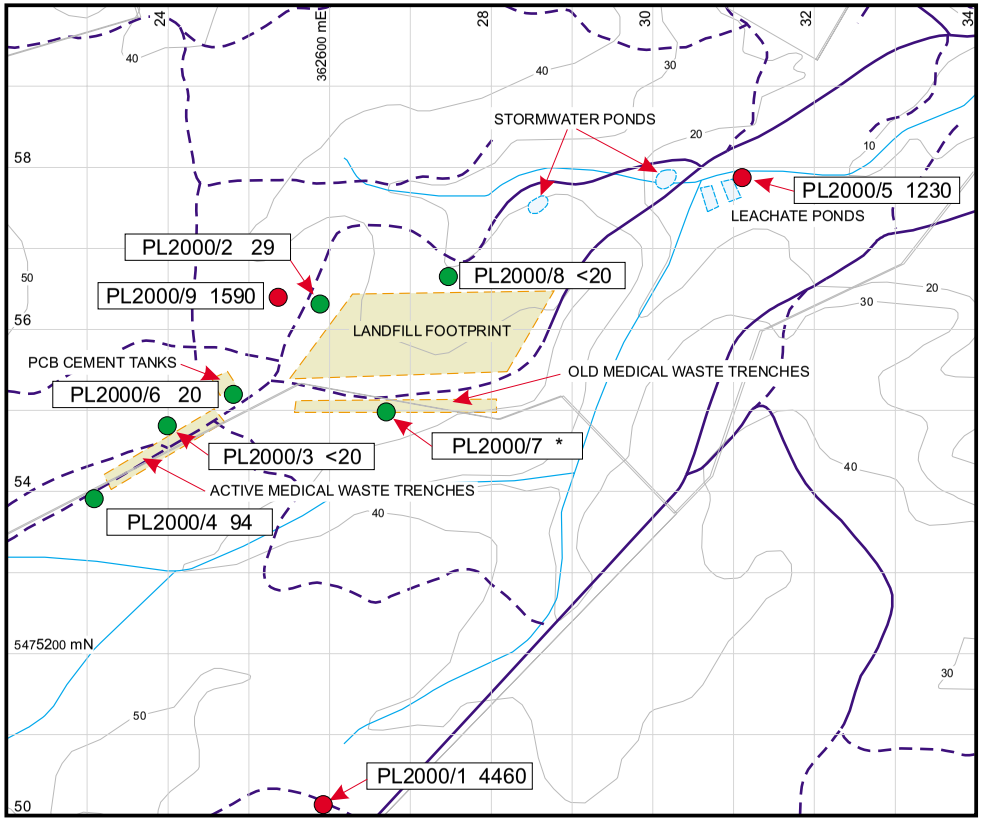
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Cu (µg/L)



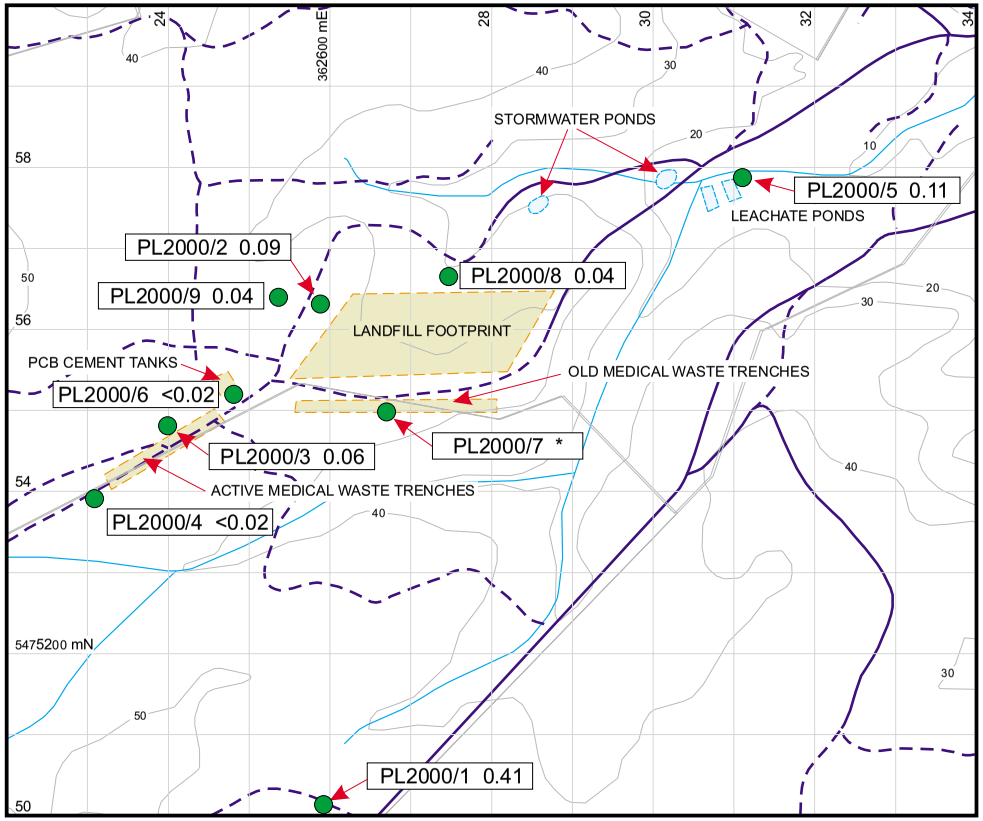
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Fe (µg/L)



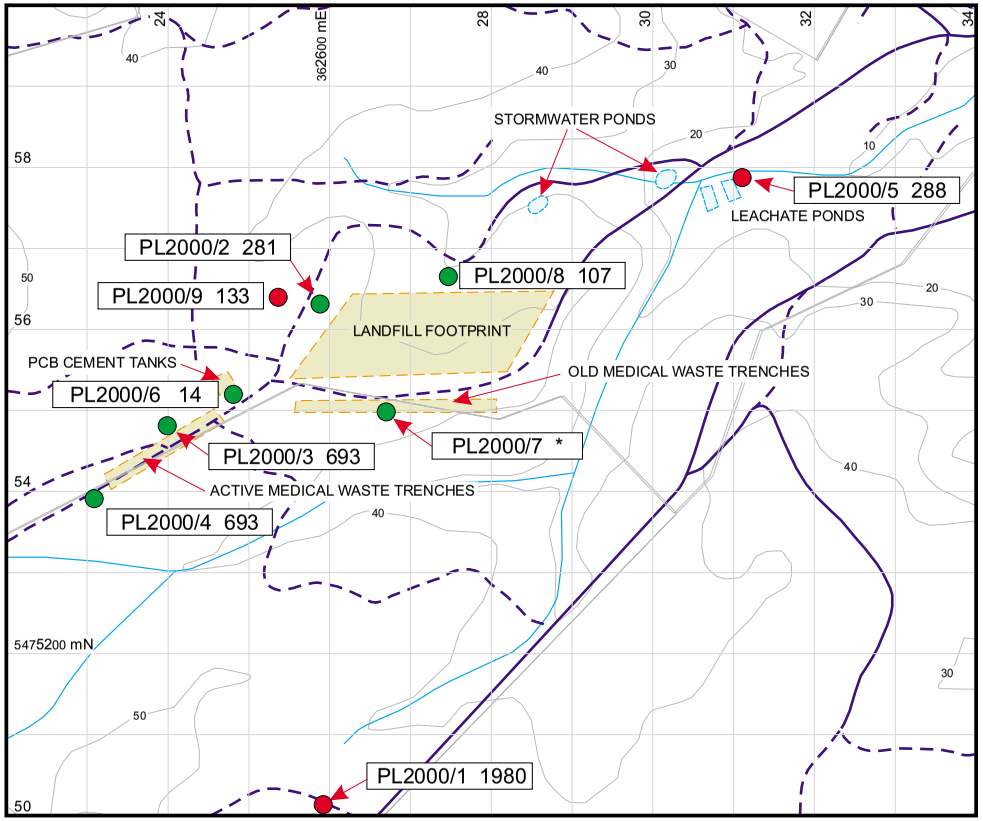
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Fluoride (mg/L)



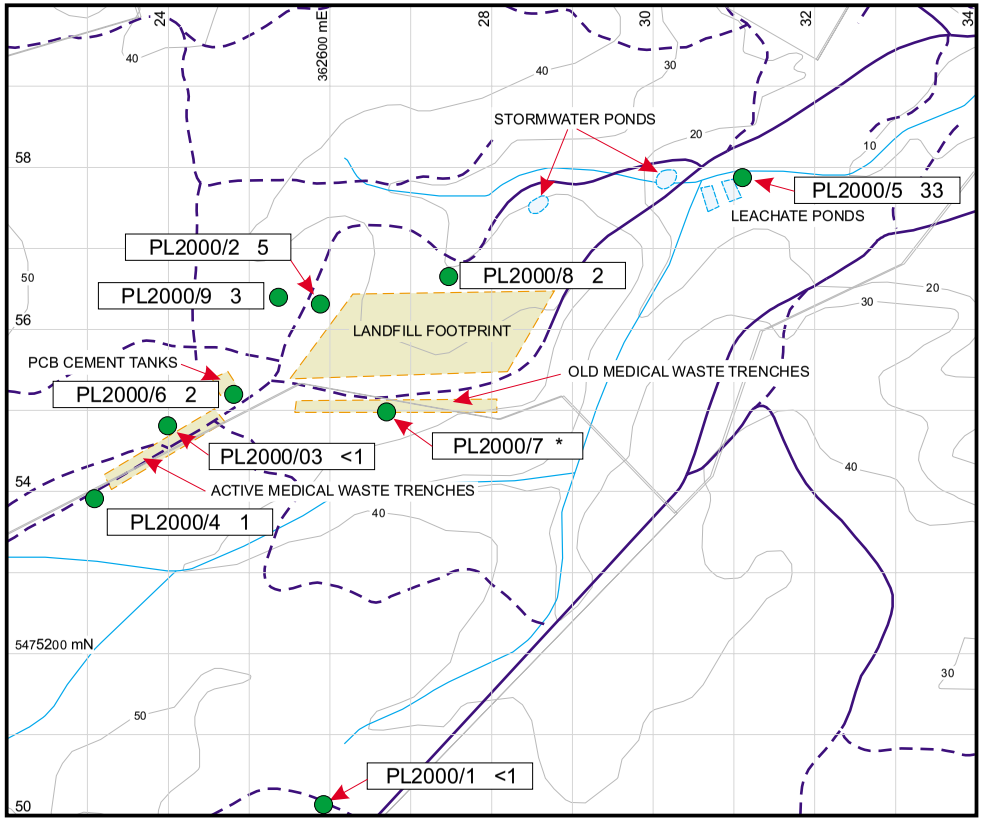
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Mn (μg/L)



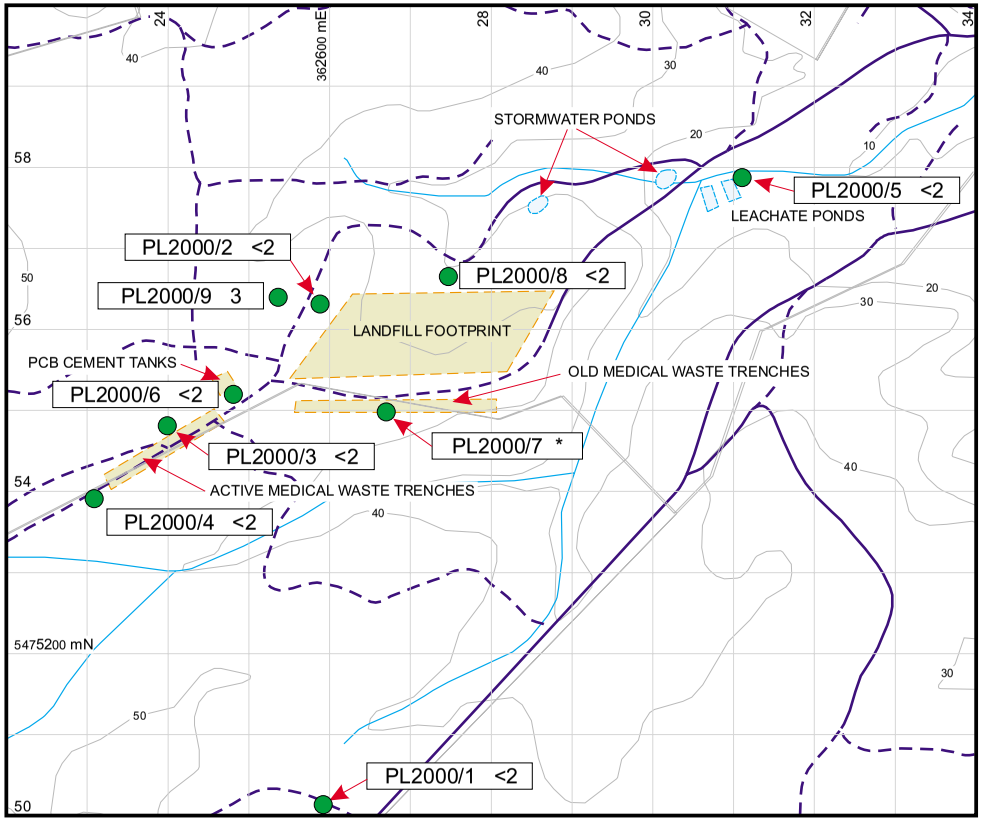
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Ni (µg/L)



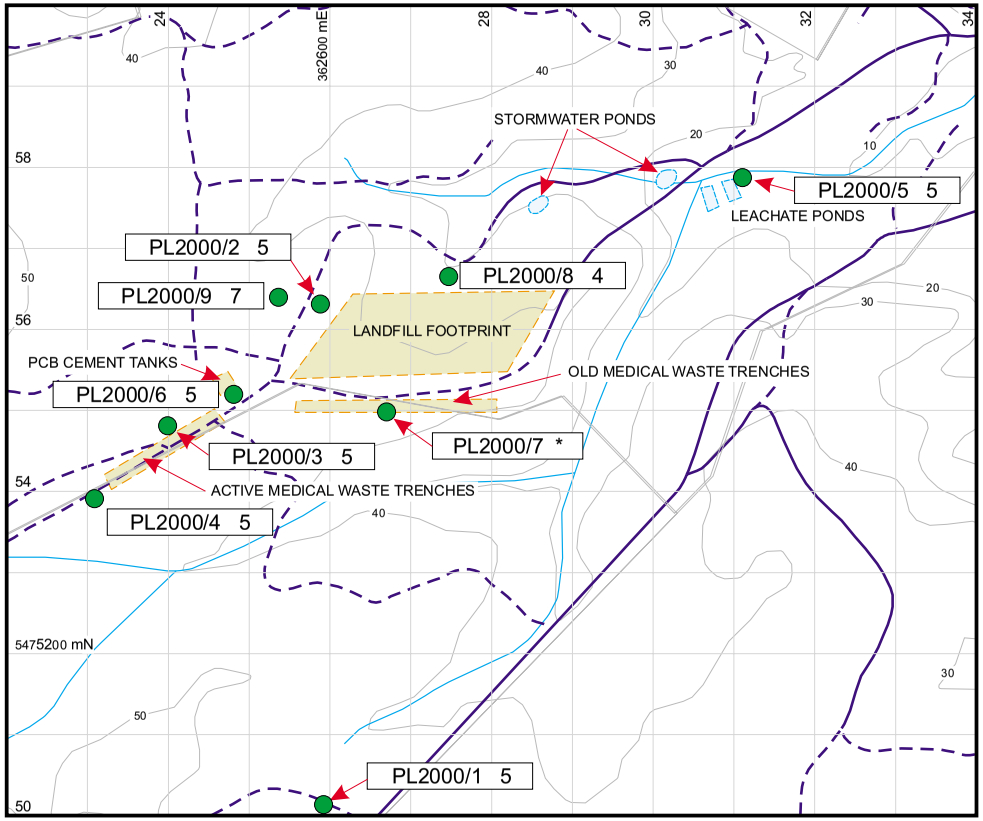
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Nitrite (µg/N-L)



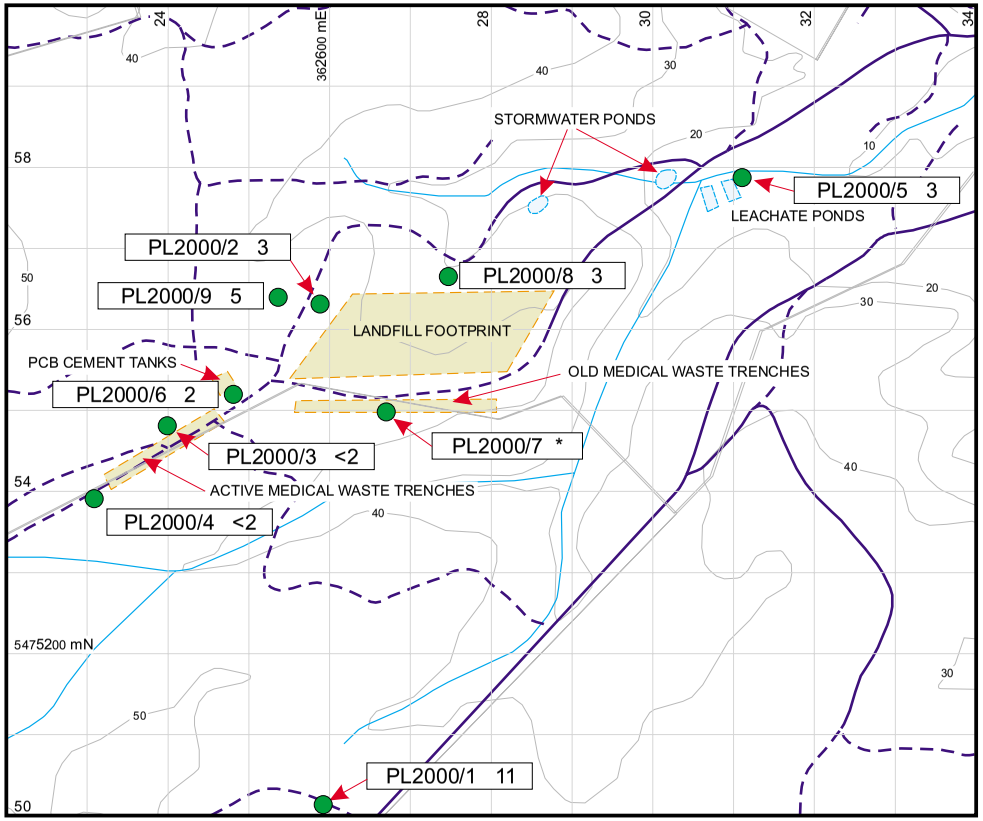
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Nitrate + Nitrite (µg-N/L)



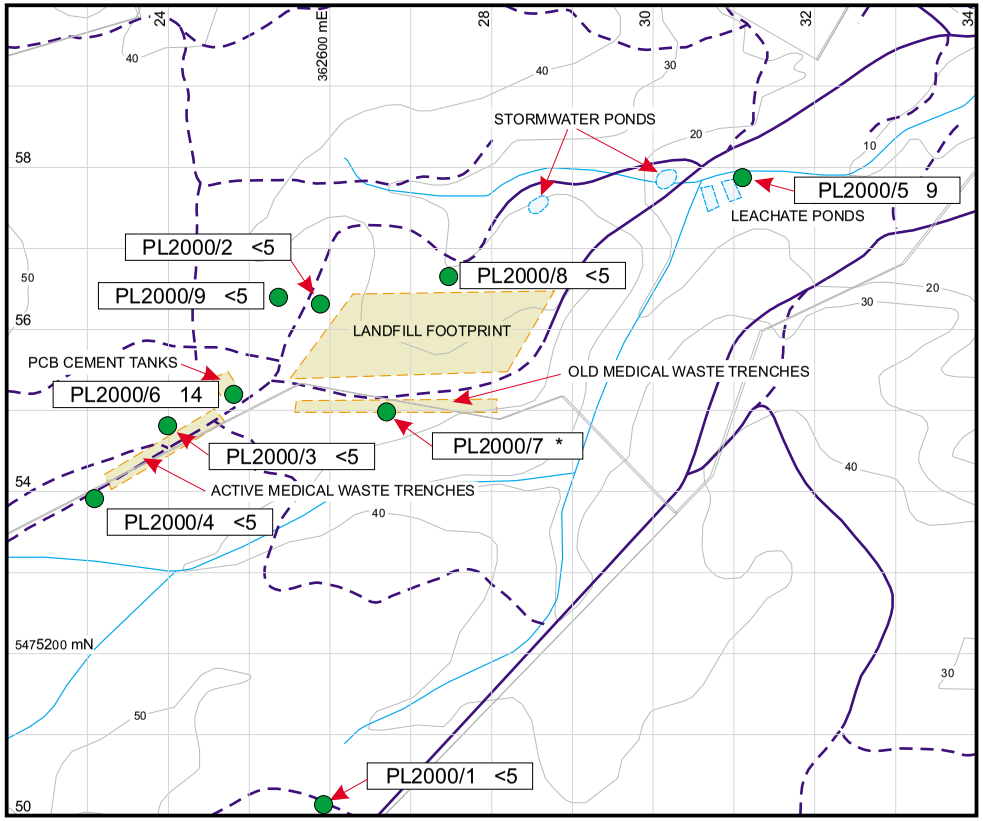
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Ortho-P (µg-P/L)



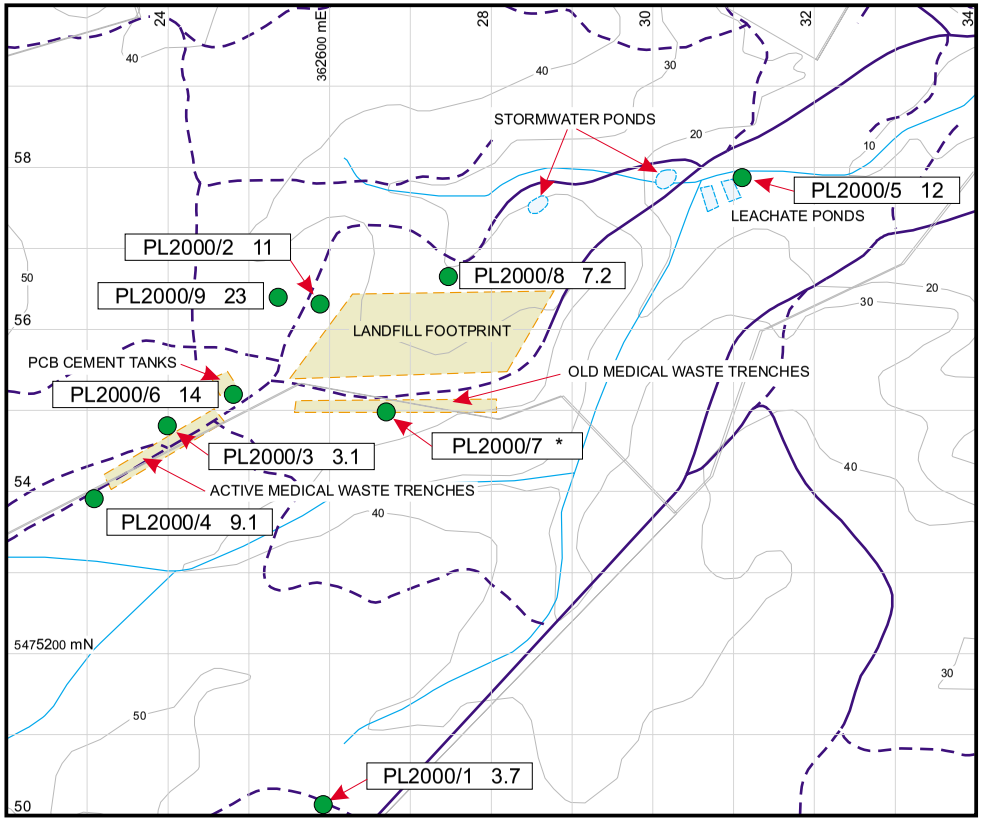
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Pb (µg/L)



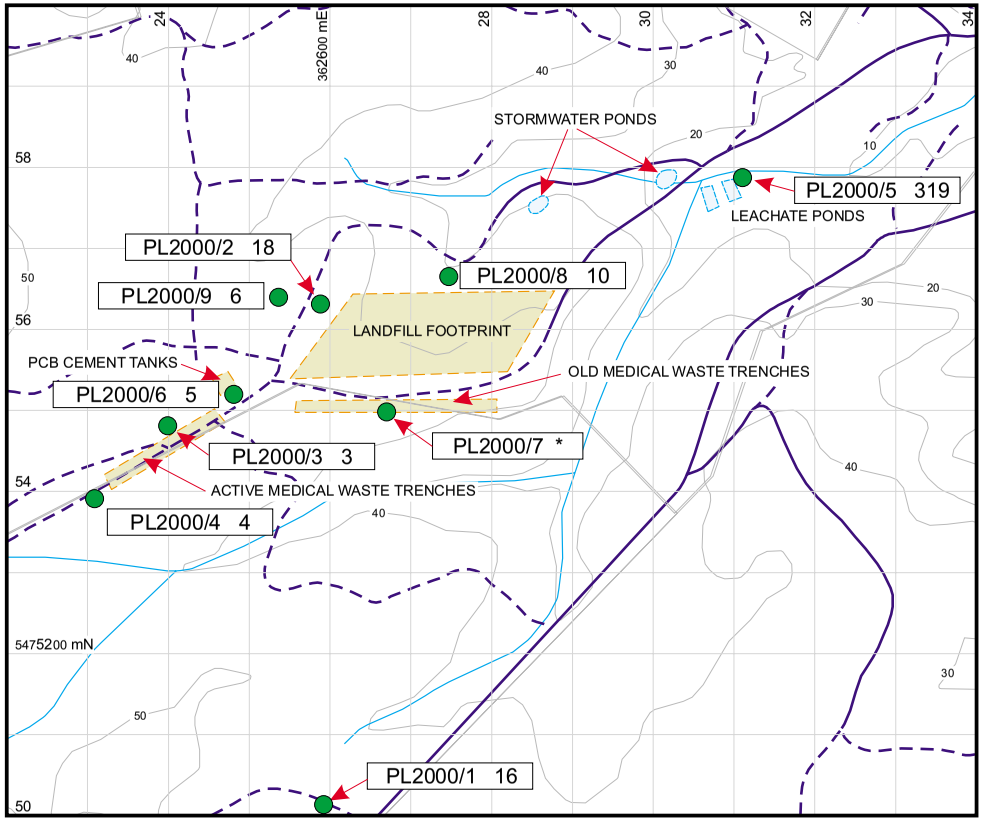
* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Sulphate (mg/L)



* Hole PL2000/7 contains no installation and was backfilled with bentonite.

Port Latta Waste Depot
October 2000
Zn (µg/L)



* Hole PL2000/7 contains no installation and was backfilled with bentonite.