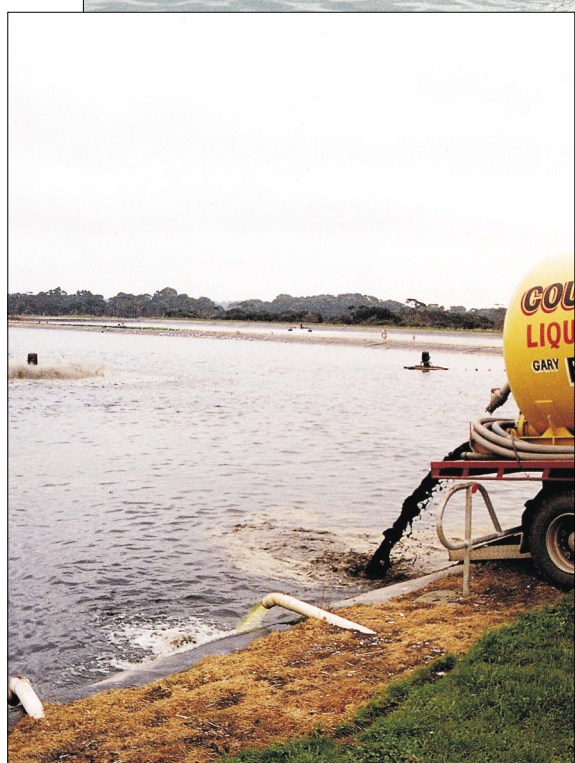


## **NHT Funded Project NLP 13188**

# **The effects of waste disposal on groundwater quality in Tasmania**



## **Smithton sewage lagoons**

**Tasmanian Geological  
Survey Record 2002/05**

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# Groundwater quality investigations at the Smithton sewage lagoons

A. R. Ezzy

## Abstract

Groundwater was investigated in the area of the Smithton sewage lagoons to determine if the lagoons were affecting groundwater quality. Significant nitrogen-based groundwater contamination was identified in excess of guideline limits. Natural attenuation processes appear to be occurring beneath adjacent farmland.

## 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 sewage lagoons at Smithton were one of these sites.

The objectives of the investigations at the Smithton sewage lagoons were to:

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

## SITE DESCRIPTION

The Smithton sewage lagoons are located approximately two kilometres northwest of Smithton (339 800 mE, 5 479 000 mN) (fig. 1). The (then) Department of Environment approved the initial lagoon construction and the facility is currently licensed by the Department of Primary Industries, Water and Environment (DPIWE). A major upgrade was undertaken between 1988 and 1990 to treat McCains Foods vegetable processing waste water under a joint agreement between the Circular Head Council, McCains Foods and the Tasmanian Government.

During the 1988–1990 upgrades, six lagoons were constructed in Quaternary sand deposits with HDPE liners installed on the lagoon bund walls (constructed from materials excavated on site). Because of the groundwater conditions encountered during the upgrade, no liners were installed in the base of the lagoons. As a result of this design, the lagoon bases are located in the unconfined water table, creating a migration pathway for waste water.

## Geology

The Tasmania Department of Mines 1:50 000 scale Smithton geological map (Lennox *et al.*, 1982) indicates that the geology of the area is mainly comprised of

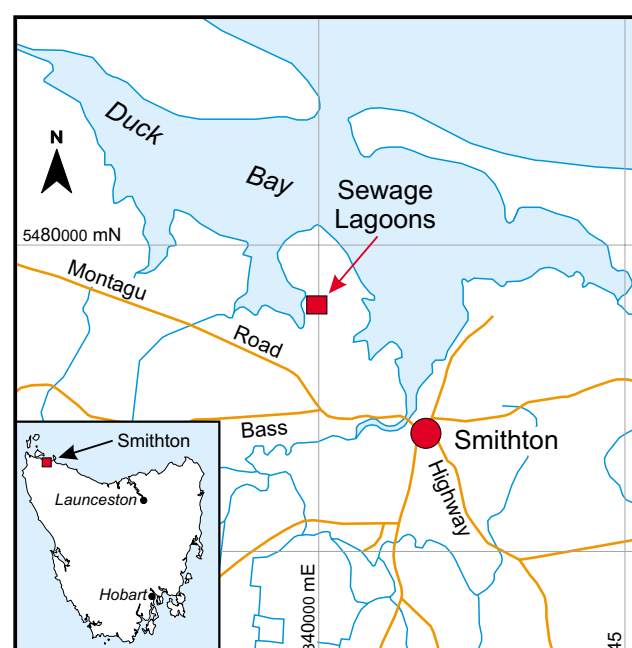
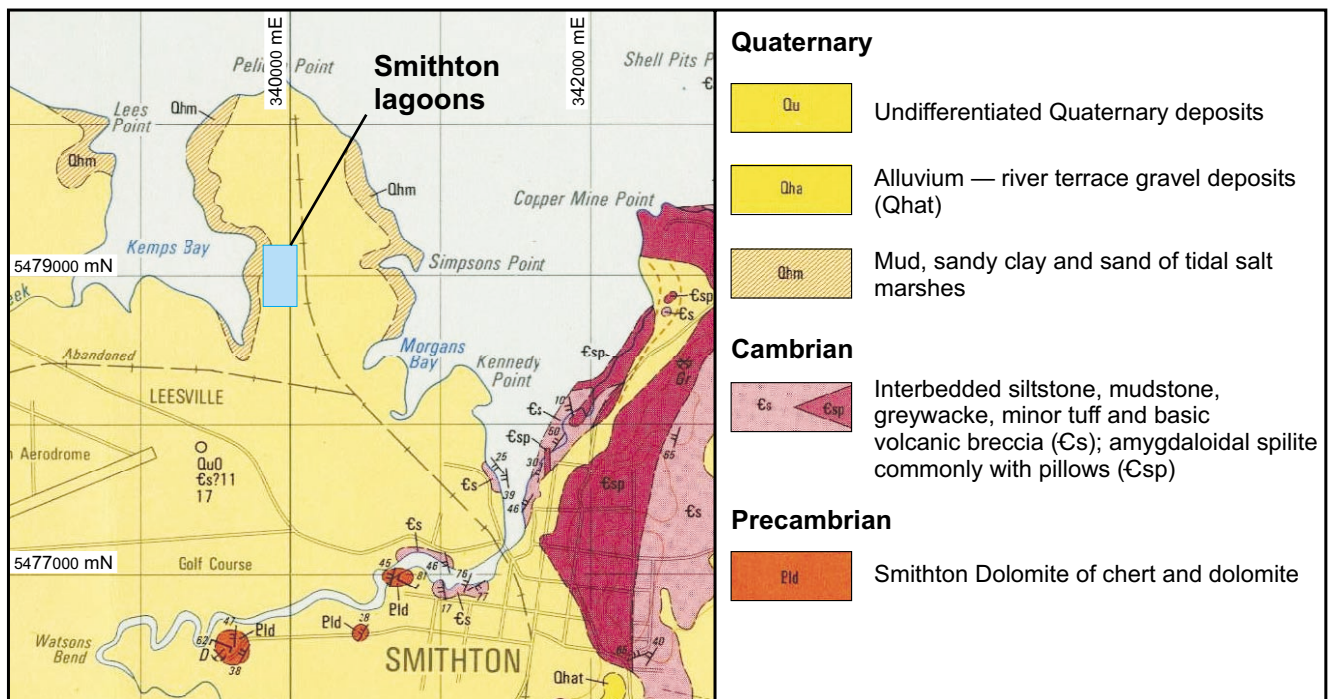


Figure 1. Location of sewage lagoons, Smithton.



**Figure 2**

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

Quaternary windblown sand, with additional clay and sand tidal salt marsh deposits in the western part of the site. Figure 2 is a modified extract from the Smithton geological map.

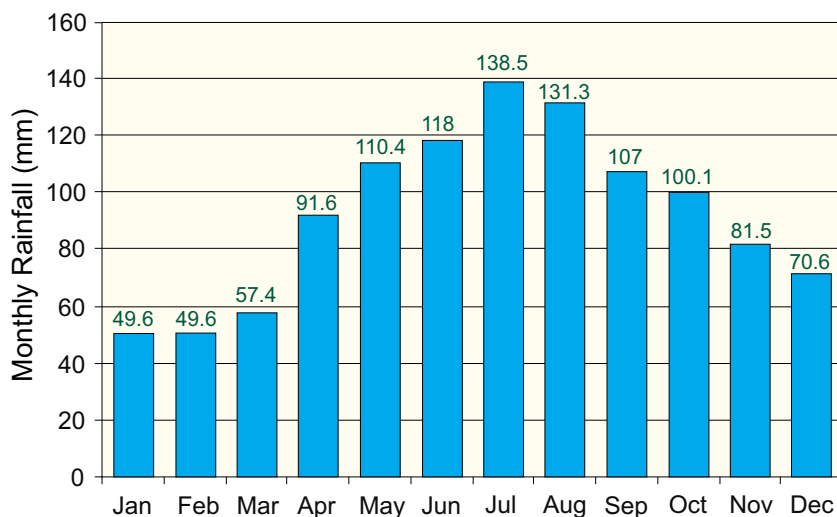
Geological mapping during the present study showed that Quaternary sand deposits dominate the site. Marshes were observed in the western area of the site grading into tidal mud salt flats. The northwestern sludge drying lagoons are located on these tidal mud deposits (Plate 1), with the remainder of the lagoons and sludge stockpiles being located on sand deposits. Shell fragments encountered during drilling suggest that most of these sand deposits were formed in a beach environment.

### Hydrology

The lagoons are located east of Kemp's Bay on Pelican Point, a low lying peninsula approximately one kilometre wide that extends into Duck Bay. Australian Bureau of Meteorology rainfall station 091092 at Smithton (Grant Street) is the closest rainfall station to the site. The rainfall chart of average monthly recorded rainfall (fig. 3) shows a marked seasonality, with the highest rainfall in autumn/winter (April to October). The average annual rainfall for the station (1105.6 mm) is high for the region.



**Plate 1.** Lagoons constructed on tidal marsh deposits in the northwest corner of the site.



**Figure 3**  
Average monthly rainfall for Australian Bureau of Meteorology rainfall station 091092, Smithton (Grant Street).

## INVESTIGATION METHODS

### Borehole drilling and installation

Fourteen 120 mm diameter monitoring bores were auger drilled to depths of between 4.0 and 7.5 metres between 30 August and 5 September 2000. Fifty millimetre PVC casing and slotted screens with bentonite seals were installed in each hole. The locations of the bores are shown on Figure 4, with engineering logs given in Appendix 1. All bores were logged in accordance with AS 1726-1993. Plate 2 shows the area where bores SLL2000/1, 4, 5 and 6 were drilled to assess any attenuation process occurring on adjoining farmland to the east of the lagoons. Bore SLL2000/14 was drilled and installed as a background hole.

Groundwater was encountered between 0.8 and 4.5 metres below ground level across the site. Flow during drilling indicated that the groundwater in all boreholes was unconfined. Recorded pumping yields of bores at the time of installation ranged between 0.01 to 0.21 litres/second. Lower yields occurred from bores installed in the clayey sand tidal marsh deposit.

Figure 5 shows a cross-section and related standing water levels on 13 August 2001 for bores SLL2000/1, 4, 5, 6, 7 and 8. Primary lagoons 1 and 2 and site investigation soil classifications are also superimposed on Figure 5.

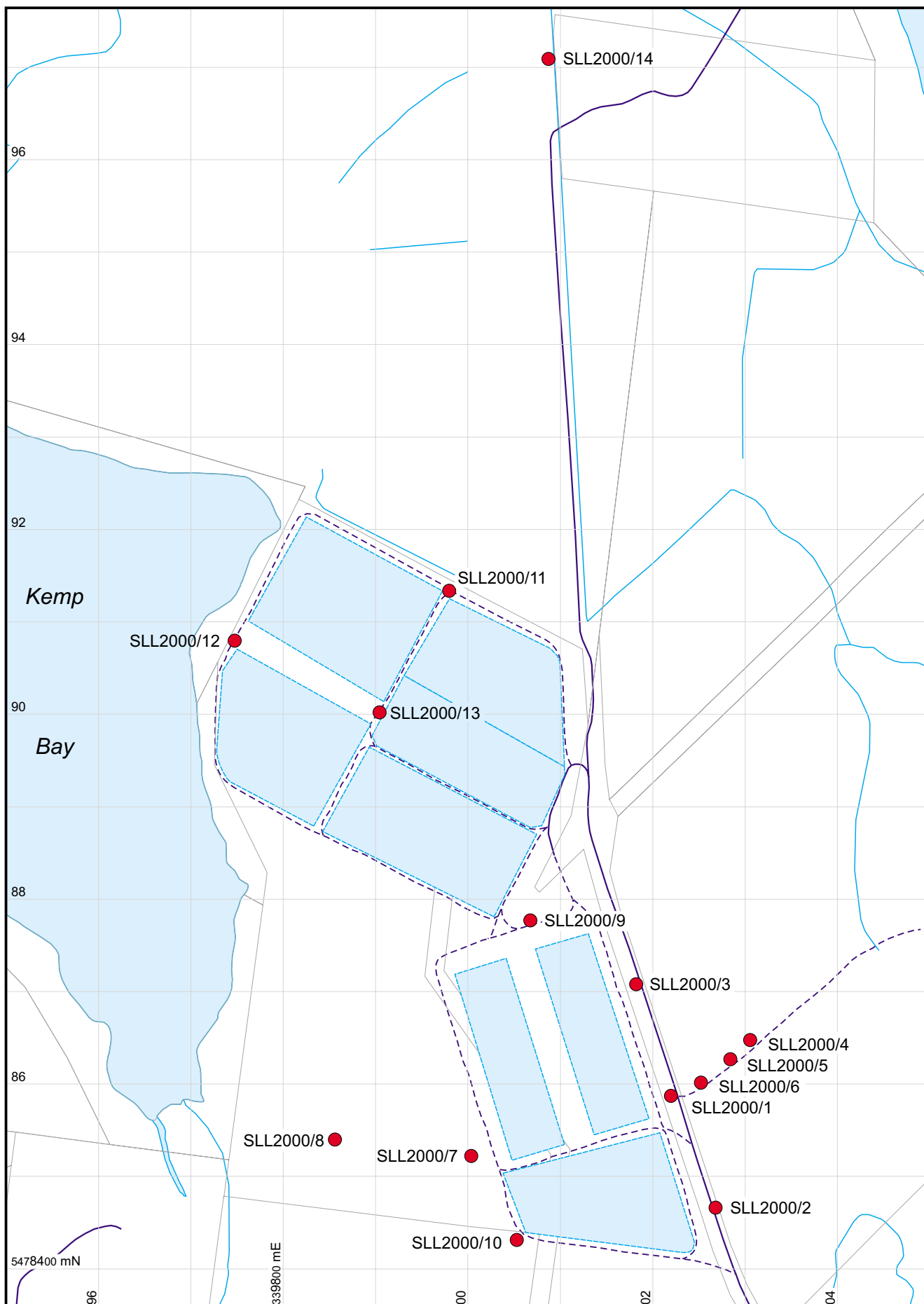
Both the unsaturated and saturated zones consist of heterogeneous layers of fine to coarse-grained sand. Shell fragments were intersected in bores SLL2000/10, SLL2000/12 and SLL2000/14 while mottled clay was intersected in bores SLL2000/3 and SLL2000/4. Waste fill was intersected in borehole SLL2000/9.

During the installation of SLL2000/8 on 31 August 2000, a significant volume of hydrogen sulphide gas vented from the borehole. The source of the gas may have been buried organic material in the tidal marsh deposits and/or biological activity in the deposits as a result of nutrients leached from the sewage sludge stockpiles. Plate 3 shows the location of SLL2000/8 with respect to stockpiles of sewage sludge in close proximity to the western-side tidal marsh deposits.

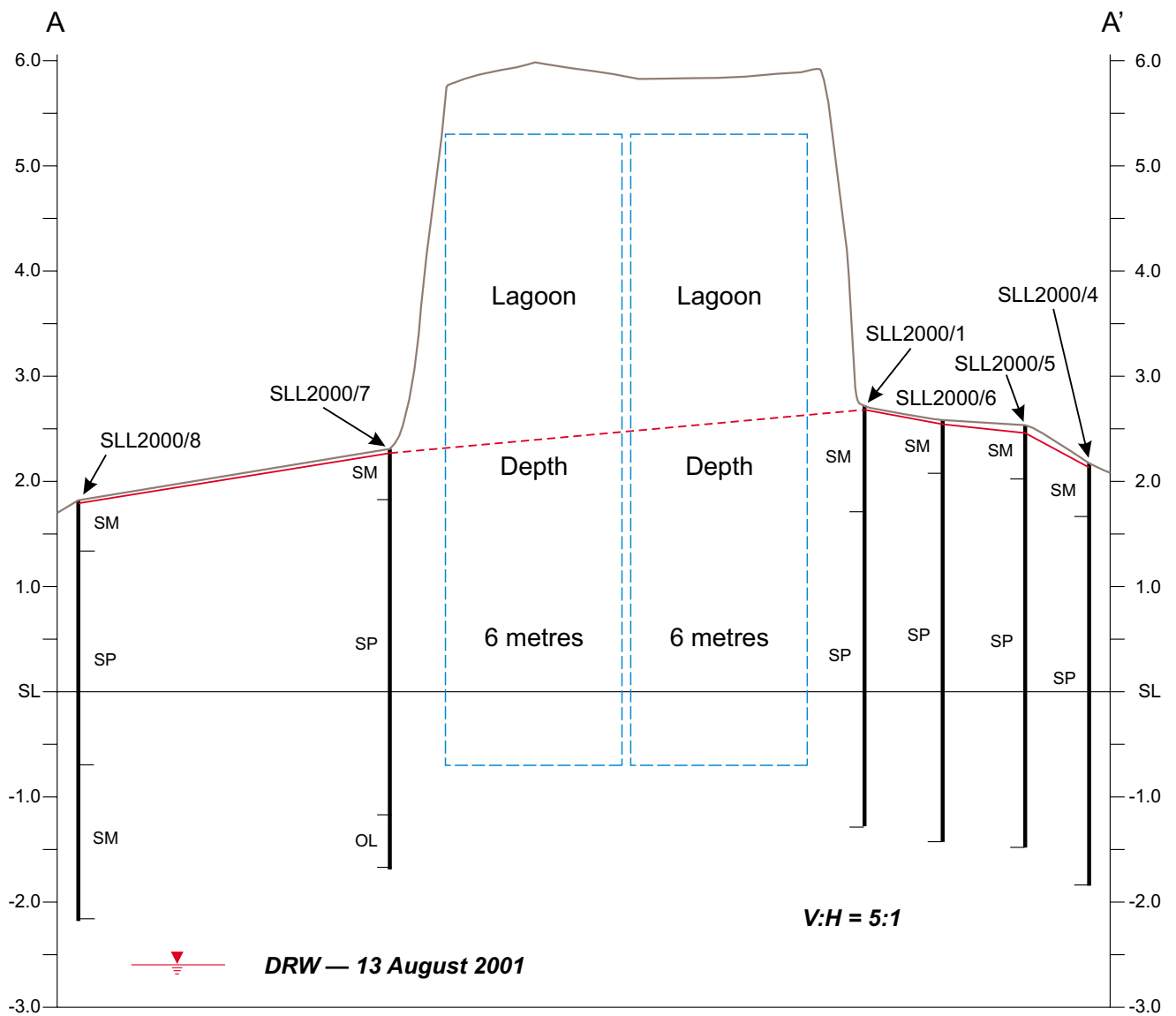


**Plate 2**

The area where bores SLL2000/1, 4, 5 and 6 were drilled to assess any attenuation process occurring on adjoining farmland to the east of the lagoons.



**Figure 4**  
Locations of environmental monitoring bores installed at the Smithton sewage lagoons.



**Figure 5.** Cross-section and related standing water levels on 13 August 2001 for bores SLL2000/1, 4, 5, 6, 7, and 8, with respect to the location of primary lagoons 1 and 2.



**Plate 3.** The location of SLL2000/8 with respect to stockpiles of sewage sludge in close proximity to the western-side marsh tidal deposits.

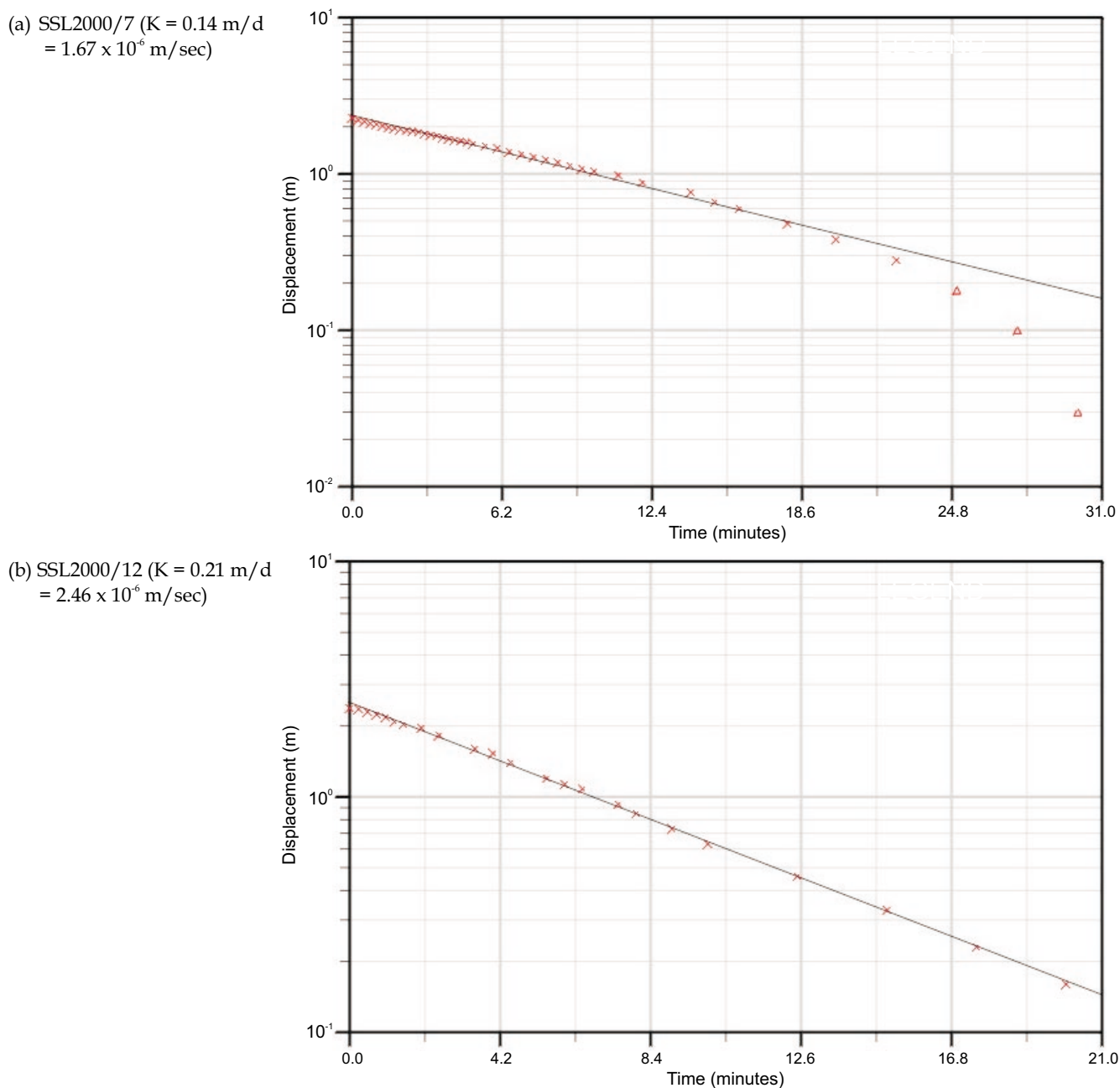
### *In situ permeability testing*

Slug extraction tests were carried out on 14 August 2001 on bores SLL2000/7 and SLL2000/12. Data collected during the slug extraction tests are presented in Appendix 2.

Slug extraction tests were completed (30 to 120 litres) and levels monitored for 30 minutes (time for 95% plus recovery). Test data were analysed in the software package AquiferWin32 (Version 2.17, Environmental Simulations Inc.). The Bouwer and Rice (1976 Unconfined Aquifer) solution was used to calculate the hydraulic conductivities illustrated in Figure 6 (a)

and (b) for holes SLL2000/7 and SLL2000/12 respectively. This method was selected as the most appropriate available within the software package.

These results imply that fines (silt) are clogging the sand. Both holes are on the western side of the lagoons, in the area of tidal marsh deposits. During construction excavated local sand was deposited at the location of SLL2000/12 and most likely also to some degree at SLL2000/7. Similar hydraulic conductivities are likely to exist in the beach sand deposits across the site, with lower permeability expected in the undisturbed tidal marsh deposits.



**Figure 6**

*Hydraulic conductivity values calculated in AquiferWin32 Version 2.17, Environmental Simulations Inc.,  
Bouwer and Rice (1976, Unconfined Aquifer) solution*

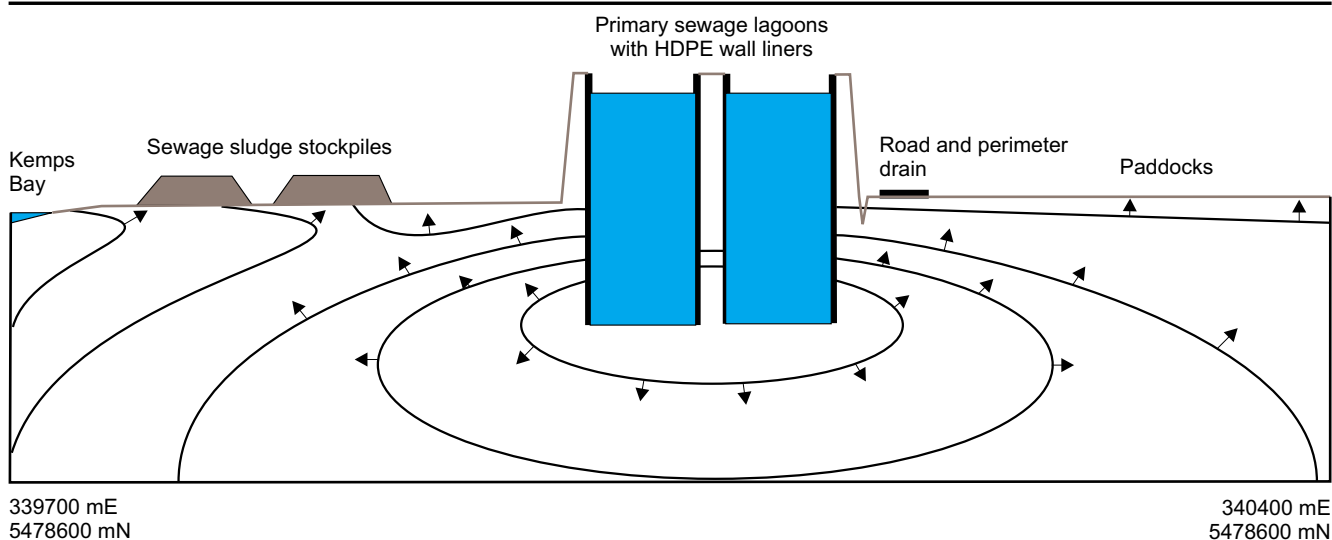
## HYDROLOGICAL MODEL

The cross section shown in Figure 5 indicates that the water table slopes towards the west and east. The cross section also suggests a direct hydraulic connection between the groundwater system and the infrastructure of primary lagoons 1 and 2. Because of the depth of water in all other bore holes, all lagoons at the site most likely directly recharge groundwater.

A groundwater mounding effect appears to be associated with the recharge of the unconsolidated Quaternary aquifer by the lagoons, with the mound probably occurring on all sides of the combined lagoon footprints. Plate 4 shows the discoloured water in the eastern area of the site perimeter drain (which could act as a discharge system to the groundwater mound). Groundwater mounding appears to be discharging via

the perimeter drain and past monitoring undertaken by the Department of Primary Industries, Water and Environment has detected high ammonia concentrations along the total length of the perimeter drain. Tidal effects are also suspected and may be affecting the groundwater hydraulic regime at this site.

Figure 7 illustrates an interpretation of the piezometric surface based on surveyed heights and groundwater depths of the boreholes. Figure 8 shows a cross-sectional conceptual model of equipotential and related flow lines at Kemps Bay, the southwest sewage sludge stockpiles, the primary sewage lagoons, and farmland to the east. This model could be further defined once the extent and influence of the tidal marsh deposits was quantified.



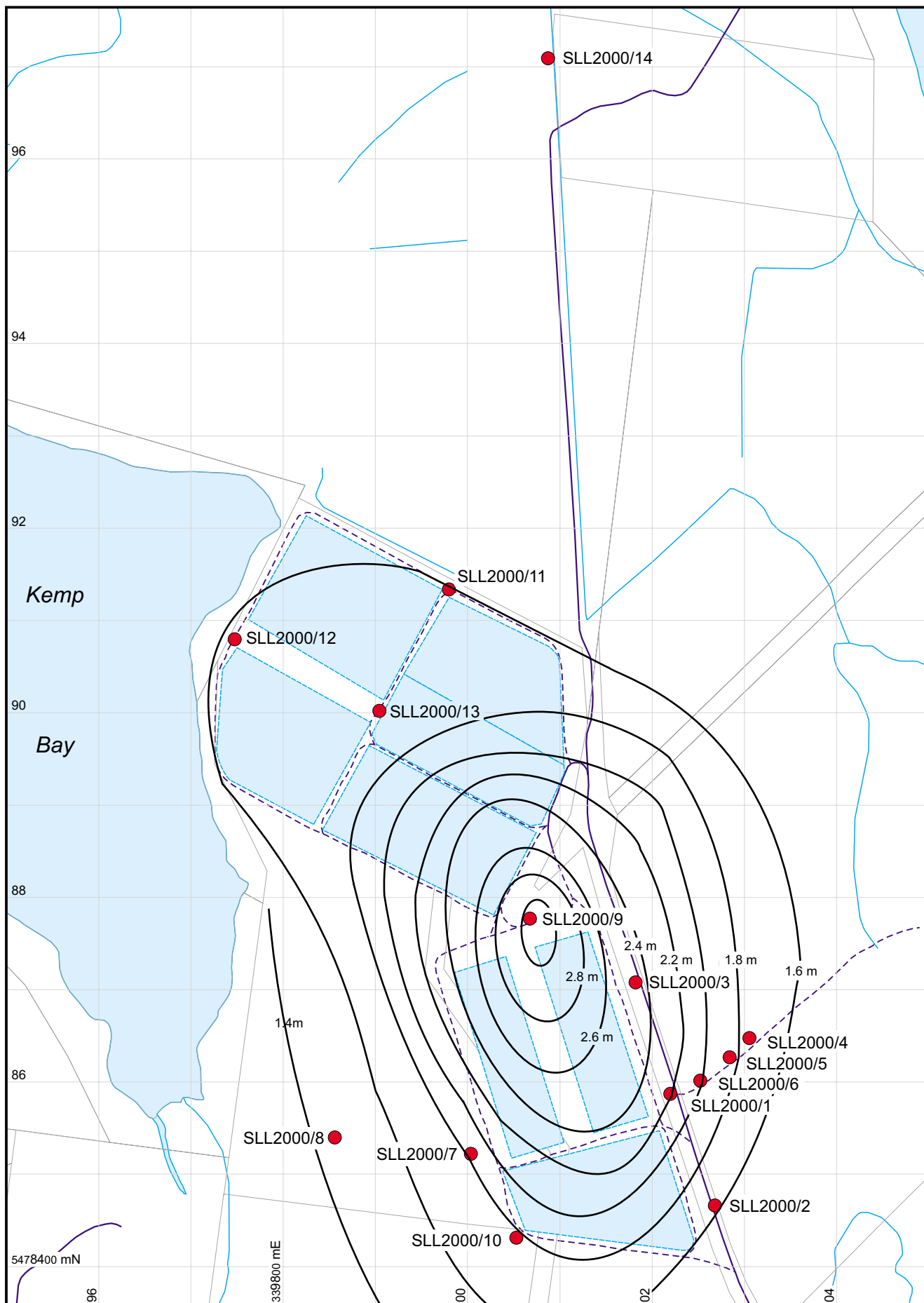
**Figure 8**

*Cross sectional conceptual model of equipotential and related flow lines of Kemps Bay, the southwest sewage sludge stockpiles, the primary sewage lagoons and farmland to the east.*



**Plate 4**

*Discoloured water in the eastern area of the site perimeter drain.*



**Figure 7**

*Interpretation of the piezometric surface (mound) based on surveyed heights and groundwater depths of the boreholes (RL metres).*

## GROUNDWATER CHEMISTRY

All bores were sampled on 1 November 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 samples of groundwater extracted from the boreholes. The laboratory report from Analytical Services Tasmania is presented in Appendix 3. Values for pH ranged from 6.5 to 7.4, with conductivity values ranging between 747 and 12 900  $\mu\text{S}/\text{cm}$ .

Analytical results are presented on site maps in Appendix 4. Figure 9 is a cation Ternary plot for the results of the groundwater samples, while Tables 1 and 2 are comparisons of the analytical results against international standards where a guideline/emission value is stated by the relevant standard.

Groundwater chemistry varies significantly between the background bore (SLL2000/14) and the thirteen other bores installed in the area of the sewage lagoons. Groundwater in the vicinity of the lagoons has elevated chemical results for selective water quality parameters, including ammonia (some results several orders of magnitude over the legal emission limit), chloride, ortho-phosphate and sulphate. Bores SLL2000/1, 4, 5 and 6 show decreasing ammonia values moving away from the eastern side of the lagoons, which may indicate a natural attenuation process.

The water chemistry on the anion Ternary plot for bores SLL2000/8 and 12 indicates a high proportion of chloride ions. Conductivity and TDS results for these two boreholes suggest that residual salinity most likely occurs within the tidal marsh deposits. The distinct water chemistry for bore SLL2000/9 on the anion Ternary plot is possibly the result of the bore being screened below buried decaying refuse fill material. This is also demonstrated by the highest recorded sulphate value (1400 mg/L) in the groundwater at the site.

## CONTAMINATION ASSESSMENT

Significant contamination of groundwater by nitrogen-based ammonia has been identified but the degree and extent of the contamination has not been fully quantified. Natural attenuation appears to be an important process occurring within the contamination plume(s). This microbiological driven process is affecting the groundwater chemistry within the local hydrogeological system. Major groundwater cations and anions also appear to be diluted by leakage from

the lagoons via the unconsolidated unconfined aquifer.

Unlined sewage sludge stockpiles may also be releasing some nutrients to the aquifer, although the main source of contamination is considered to be the lagoons themselves.

## PRINCIPAL CONCLUSIONS

Major nutrient contamination of groundwater has been confirmed in the area of the Smithton sewage lagoons. The pond bases are below the unconfined water table, which is undesirable. Tidal marsh deposits have the potential to act as an aquitard. A process of natural attenuation appears to be occurring beneath adjacent farmland. Monitored natural attenuation (MNA) is considered the most appropriate action for this site.

## FURTHER WORK

Pump tests are required on bores on the eastern side of the lagoons. Further work may quantify the southern and northern extent of the groundwater mound and associated contamination. The calculation of seepage estimates could be undertaken by measuring hydraulic gradients (and assuming a porosity of 0.35).

An electromagnetic (EM31/EM34, TEM) survey is recommended to identify zones of high and low ground conductivity. The survey could help to define the extent of variations in groundwater chemistry and potentially the extent of the groundwater mound associated with the lagoons. The extent and nature of the tidal marsh deposits (residual salinity) should be considered in the analysis of geophysical investigations at the site. This would require more detailed geological mapping of the tidal marsh deposits. Calibration of the mound and migrating plume(s) should also consider both water chemistry and conductivity of the sewage pond water.

Future monitoring of microbiological water quality parameters may help to confirm the extent of the degradation of groundwater quality in the local area and the processes associated with natural attenuation at the site. Monitoring of microbiological water quality parameters is considered to be a priority.

## REFERENCES

- 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]

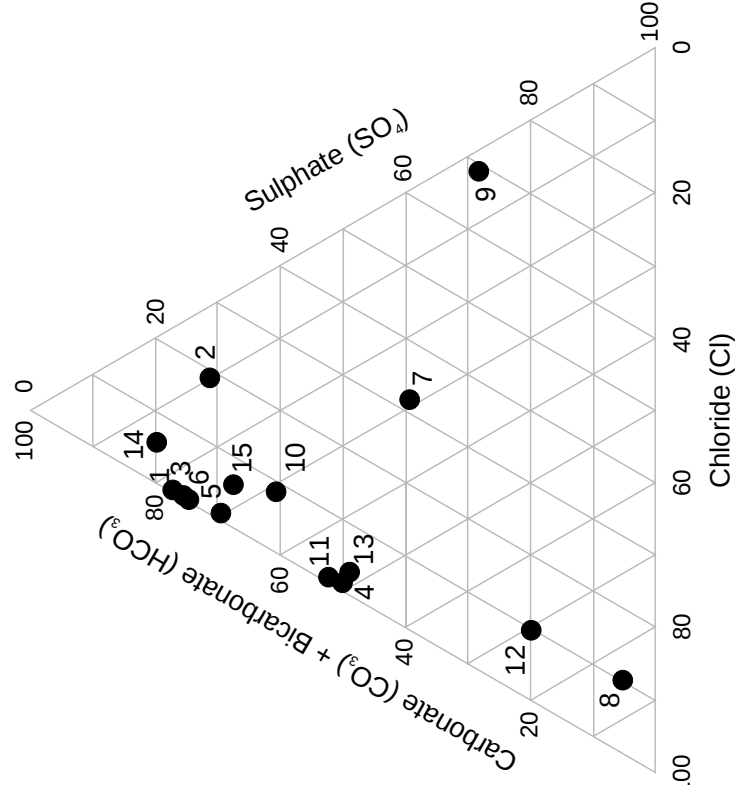
**Table 1**

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 | 2000/7 | 2000/8 | 2000/9 | 2000/10 | 2000/11 | 2000/12 | 2000/13 | 2000/14 | Emission limit                                |
|------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|-----------------------------------------------|
| pH                                       | 7.0    | 6.7    | 7.0    | 7.0    | 6.5    | 6.9    | 7.0    | 7.1    | 6.7    | 7.0     | 7.4     | 6.8     | 6.8     | 7.2     | N/A                                           |
| Conductivity ( $\mu\text{S}/\text{cm}$ ) | 1920   | 3700   | 2060   | 2180   | 1280   | 1630   | 2980   | 12900  | 3240   | 3740    | 1200    | 7770    | 1440    | 747     | N/A: note average sea water value 36 000      |
| TDS (mg/L)                               | 752    | 1390   | 877    | 1260   | 851    | 960    | 2010   | 8750   | 2910   | -       | -       | -       | -       | -       | N/A                                           |
| Alkalinity $\text{CO}_3$ (mg/L)          | <1     | <1     | <1     | <1     | <1     | <1     | <1     | <1     | <1     | <1      | <1      | <1      | <1      | <1      | N/A                                           |
| Alkalinity $\text{HCO}_3$ (mg/L)         | 730    | 1410   | 779    | 672    | 455    | 697    | 761    | 429    | 740    | 1300    | 312     | 778     | 356     | 252     | N/A                                           |
| Chloride (mg/L)                          | 120    | 110    | 140    | 380    | 110    | 130    | 320    | 4000   | 41     | 380     | 160     | 1600    | 200     | 26      | 250* (mg/L)                                   |
| Fluoride (mg/L)                          | 0.29   | 0.40   | 0.29   | 0.27   | 0.09   | 0.07   | 1.5    | 1.1    | 0.05   | -       | -       | -       | -       | -       | 1.5* (mg/L)                                   |
| Sulphate (mg/L)                          | 1.4    | 290    | 2.7    | 11     | 4.8    | 1.0    | 480    | 650    | 1400   | 140     | 3.5     | 300     | 18      | 14      | 250* (mg/L)                                   |
| Ammonia(mg/L)                            | 89.3   | 250    | 84.4   | 0.80   | 1.40   | 23.1   | 0.837  | 0.406  | 12.5   | 11.7    | 16.1    | 24.7    | 33.2    | 0.295   | 0.5* (mg/L) nitrogen (as ammonia)             |
| Nitrate + Nitrite (mg/L)                 | 0.007  | 0.008  | 0.006  | 0.004  | 0.012  | 0.008  | 0.006  | 0.012  | 0.006  | 0.009   | 0.007   | 0.012   | 0.007   | 2.9     | 10.0* (mg/L) nitrogen (as nitrate or nitrite) |
| Nitrite (mg/L)                           | 0.002  | 0.004  | 0.002  | <0.002 | 0.007  | 0.003  | <0.002 | 0.006  | 0.002  | 0.004   | 0.003   | 0.006   | 0.003   | 0.005   | 10.0* (mg/L) nitrogen (as nitrate or nitrite) |
| Ortho-P (mg/L)                           | 0.132  | 1.33   | 5.44   | 0.004  | 0.006  | 0.003  | 0.007  | 0.013  | 0.004  | 0.012   | 2.18    | 0.005   | 0.031   | 0.01    | 2.0* as phosphorus                            |

\* 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 ND – not detected



**Figure 9**

Anion Ternary plot for groundwater bores at the Smithton sewage lagoons.

1 – SLL2000/1; 2 – SLL2000/2; 3 – SLL2000/3; 4 – SLL2000/4; 5 – SLL2000/5;

6 – SLL2000/6; 7 – SLL2000/7; 8 – SLL2000/8; 9 – SLL2000/9;

10 – SLL2000/10; 11 – SLL2000/11; 12 – SLL2000/12; 13 – SLL2000/13; 14 – SLL2000/14;

15 – average of all MRT groundwater records for Quaternary coastal sands.

**Table 2**

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

| SMITHTON SEWAGE LAGOONS                       |       |       |       |        |       |       |        |       |       |       |       |       |       |                        |                     | ANZECC 2000                                          |                                         |  |
|-----------------------------------------------|-------|-------|-------|--------|-------|-------|--------|-------|-------|-------|-------|-------|-------|------------------------|---------------------|------------------------------------------------------|-----------------------------------------|--|
| Bore hole number (SLL2000/)                   | 1     | 2     | 3     | 4      | 5     | 6     | 7      | 8     | 9     | 10    | 11    | 12    | 13    | 14<br>(back<br>ground) | IRRIGATION          |                                                      | LIVESTOCK<br>DRINKING                   |  |
| Analyte                                       |       |       |       |        |       |       |        |       |       |       |       |       |       |                        | STV<br>(Short-term) | LTV<br>(Long-term)                                   |                                         |  |
| Standing Water Level (m)                      | 0.63  | 0.98  | 0.32  | 0.80   | 1.01  | 0.65  | 0.50   | 0.46  | 2.65  | 3.74  | 1.35  | 1.50  | 1.55  | 1.05                   |                     |                                                      |                                         |  |
| pH - laboratory (pH Units)                    | 7.0   | 6.7   | 7.0   | 7.0    | 6.5   | 6.9   | 7.0    | 7.1   | 6.7   | 7.0   | 7.4   | 6.8   | 6.8   | 7.2                    |                     | **6.0-8.5                                            |                                         |  |
| Conductivity (µS/cm)                          | 1920  | 3700  | 2060  | 2180   | 1280  | 1630  | 2980   | 12900 | 3240  | 3740  | 1200  | 7770  | 1440  | 747                    |                     | (1) (Refer Tables 4.2.3 & 4.2.4)                     | (2) 2,000–10,000<br>(Refer Table 4.3.1) |  |
| TDS (mg/L)                                    | 752   | 1390  | 877   | 1260   | 851   | 960   | 2010   | 8750  | 2910  | -     | -     | -     | -     | -                      |                     |                                                      |                                         |  |
| Chloride (mg/L)                               | 120   | 110   | 40    | 380    | 110   | 130   | 320    | 4000  | 41    | 380   | 160   | 1600  | 200   | 26                     |                     | (3) MT (Refer Table 4.2.6)<br>MR (Refer Table 4.2.7) |                                         |  |
| Fluoride (mg/L)                               | 0.29  | 0.4   | 0.29  | 0.27   | 0.09  | 0.07  | 1.5    | 1.1   | 0.05  | -     | -     | -     | -     | -                      | 4                   | 1                                                    |                                         |  |
| Sulphate (mg/L)                               | 1.4   | 290   | 2.7   | 11     | 4.8   | 1.0   | 480    | 650   | 1400  | 140   | 3.5   | 300   | 18    | 14                     |                     |                                                      |                                         |  |
| NH <sub>3</sub> -N (mg/L)                     | 89.3  | 250   | 84.4  | 0.8    | 1.44  | 23.1  | 0.837  | 0.406 | 12.5  | 117   | 16.1  | 24.7  | 33.2  | 0.295                  |                     |                                                      |                                         |  |
| (NO <sub>2</sub> + NO <sub>3</sub> )-N (mg/L) | 0.007 | 0.008 | 0.006 | 0.004  | 0.012 | 0.008 | 0.006  | 0.012 | 0.006 | 0.009 | 0.007 | 0.012 | 0.007 | 2.9                    |                     |                                                      |                                         |  |
| NO <sub>2</sub> -N (mg/L)                     | 0.002 | 0.004 | 0.002 | <0.002 | 0.007 | 0.003 | <0.002 | 0.006 | 0.002 | 0.004 | 0.003 | 0.006 | 0.003 | 0.005                  |                     |                                                      |                                         |  |
| PO <sub>4</sub> -P (mg/L)                     | 0.321 | 1.33  | 5.44  | 0.004  | 0.006 | 0.003 | 0.007  | 0.013 | 0.004 | 0.012 | 2.18  | 0.005 | 0.031 | 0.01                   |                     |                                                      |                                         |  |

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 EC<sub>se</sub>, the average root zone salinity. EC<sub>se</sub> depends on soil type & average root zone leaching fraction depending on animal type

(3) ES = Suits extremely sensitive crops

MT = Suits moderately tolerant crops

MR = Medium risk of increasing crop cadmium concentrations

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

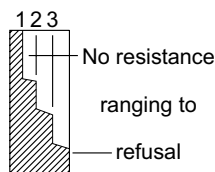
# Appendix 1

## Engineering logs

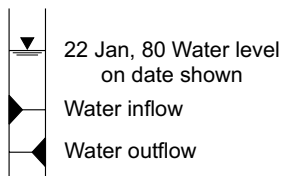
### EXPLANATION SHEET FOR ENGINEERING LOGS

#### Borehole and excavation log

##### Penetration



##### Water



##### Notes — samples and tests

|     |                                                |
|-----|------------------------------------------------|
| U50 | Undisturbed sample<br>50 mm diameter           |
| D   | Disturbed sample                               |
| N   | Standard penetrometer<br>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

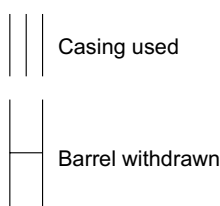
|    |              |          |
|----|--------------|----------|
|    |              | %        |
| VL | Very loose   | 0 – 15   |
| L  | Loose        | 15 – 35  |
| MD | Medium dense | 35 – 65  |
| D  | Dense        | 65 – 85  |
| VD | Very dense   | 85 – 100 |

##### Fracture description

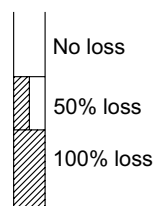
|    |                  |
|----|------------------|
| RP | Rough planar     |
| RL | Rough irregular  |
| SP | Smooth planar    |
| SL | Smooth irregular |

### Cored borehole log

##### Case - lift



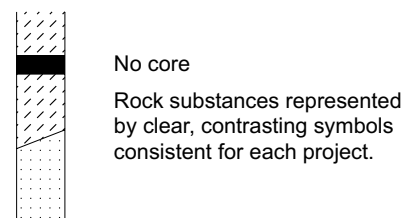
##### Fluid loss



##### 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  $1 \times 10^{-4}$  mm / sec.

##### Graphic log



##### Weathering

|    |                     |
|----|---------------------|
| Fr | Fresh               |
| SW | Slightly weathered  |
| HW | Highly weathered    |
| EW | Extremely weathered |

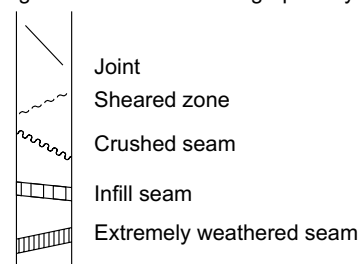
##### Strength

|    |                |                                                 |
|----|----------------|-------------------------------------------------|
|    |                | point load strength index $1.5 \sqrt{50}$ (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



## ENGINEERING LOG - BOREHOLE

 Borehole no.  
 SLL2000/1  
 Sheet 1 of 1

| Project      |  |         |                                               | Smithton sewage lagoons                                    |        |              |             | Location              |                                                                                                                 | Pelican Point, Smithton |                           |                           |  |
|--------------|--|---------|-----------------------------------------------|------------------------------------------------------------|--------|--------------|-------------|-----------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------|---------------------------|---------------------------|--|
| Co-ordinates |  |         |                                               | 55 340219 mE<br>5478587 mN                                 |        | Drill type   |             | Auger                 |                                                                                                                 | Hole commenced          |                           | 30 August 2000            |  |
|              |  |         |                                               |                                                            |        | Drill method |             | Rotary                |                                                                                                                 | Hole completed          |                           | 30 August 2000            |  |
| R.L.         |  |         |                                               |                                                            |        | Drill fluid  |             | Nil                   |                                                                                                                 | Drilled by              |                           | Mr Shane Heawood          |  |
| Inclination  |  |         |                                               | Vertical                                                   |        |              |             |                       |                                                                                                                 | Logged by               |                           | Mr Andrew Ezzy            |  |
| Bearing      |  |         |                                               |                                                            |        |              |             |                       |                                                                                                                 | Checked by              |                           | Mr Adrian Waite           |  |
| penetration  |  | support | water                                         | notes                                                      | metres |              |             | material              |                                                                                                                 |                         |                           |                           |  |
| 1 2 3        |  |         |                                               | samples, tests                                             | R.L.   | depth        | graphic log | classification symbol | soil type: plasticity or particle characteristics, colour, secondary and minor components.                      | moisture condition      | consistency density index | structure, geology        |  |
|              |  |         | Bentonite                                     | D<br>Sample ID 1                                           |        | 0.5          |             | SM                    | SAND - fine, black                                                                                              | M                       | S<br>L                    | Quaternary windblown sand |  |
|              |  |         | No Screen                                     | D<br>Sample ID 2                                           |        | 1.0          |             | SP                    | SAND- medium, grey                                                                                              | W                       | VS<br>VL                  | Quaternary beach sand     |  |
|              |  |         | 7 mm Gravel                                   | D<br>Sample ID 3                                           |        | 1.5          |             |                       |                                                                                                                 |                         |                           |                           |  |
|              |  |         |                                               | D<br>Sample ID 4                                           |        | 2.0          |             |                       |                                                                                                                 |                         |                           |                           |  |
|              |  |         | 1.5 metre Screen - 4 x 150mm spaced 5mm holes | D<br>Sample ID 5                                           |        | 2.5          |             |                       |                                                                                                                 |                         |                           |                           |  |
|              |  |         |                                               | D<br>Sample ID 6                                           |        | 3.0          |             |                       |                                                                                                                 |                         |                           |                           |  |
|              |  |         | Back fill                                     | D<br>Sample ID 7                                           |        | 3.5          |             |                       |                                                                                                                 |                         |                           |                           |  |
|              |  |         | No Screen                                     | D<br>Sample ID 8                                           |        | 4.0          |             |                       |                                                                                                                 |                         |                           |                           |  |
|              |  |         |                                               | Sample ID numbers refer to samples stored in MRT core shed |        |              |             |                       | End of hole at 4.0 m<br>Hand bailed for 10 minutes<br>At end of bailing,<br>pH 7.2 and conductivity 1850 µS/cm. |                         |                           |                           |  |

## ENGINEERING LOG - BOREHOLE

Borehole no.  
SLL2000/2  
Sheet 1 of 1

| Project      |   |         |                          | Smithton sewage lagoons                                    |        |              |                | Location                                                                                                           |           | Pelican Point, Smithton |                                                |                  |  |
|--------------|---|---------|--------------------------|------------------------------------------------------------|--------|--------------|----------------|--------------------------------------------------------------------------------------------------------------------|-----------|-------------------------|------------------------------------------------|------------------|--|
| Co-ordinates |   |         |                          | 55 340268 mE<br>5478466 mN                                 |        | Drill type   |                | Auger                                                                                                              |           | Hole commenced          |                                                | 30 August 2000   |  |
|              |   |         |                          |                                                            |        | Drill method |                | Rotary                                                                                                             |           | Hole completed          |                                                | 30 August 2000   |  |
| R.L.         |   |         |                          |                                                            |        | Drill fluid  |                | Nil                                                                                                                |           | Drilled by              |                                                | Mr Shane Heawood |  |
| Inclination  |   |         |                          | Vertical                                                   |        |              |                |                                                                                                                    |           | Logged by               |                                                | Mr Andrew Ezzy   |  |
| Bearing      |   |         |                          |                                                            |        |              |                |                                                                                                                    |           | Checked by              |                                                | Mr Adrian Waite  |  |
| penetration  |   | support | water                    | notes                                                      | metres | graphic log  | classification | material                                                                                                           | moisture  | consistency             | structure, geology                             |                  |  |
| 1            | 2 | 3       |                          | samples, tests                                             | R.L.   | depth        | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components.                         | condition | density index           |                                                |                  |  |
|              |   |         | Bentonite                | D<br>Sample ID 1                                           |        |              | SP             | SAND - medium, dark grey, various rock chips                                                                       | M         | S<br>L                  | Reworked Quaternary material                   |                  |  |
|              |   |         | No Screen                | D<br>Sample ID 2                                           | 0.5    |              | SP             | SAND - medium, grey, 10% clay mottled black                                                                        | M         | L<br>S                  | Quaternary beach sand with decayed organics    |                  |  |
|              |   |         |                          | D<br>Sample ID 3                                           | 1.0    |              | SP             | SAND - medium, grey, strong organic odour                                                                          | W         | L<br>S                  | Quaternary sand zone enriched in organic gases |                  |  |
|              |   |         |                          | D<br>Sample ID 4                                           | 1.5    |              | SP             | SAND - medium, grey                                                                                                | W         | VS<br>VL                | Quaternary beach sand                          |                  |  |
|              |   |         | 7 mm Gravel              | D<br>Sample ID 5                                           | 2.0    |              |                |                                                                                                                    |           |                         |                                                |                  |  |
|              |   |         | 1.5 metre slotted screen | D<br>Sample ID 6                                           | 2.5    |              |                |                                                                                                                    |           |                         |                                                |                  |  |
|              |   |         |                          | D<br>Sample ID 7                                           | 3.0    |              |                |                                                                                                                    |           |                         |                                                |                  |  |
|              |   |         | Back fill                | D<br>Sample ID 8                                           | 3.5    |              |                |                                                                                                                    |           |                         |                                                |                  |  |
|              |   |         | No Screen                |                                                            | 4.0    |              |                | End of hole at 4.0 m<br>Pumped for 60 minutes at 3 L/m.<br>At end of pumping,<br>pH 6.7 and conductivity unstable. |           |                         |                                                |                  |  |
|              |   |         |                          | Sample ID numbers refer to samples stored in MRT core shed |        |              |                |                                                                                                                    |           |                         |                                                |                  |  |

## ENGINEERING LOG - BOREHOLE

 Borehole no.  
**SLL2000/3**  
 Sheet 1 of 1

| Project      |  |  | Smithton sewage lagoons    |             |                                                            |                  | Location |             | Pelican Point, Smithton |                                                                                                                        |                  |           |               |                                       |  |
|--------------|--|--|----------------------------|-------------|------------------------------------------------------------|------------------|----------|-------------|-------------------------|------------------------------------------------------------------------------------------------------------------------|------------------|-----------|---------------|---------------------------------------|--|
| Co-ordinates |  |  | 55 340182 mE<br>5478708 mN |             | Drill type                                                 |                  | Auger    |             | Hole commenced          |                                                                                                                        | 30 August 2000   |           |               |                                       |  |
|              |  |  |                            |             | Drill method                                               |                  | Rotary   |             | Hole completed          |                                                                                                                        | 30 August 2000   |           |               |                                       |  |
| R.L.         |  |  |                            |             | Drill fluid                                                |                  | Nil      |             | Drilled by              |                                                                                                                        | Mr Shane Heawood |           |               |                                       |  |
| Inclination  |  |  | Vertical                   |             |                                                            |                  |          |             | Logged by               |                                                                                                                        | Mr Andrew Ezzy   |           |               |                                       |  |
| Bearing      |  |  |                            |             |                                                            |                  |          |             | Checked by              |                                                                                                                        | Mr Adrian Waite  |           |               |                                       |  |
| penetration  |  |  | support                    | water       | notes                                                      | metres           |          | graphic log | classification          | material                                                                                                               |                  | moisture  | consistency   | structure, geology                    |  |
| 1 2 3        |  |  |                            |             | samples, tests                                             | R.L.             | depth    |             | symbol                  | soil type: plasticity or particle characteristics, colour, secondary and minor components.                             |                  | condition | density index |                                       |  |
|              |  |  | No Screen                  | Bentonite   | D<br>Sample ID 1                                           |                  |          |             | SP                      | SAND - medium, dark grey, quartzite fragments                                                                          |                  | M         | S<br>L        | Reworked Quaternary material          |  |
|              |  |  |                            |             | D<br>Sample ID 2                                           |                  | 0.5      |             | SP                      | SAND - medium, grey, 15% clay mottled black                                                                            |                  | M         | VL<br>VS      | Quaternary sand with decayed organics |  |
|              |  |  |                            |             | D<br>Sample ID 3                                           |                  | 1.0      |             | SP                      | SAND - medium, grey                                                                                                    |                  | W         | VL<br>S       | Quaternary beach sand                 |  |
|              |  |  |                            |             | D<br>Sample ID 4                                           |                  | 1.5      |             | SP                      | SAND -medium, grey                                                                                                     |                  | W         | VS<br>VL      | Quaternary beach sand                 |  |
|              |  |  | 1.5 metre slotted screen   | 7 mm Gravel | D<br>Sample ID 5                                           |                  | 2.0      |             |                         |                                                                                                                        |                  |           |               |                                       |  |
|              |  |  |                            |             | D<br>Sample ID 6                                           |                  | 2.5      |             |                         |                                                                                                                        |                  |           |               |                                       |  |
|              |  |  |                            |             | D<br>Sample ID 7                                           |                  | 3.0      |             |                         |                                                                                                                        |                  |           |               |                                       |  |
|              |  |  |                            | No Screen   | Back fill                                                  | D<br>Sample ID 8 |          | 3.5         |                         |                                                                                                                        |                  |           |               |                                       |  |
|              |  |  |                            |             |                                                            |                  | 4.0      |             |                         | End of hole at 4.0 m<br>Pumped for 30 minutes at 0.6 L/m.<br>At end of pumping,<br>pH 7.4 and conductivity 1810 µS/cm. |                  |           |               |                                       |  |
|              |  |  |                            |             | Sample ID numbers refer to samples stored in MRT core shed |                  |          |             |                         |                                                                                                                        |                  |           |               |                                       |  |

## ENGINEERING LOG - BOREHOLE

Borehole no.  
SLL2000/4  
Sheet 1 of 1

|              |  |                            |  |                |  |                         |  |
|--------------|--|----------------------------|--|----------------|--|-------------------------|--|
| Project      |  | Smithton sewage lagoons    |  | Location       |  | Pelican Point, Smithton |  |
| Co-ordinates |  | 55 340306 mE<br>5478647 mN |  | Drill type     |  | Auger                   |  |
|              |  |                            |  | Drill method   |  | Rotary                  |  |
| R.L.         |  |                            |  | Drill fluid    |  | Nil                     |  |
| Inclination  |  | Vertical                   |  | Hole commenced |  | 30 August 2000          |  |
| Bearing      |  |                            |  | Hole completed |  | 30 August 2000          |  |
|              |  |                            |  | Drilled by     |  | Mr Shane Heawood        |  |
|              |  |                            |  | Logged by      |  | Mr Andrew Ezzy          |  |
|              |  |                            |  | Checked by     |  | Mr Adrian Waite         |  |

| penetration | support | water | notes            | metres | graphic log | classification | material                                                                                                             | moisture  | consistency   | structure, geology           |
|-------------|---------|-------|------------------|--------|-------------|----------------|----------------------------------------------------------------------------------------------------------------------|-----------|---------------|------------------------------|
| 1           | 2       | 3     | samples, tests   | R.L.   | depth       | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components.                           | condition | density index |                              |
|             |         |       | D<br>Sample ID 1 |        |             | SM             | SAND -medium, mottled dark grey and light yellow                                                                     | M         | S<br>L        | Reworked Quaternary material |
|             |         |       | D<br>Sample ID 2 |        | 0.5         | SP             | SAND - medium, grey, 5% sand mottled light red                                                                       | M         | S<br>L        | Reworked Quaternary material |
|             |         |       | D<br>Sample ID 3 |        | 1.0         | SP             | SAND - medium, dark grey                                                                                             | M         | VL<br>VS      | Quaternary beach sand        |
|             |         |       | D<br>Sample ID 4 |        | 1.5         | SP             | SAND - medium, grey                                                                                                  | W         | VS<br>VL      | Quaternary beach sand        |
|             |         |       | D<br>Sample ID 5 |        | 2.0         |                |                                                                                                                      |           |               |                              |
|             |         |       | D<br>Sample ID 6 |        | 2.5         |                |                                                                                                                      |           |               |                              |
|             |         |       | D<br>Sample ID 7 |        | 3.0         |                |                                                                                                                      |           |               |                              |
|             |         |       | D<br>Sample ID 8 |        | 3.5         |                |                                                                                                                      |           |               |                              |
|             |         |       |                  |        | 4.0         |                | End of hole at 4.0 m<br>Pumped for 30 minutes at 7 L/m.<br>At end of pumping,<br>pH 7.4 and conductivity 1840 µS/cm. |           |               |                              |

## ENGINEERING LOG - BOREHOLE

Borehole no.  
SLL2000/5  
Sheet 1 of 1

| Project      |  |                                               |           | Smithton sewage lagoons                                    |        |                                                                                     |                | Location                                                                                                            |           | Pelican Point, Smithton |                              |                  |  |
|--------------|--|-----------------------------------------------|-----------|------------------------------------------------------------|--------|-------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------|-----------|-------------------------|------------------------------|------------------|--|
| Co-ordinates |  |                                               |           | 55 340284 mE<br>5478626 mN                                 |        | Drill type                                                                          |                | Auger                                                                                                               |           | Hole commenced          |                              | 30 August 2000   |  |
|              |  |                                               |           |                                                            |        | Drill method                                                                        |                | Rotary                                                                                                              |           | Hole completed          |                              | 30 August 2000   |  |
| R.L.         |  |                                               |           |                                                            |        | Drill fluid                                                                         |                | Nil                                                                                                                 |           | Drilled by              |                              | Mr Shane Heawood |  |
| Inclination  |  |                                               |           | Vertical                                                   |        |                                                                                     |                |                                                                                                                     |           | Logged by               |                              | Mr Andrew Ezzy   |  |
| Bearing      |  |                                               |           |                                                            |        |                                                                                     |                |                                                                                                                     |           | Checked by              |                              | Mr Adrian Waite  |  |
| penetration  |  | support                                       | water     | notes                                                      | metres | graphic log                                                                         | classification | material                                                                                                            | moisture  | consistency             | structure, geology           |                  |  |
| 1 2 3        |  |                                               |           | samples, tests                                             | R.L.   | depth                                                                               | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components.                          | condition | density index           |                              |                  |  |
|              |  |                                               | Bentonite | D Sample ID 1                                              |        |    | SM             | SAND - medium, grey, 10% clay black mottles                                                                         | M         | S L                     | Reworked Quaternary material |                  |  |
|              |  | No Screen                                     |           | D Sample ID 2                                              | 0.5    |    | SP             | SAND - fine, black and brown                                                                                        | M         | S L                     | Quaternary windblown sand    |                  |  |
|              |  |                                               |           | D Sample ID 3                                              | 1.0    |   | SP             | SAND - fine, light grey, 5% sand black                                                                              | W         | S L                     | Quaternary windblown sand    |                  |  |
|              |  |                                               |           | D Sample ID 4                                              | 1.5    |  | SP             | SAND - medium, light yellow-brown                                                                                   | W         | VS VL                   | Quaternary dune sand         |                  |  |
|              |  | 1.5 metre Screen - 4 x 150mm spaced 5mm holes |           |                                                            | 2.0    |  |                |                                                                                                                     |           |                         |                              |                  |  |
|              |  | No Screen                                     |           |                                                            | 2.5    |  | SP             | SAND - medium, grey                                                                                                 | W         | VS VL                   | Quaternary beach sand        |                  |  |
|              |  |                                               |           |                                                            | 3.0    |  |                |                                                                                                                     |           |                         |                              |                  |  |
|              |  |                                               |           |                                                            | 3.5    |  |                |                                                                                                                     |           |                         |                              |                  |  |
|              |  |                                               |           |                                                            | 4.0    |  |                |                                                                                                                     |           |                         |                              |                  |  |
|              |  |                                               |           | Sample ID numbers refer to samples stored in MRT core shed |        |                                                                                     |                | End of hole at 4.0 m<br>Pumped for 30 minutes at 3 L/m.<br>At end of pumping,<br>pH 6.8 and conductivity 940 µS/cm. |           |                         |                              |                  |  |

## ENGINEERING LOG - BOREHOLE

Borehole no. SLL2000/6  
Sheet 1 of 1

| Project      |  |  | Smithton sewage lagoons    |              |                | Location |                | Pelican Point, Smithton |                       |          |                    |                           |                    |
|--------------|--|--|----------------------------|--------------|----------------|----------|----------------|-------------------------|-----------------------|----------|--------------------|---------------------------|--------------------|
| Co-ordinates |  |  | 55 340253 mE<br>5478602 mN | Drill type   |                | Auger    | Hole commenced |                         | 31 August 2000        |          |                    |                           |                    |
|              |  |  |                            | Drill method |                | Rotary   | Hole completed |                         | 31 August 2000        |          |                    |                           |                    |
| R.L.         |  |  |                            | Drill fluid  |                | Nil      | Drilled by     |                         | Mr Shane Heawood      |          |                    |                           |                    |
| Inclination  |  |  | Vertical                   |              |                |          | Logged by      |                         | Mr Andrew Ezzy        |          |                    |                           |                    |
| Bearing      |  |  |                            |              |                |          | Checked by     |                         | Mr Adrian Waite       |          |                    |                           |                    |
| penetration  |  |  | support                    | water        | notes          | metres   |                |                         |                       |          |                    |                           |                    |
| 1 2 3        |  |  |                            |              | samples, tests | R.L.     | depth          | graphic log             | classification symbol | material | moisture condition | consistency density index | structure, geology |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |
|              |  |  |                            |              |                |          |                |                         |                       |          |                    |                           |                    |

## ENGINEERING LOG - BOREHOLE

Borehole no.  
SLL2000/7  
Sheet 1 of 1

| Project      |   |   |         | Smithton sewage lagoons    |                                                            |              |       | Location    |                       | Pelican Point, Smithton                                                                                                |                    |                           |                                |
|--------------|---|---|---------|----------------------------|------------------------------------------------------------|--------------|-------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|--------------------------------|
| Co-ordinates |   |   |         | 55 340003 mE<br>5478522 mN |                                                            | Drill type   |       | Auger       |                       | Hole commenced                                                                                                         |                    | 31 August 2000            |                                |
|              |   |   |         |                            |                                                            | Drill method |       | Rotary      |                       | Hole completed                                                                                                         |                    | 31 August 2000            |                                |
| R.L.         |   |   |         |                            |                                                            | Drill fluid  |       | Nil         |                       | Drilled by                                                                                                             |                    | Mr Shane Heawood          |                                |
| Inclination  |   |   |         | Vertical                   |                                                            |              |       |             |                       | Logged by                                                                                                              |                    | Mr Andrew Ezzy            |                                |
| Bearing      |   |   |         |                            |                                                            |              |       |             |                       | Checked by                                                                                                             |                    | Mr Adrian Waite           |                                |
| penetration  |   |   | support | water                      | notes                                                      | metres       |       |             |                       |                                                                                                                        |                    |                           |                                |
| 1            | 2 | 3 |         |                            | samples, tests                                             | R.L.         | depth | graphic log | classification symbol | material                                                                                                               | moisture condition | consistency density index | structure, geology             |
|              |   |   |         |                            | D<br>Sample ID 1                                           |              |       |             | SM                    | SAND - medium, black-grey, quartzite chips up to 100 mm x 30 mm                                                        | M                  | S<br>L                    | Reworked Quaternary material   |
|              |   |   |         |                            | D<br>Sample ID 2                                           |              | 0.5   |             | SP                    | SAND - medium, black-grey, various rock fragments                                                                      | M                  | S<br>L                    | Reworked Quaternary material   |
|              |   |   |         |                            | D<br>Sample ID 3                                           |              | 1.0   |             | SP                    | SAND - fine, light yellow- brown                                                                                       | M                  | S<br>L                    | Quaternary windblown sand      |
|              |   |   |         |                            | D<br>Sample ID 4                                           |              | 1.5   |             | SP                    | SAND - medium, light yellow-brown                                                                                      | W                  | VL<br>VS                  | Quaternary dune sand           |
|              |   |   |         |                            | D<br>Sample ID 5                                           |              | 2.0   |             |                       |                                                                                                                        |                    |                           |                                |
|              |   |   |         |                            | D<br>Sample ID 6                                           |              | 2.5   |             | SP                    | SAND - medium, grey                                                                                                    | W                  | VS<br>VL                  | Quaternary beach sand          |
|              |   |   |         |                            | D<br>Sample ID 7                                           |              | 3.5   |             | OL                    | CLAY - dark grey                                                                                                       | W                  | F                         | Quaternary tidal marsh deposit |
|              |   |   |         |                            |                                                            |              | 4.0   |             |                       | End of hole at 4.0 m<br>Pumped for 30 minutes at 0.3 L/m.<br>At end of pumping,<br>pH 6.8 and conductivity 1390 µS/cm. |                    |                           |                                |
|              |   |   |         |                            | Sample ID numbers refer to samples stored in MRT core shed |              |       |             |                       |                                                                                                                        |                    |                           |                                |

## ENGINEERING LOG - BOREHOLE

Borehole no. SLL2000/8  
Sheet 1 of 1

| Project      |   |         |                          | Smithton sewage lagoons                                    |               |              |                | Location                                                                                                                                                                                                                                                                                                                                                                                               |           | Pelican Point, Smithton |                                |                  |  |
|--------------|---|---------|--------------------------|------------------------------------------------------------|---------------|--------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------------------|--------------------------------|------------------|--|
| Co-ordinates |   |         |                          | 55 339856 mE<br>5478540 mN                                 |               | Drill type   |                | Auger                                                                                                                                                                                                                                                                                                                                                                                                  |           | Hole commenced          |                                | 31 August 2000   |  |
|              |   |         |                          |                                                            |               | Drill method |                | Rotary                                                                                                                                                                                                                                                                                                                                                                                                 |           | Hole completed          |                                | 31 August 2000   |  |
| R.L.         |   |         |                          |                                                            |               | Drill fluid  |                | Nil                                                                                                                                                                                                                                                                                                                                                                                                    |           | Drilled by              |                                | Mr Shane Heawood |  |
| Inclination  |   |         |                          | Vertical                                                   |               |              |                |                                                                                                                                                                                                                                                                                                                                                                                                        |           | Logged by               |                                | Mr Andrew Ezzy   |  |
| Bearing      |   |         |                          |                                                            |               |              |                |                                                                                                                                                                                                                                                                                                                                                                                                        |           | Checked by              |                                | Mr Adrian Waite  |  |
| penetration  |   | support | water                    | notes                                                      | metres        | graphic log  | classification | material                                                                                                                                                                                                                                                                                                                                                                                               | moisture  | consistency             | structure, geology             |                  |  |
| 1            | 2 | 3       |                          | samples, tests                                             | R.L.<br>depth |              | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components.                                                                                                                                                                                                                                                                                                             | condition | density index           |                                |                  |  |
|              |   |         | Bentonite                | D Sample ID 1                                              |               |              | SM             | SAND - fine, dark grey, 30% orange                                                                                                                                                                                                                                                                                                                                                                     | M         | L                       | Quaternary windblown sand      |                  |  |
|              |   |         | No Screen                | D Sample ID 2                                              | 0.5           |              | SP             | SAND - fine, grey, white and light red                                                                                                                                                                                                                                                                                                                                                                 | M         | S L                     | Quaternary windblown sand      |                  |  |
|              |   |         |                          | D Sample ID 3                                              | 1.0           |              | SP             | SAND - medium, grey                                                                                                                                                                                                                                                                                                                                                                                    | W         | VS VL                   | Quaternary beach sand          |                  |  |
|              |   |         | 7 mm Gravel              |                                                            | 1.5           |              |                |                                                                                                                                                                                                                                                                                                                                                                                                        |           |                         |                                |                  |  |
|              |   |         |                          |                                                            | 2.0           |              |                |                                                                                                                                                                                                                                                                                                                                                                                                        |           |                         |                                |                  |  |
|              |   |         | 1.5 metre slotted screen | D Sample ID 4                                              | 2.5           |              | SM             | SAND - fine to medium, dark grey and black, silty                                                                                                                                                                                                                                                                                                                                                      | W         | VS VL                   | Quaternary tidal marsh deposit |                  |  |
|              |   |         |                          |                                                            | 3.0           |              |                |                                                                                                                                                                                                                                                                                                                                                                                                        |           |                         |                                |                  |  |
|              |   |         | No Screen                | D Sample ID 5                                              | 3.5           |              | SM             | SAND - fine, dark brown, silty, strong organic odour                                                                                                                                                                                                                                                                                                                                                   | W         | VL VS                   | Quaternary tidal marsh deposit |                  |  |
|              |   |         | Back fill                |                                                            | 4.0           |              |                |                                                                                                                                                                                                                                                                                                                                                                                                        |           |                         |                                |                  |  |
|              |   |         |                          | Sample ID numbers refer to samples stored in MRT core shed |               |              |                | End of hole at 4.0 m<br>Pumped for 30 minutes at 1.2 L/m.<br>At end of pumping,<br>pH 7.4 and conductivity 1660 µS/cm.<br><b>Extreme H<sub>2</sub>S odour from bore while installing gravel pack and during pumping.</b><br>(Vapour gas masks worn)<br> <b>OH&amp;S warning for future monitoring of this bore.</b> |           |                         |                                |                  |  |

## ENGINEERING LOG - BOREHOLE

Borehole no.  
SLL2000/9  
Sheet 1 of 2

| Project      |  |                          | Smithton sewage lagoons    |                  |               | Location    |                | Pelican Point, Smithton                                                                    |                  |               |                              |
|--------------|--|--------------------------|----------------------------|------------------|---------------|-------------|----------------|--------------------------------------------------------------------------------------------|------------------|---------------|------------------------------|
| Co-ordinates |  |                          | 55 340068 mE<br>5478777 mN |                  | Drill type    | Auger       |                | Hole commenced                                                                             | 31 August 2000   |               |                              |
|              |  |                          |                            |                  | Drill method  | Rotary      |                | Hole completed                                                                             | 31 August 2000   |               |                              |
| R.L.         |  |                          |                            |                  | Drill fluid   | Nil         |                | Drilled by                                                                                 | Mr Shane Heawood |               |                              |
| Inclination  |  |                          | Vertical                   |                  |               |             |                | Logged by                                                                                  | Mr Andrew Ezzy   |               |                              |
| Bearing      |  |                          |                            |                  |               |             |                | Checked by                                                                                 | Mr Adrian Waite  |               |                              |
| penetration  |  | support                  | water                      | notes            | metres        | graphic log | classification | material                                                                                   | moisture         | consistency   | structure, geology           |
| 1 2 3        |  |                          |                            | samples, tests   | R.L.<br>depth |             | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components. | condition        | density index |                              |
|              |  |                          | Bentonite                  | D<br>Sample ID 1 |               |             | SP             | SAND - fine to medium, light yellow-brown                                                  | M                | S<br>L        | Reworked Quaternary material |
|              |  | No Screen                |                            | D<br>Sample ID 2 | 0.5           |             |                | WASTE FILL - wood and plastic, sand, light yellow-brown                                    | M                |               | Domestic refuse              |
|              |  |                          |                            | D<br>Sample ID 3 | 1.0           |             |                | WASTE FILL - wood and plastic, sand, light red-grey                                        | M                |               | Domestic refuse              |
|              |  |                          |                            | D<br>Sample ID 4 | 1.5           |             |                | WASTE FILL - wood and plastic, sand, light brown-grey                                      | M                |               | Domestic refuse              |
|              |  | 7 mm Gravel              |                            | D<br>Sample ID 5 | 2.0           |             |                | WASTE FILL - wood and plastic, sand, light brown-grey                                      | M                |               | Domestic refuse              |
|              |  |                          |                            | D<br>Sample ID 6 | 2.5           |             | SP             | SAND - fine to medium, light brown-grey                                                    | W                | S<br>L        | Reworked Quaternary material |
|              |  | 2.0 metre slotted screen |                            |                  | 3.0           |             | SP             | SAND - medium, grey                                                                        | W                | VL<br>VS      | Quaternary beach sand        |
|              |  | No Screen                |                            |                  | 3.5           |             |                |                                                                                            |                  |               |                              |
|              |  | Back fill                |                            |                  | 4.0           |             |                |                                                                                            |                  |               |                              |
|              |  |                          |                            |                  | 4.5           |             |                |                                                                                            |                  |               |                              |

**ENGINEERING LOG - BOREHOLE**
 Borehole no. **SLL2000/9**  
 Sheet **2** of **2**

|              |  |                            |  |              |  |          |  |                         |  |                  |  |
|--------------|--|----------------------------|--|--------------|--|----------|--|-------------------------|--|------------------|--|
| Project      |  | Smithton sewage lagoons    |  |              |  | Location |  | Pelican Point, Smithton |  |                  |  |
| Co-ordinates |  | 55 340068 mE<br>5478777 mN |  | Drill type   |  | Auger    |  | Hole commenced          |  | 31 August 2000   |  |
|              |  |                            |  | Drill method |  | Rotary   |  | Hole completed          |  | 31 August 2000   |  |
| R.L.         |  |                            |  | Drill fluid  |  | Nil      |  | Drilled by              |  | Mr Shane Heawood |  |
| Inclination  |  | Vertical                   |  |              |  |          |  | Logged by               |  | Mr Andrew Ezzy   |  |
| Bearing      |  |                            |  |              |  |          |  | Checked by              |  | Mr Adrian Waite  |  |

| penetration<br>1 2 3 | support<br>water | notes<br>samples,<br>tests                                    | metres |       | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components.                                                                            | moisture<br>condition | consistency<br>density index | structure, geology |
|----------------------|------------------|---------------------------------------------------------------|--------|-------|-------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------|--------------------|
|                      |                  |                                                               | R.L.   | depth |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      | Back fill        |                                                               |        |       |             |                          | (As sheet 1)                                                                                                                                                                         |                       |                              |                    |
|                      |                  | Sample ID numbers refer to<br>samples stored in MRT core shed |        | 5.5   |             |                          | End of hole at 5.5 m<br>Pumped for 30 minutes at 0.7 L/m.<br>At end of pumping, pH 7.5 and<br>conductivity 1760 $\mu$ S/cm.<br>Note: Water samples had detergent<br>foam on surface. |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |
|                      |                  |                                                               |        |       |             |                          |                                                                                                                                                                                      |                       |                              |                    |

## ENGINEERING LOG - BOREHOLE

 Borehole no.  
 SLL2000/10  
 Sheet 1 of 2

| Project      |         | Smithton sewage lagoons    |                  |        |             | Location       |                                                                                            | Pelican Point, Smithton |               |                              |  |
|--------------|---------|----------------------------|------------------|--------|-------------|----------------|--------------------------------------------------------------------------------------------|-------------------------|---------------|------------------------------|--|
| Co-ordinates |         | 55 340053 mE<br>5478431 mN |                  |        |             | Drill type     |                                                                                            | Auger                   |               |                              |  |
|              |         |                            |                  |        |             | Drill method   |                                                                                            | Rotary                  |               |                              |  |
| R.L.         |         |                            |                  |        |             | Drill fluid    |                                                                                            | Nil                     |               |                              |  |
| Inclination  |         | Vertical                   |                  |        |             | Hole commenced |                                                                                            | 31 August 2000          |               |                              |  |
| Bearing      |         |                            |                  |        |             | Hole completed |                                                                                            | 31 August 2000          |               |                              |  |
|              |         |                            |                  |        |             | Drilled by     |                                                                                            | Mr Shane Heawood        |               |                              |  |
|              |         |                            |                  |        |             | Logged by      |                                                                                            | Mr Andrew Ezzy          |               |                              |  |
|              |         |                            |                  |        |             | Checked by     |                                                                                            | Mr Adrian Waite         |               |                              |  |
| penetration  | support | water                      | notes            | metres | graphic log | classification | material                                                                                   | moisture                | consistency   | structure, geology           |  |
| 1            | 2       | 3                          | samples, tests   | R.L.   | depth       | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components. | condition               | density index |                              |  |
|              |         |                            | D<br>Sample ID 1 |        |             | SP             | SAND - fine to medium, light grey                                                          | M                       | S<br>L        | Reworked Quaternary material |  |
|              |         |                            | D<br>Sample ID 2 |        | 0.5         | SP             | SAND - medium, dark grey and light yellow, metamorphic rock chips                          | M                       | S<br>L        | Reworked Quaternary material |  |
|              |         |                            | D<br>Sample ID 3 |        | 1.0         | SP             | SAND - fine to medium, light brown-grey, metamorphic rock chips                            | M                       | S<br>L        | Reworked Quaternary material |  |
|              |         |                            |                  |        | 1.5         |                |                                                                                            |                         |               |                              |  |
|              |         |                            |                  |        | 2.0         |                |                                                                                            |                         |               |                              |  |
|              |         |                            |                  |        | 2.5         |                |                                                                                            |                         |               |                              |  |
|              |         |                            |                  |        | 3.0         | SP             | SAND - medium, brown-grey                                                                  | W                       | L<br>S        | Reworked Quaternary material |  |
|              |         |                            | D<br>Sample ID 4 |        | 3.5         |                |                                                                                            |                         |               |                              |  |
|              |         |                            |                  |        | 4.0         |                |                                                                                            |                         |               |                              |  |
|              |         |                            | D<br>Sample ID 5 |        | 4.5         | SP             | SAND - medium, grey                                                                        | W                       | VS<br>VL      | Quaternary beach sand        |  |



## ENGINEERING LOG - BOREHOLE

 Borehole no. SLL2000/11  
 Sheet 1 of 1

| Project      |   |   |         | Smithton sewage lagoons    |                |              |       | Location    |                       | Pelican Point, Smithton                                                                                                                                                                    |                    |                           |                                         |
|--------------|---|---|---------|----------------------------|----------------|--------------|-------|-------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|-----------------------------------------|
| Co-ordinates |   |   |         | 55 339980 mE<br>5479134 mN |                | Drill type   |       | Auger       |                       | Hole commenced                                                                                                                                                                             |                    | 5 September 2000          |                                         |
|              |   |   |         |                            |                | Drill method |       | Rotary      |                       | Hole completed                                                                                                                                                                             |                    | 5 September 2000          |                                         |
| R.L.         |   |   |         |                            |                | Drill fluid  |       | Nil         |                       | Drilled by                                                                                                                                                                                 |                    | Mr Shane Heawood          |                                         |
| Inclination  |   |   |         | Vertical                   |                |              |       |             |                       | Logged by                                                                                                                                                                                  |                    | Mr Andrew Ezzy            |                                         |
| Bearing      |   |   |         |                            |                |              |       |             |                       | Checked by                                                                                                                                                                                 |                    | Mr Adrian Waite           |                                         |
| penetration  |   |   | support | water                      | notes          | metres       |       |             |                       |                                                                                                                                                                                            |                    |                           |                                         |
| 1            | 2 | 3 |         |                            | samples, tests | R.L.         | depth | graphic log | classification symbol | material                                                                                                                                                                                   | moisture condition | consistency density index | structure, geology                      |
|              |   |   |         |                            | D Sample ID 1  |              |       |             | SP                    | SAND - fine, light yellow, rock fragments                                                                                                                                                  | M                  | S L                       | Reworked Quaternary material            |
|              |   |   |         |                            | D Sample ID 2  |              | 0.5   |             | SP                    | SAND - medium, light and dark grey                                                                                                                                                         | M                  | S L                       | Reworked Quaternary material            |
|              |   |   |         |                            | D Sample ID 3  |              | 1.0   |             | SC                    | SAND - fine, black, clayey, sand light yellow                                                                                                                                              | M                  | S L                       | Reworked Quaternary tidal marsh deposit |
|              |   |   |         |                            | D Sample ID 4  |              | 1.5   |             | SP                    | SAND - fine, grey-brown                                                                                                                                                                    | M                  | S L                       | Reworked Quaternary tidal marsh deposit |
|              |   |   |         |                            | D Sample ID 5  |              | 2.0   |             | SP                    | SAND - fine to medium, grey-brown                                                                                                                                                          | W                  | VL S                      | Reworked Quaternary tidal marsh deposit |
|              |   |   |         |                            | D Sample ID 6  |              | 2.5   |             | SP                    | SAND - medium, grey                                                                                                                                                                        | W                  | VS VL                     | Quaternary beach sand                   |
|              |   |   |         |                            |                |              | 3.0   |             |                       |                                                                                                                                                                                            |                    |                           |                                         |
|              |   |   |         |                            |                |              | 3.5   |             |                       |                                                                                                                                                                                            |                    |                           |                                         |
|              |   |   |         |                            |                |              | 4.0   |             |                       | End of hole at 4.0 m<br>Pumped for 30 minutes at 4 L/m.<br>At end of pumping,<br>pH 7.5 and conductivity 1180 µS/cm.<br>Note: During pumping water had very strong H <sub>2</sub> S odour. |                    |                           |                                         |

## ENGINEERING LOG - BOREHOLE

 Borehole no. SLL2000/12  
 Sheet 1 of 1

| Project      |   |         |                          | Smithton sewage lagoons                                    |        |              |                | Location                                                                                                                                                                                        |           | Pelican Point, Smithton |                                                        |                  |  |
|--------------|---|---------|--------------------------|------------------------------------------------------------|--------|--------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------------------|--------------------------------------------------------|------------------|--|
| Co-ordinates |   |         |                          | 55 339748 mE<br>5479080 mN                                 |        | Drill type   |                | Auger                                                                                                                                                                                           |           | Hole commenced          |                                                        | 5 September 2000 |  |
|              |   |         |                          |                                                            |        | Drill method |                | Rotary                                                                                                                                                                                          |           | Hole completed          |                                                        | 5 September 2000 |  |
| R.L.         |   |         |                          |                                                            |        | Drill fluid  |                | Nil                                                                                                                                                                                             |           | Drilled by              |                                                        | Mr Shane Heawood |  |
| Inclination  |   |         |                          | Vertical                                                   |        |              |                |                                                                                                                                                                                                 |           | Logged by               |                                                        | Mr Andrew Ezzy   |  |
| Bearing      |   |         |                          |                                                            |        |              |                |                                                                                                                                                                                                 |           | Checked by              |                                                        | Mr Adrian Waite  |  |
| penetration  |   | support | water                    | notes                                                      | metres | graphic log  | classification | material                                                                                                                                                                                        | moisture  | consistency             | structure, geology                                     |                  |  |
| 1            | 2 | 3       |                          | samples, tests                                             | R.L.   | depth        | symbol         | soil type: plasticity or particle characteristics, colour, secondary and minor components.                                                                                                      | condition | density index           |                                                        |                  |  |
|              |   |         | No Screen                | D Sample ID 1                                              |        |              | SP             | SAND - fine, light yellow, rock fragments                                                                                                                                                       | M         | S L                     | Reworked Quaternary material                           |                  |  |
|              |   |         |                          | D Sample ID 2                                              | 0.5    |              | SP             | SAND - medium, black, rock fragments                                                                                                                                                            | M         | S L                     | Reworked Quaternary material                           |                  |  |
|              |   |         |                          | D Sample ID 3                                              | 1.0    |              | SP             | SAND - medium, brown-grey                                                                                                                                                                       | M         | S L                     | Reworked Quaternary tidal marsh deposit                |                  |  |
|              |   |         | 7 mm Gravel              | D Sample ID 4                                              | 1.5    |              | SC             | SAND - fine, grey, clayey                                                                                                                                                                       | M         | S L                     | Reworked Quaternary tidal marsh deposit                |                  |  |
|              |   |         |                          | D Sample ID 5                                              | 2.0    |              | SC             | SAND - fine to medium, grey, clayey, shell fragments                                                                                                                                            | M         | S L                     | Reworked Quaternary tidal marsh deposit and beach sand |                  |  |
|              |   |         |                          | D Sample ID 6                                              | 2.5    |              | SM             | SAND - fine to medium, grey, silty                                                                                                                                                              | W         | VS VL                   | Reworked Quaternary tidal marsh deposit and beach sand |                  |  |
|              |   |         | 1.5 metre slotted screen | D Sample ID 7                                              | 3.0    |              | SP             | SAND -medium, grey, quartzite rock fragments                                                                                                                                                    | W         | VS VL                   | Reworked Quaternary beach sand including imported rock |                  |  |
|              |   |         |                          |                                                            |        | 3.5          |                |                                                                                                                                                                                                 |           |                         |                                                        |                  |  |
|              |   |         | No Screen                |                                                            |        |              |                |                                                                                                                                                                                                 |           |                         |                                                        |                  |  |
|              |   |         | Back fill                |                                                            |        |              |                |                                                                                                                                                                                                 |           |                         |                                                        |                  |  |
|              |   |         |                          |                                                            | 4.0    |              |                | End of hole at 4.0 m<br>Pumped for 30 minutes at 0.4 L/m.<br>At end of pumping,<br>pH 7.6 and conductivity 1280 µS/cm.<br>Note: During pumping water had strong detergent appearance and odour. |           |                         |                                                        |                  |  |
|              |   |         |                          | Sample ID numbers refer to samples stored in MRT core shed |        |              |                |                                                                                                                                                                                                 |           |                         |                                                        |                  |  |

## ENGINEERING LOG - BOREHOLE

 Borehole no.  
**SLL2000/13**  
 Sheet 1 of 1

| Project      |  |  |         | Smithton sewage lagoons    |                |              |       | Location    |                       | Pelican Point, Smithton                                                                                                |                    |                           |                                         |
|--------------|--|--|---------|----------------------------|----------------|--------------|-------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|-----------------------------------------|
| Co-ordinates |  |  |         | 55 339904 mE<br>5479002 mN |                | Drill type   |       | Auger       |                       | Hole commenced                                                                                                         |                    | 5 September 2000          |                                         |
|              |  |  |         |                            |                | Drill method |       | Rotary      |                       | Hole completed                                                                                                         |                    | 5 September 2000          |                                         |
| R.L.         |  |  |         |                            |                | Drill fluid  |       | Nil         |                       | Drilled by                                                                                                             |                    | Mr Shane Heawood          |                                         |
| Inclination  |  |  |         | Vertical                   |                |              |       |             |                       | Logged by                                                                                                              |                    | Mr Andrew Ezzy            |                                         |
| Bearing      |  |  |         |                            |                |              |       |             |                       | Checked by                                                                                                             |                    | Mr Adrian Waite           |                                         |
| penetration  |  |  | support | water                      | notes          | metres       |       |             |                       |                                                                                                                        |                    |                           |                                         |
| 1 2 3        |  |  |         |                            | samples, tests | R.L.         | depth | graphic log | classification symbol | material                                                                                                               | moisture condition | consistency density index | structure, geology                      |
|              |  |  |         |                            | D Sample ID 1  |              |       |             | SP                    | SAND - medium, dark grey, quartzite fragments                                                                          | M                  | S L                       | Reworked Quaternary material            |
|              |  |  |         |                            | D Sample ID 2  |              | 0.5   |             | SM                    | SAND - fine to medium, mottled light yellow, light red, dark grey and black, silty                                     | M                  | S L                       | Reworked Quaternary material            |
|              |  |  |         |                            | D Sample ID 3  |              | 1.0   |             | SM                    | SAND - fine to medium, mottled dark brown-grey and light yellow, silty                                                 | M                  | S L                       | Reworked Quaternary material            |
|              |  |  |         |                            | D Sample ID 4  |              | 1.5   |             | SP                    | SAND - fine to medium, dark brown and light grey                                                                       | M                  | S L                       | Reworked Quaternary tidal marsh deposit |
|              |  |  |         |                            | D Sample ID 5  |              | 2.0   |             | SP                    | SAND - medium, dark and light grey                                                                                     | M                  | S L                       | Reworked Quaternary beach sand          |
|              |  |  |         |                            | D Sample ID 6  |              | 2.5   |             | SP                    | SAND - medium, grey                                                                                                    | W                  | S L                       | Quaternary beach sand                   |
|              |  |  |         |                            | D Sample ID 7  |              | 3.0   |             | SP                    | SAND - medium, grey                                                                                                    | W                  | VS VL                     | Quaternary beach sand                   |
|              |  |  |         |                            | D Sample ID 8  |              | 3.5   |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              | 4.0   |             |                       | End of hole at 4.0 m<br>Pumped for 30 minutes at 3.2 L/m.<br>At end of pumping,<br>pH 7.3 and conductivity 1560 µS/cm. |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |
|              |  |  |         |                            |                |              |       |             |                       |                                                                                                                        |                    |                           |                                         |

## ENGINEERING LOG - BOREHOLE

Borehole no.  
SLL2000/14  
Sheet 1 of 1

| Project      |  |                          | Smithton sewage lagoons    |                                                            |              | Location |             | Pelican Point, Smithton |                                                                                                                      |                    |                           |                              |
|--------------|--|--------------------------|----------------------------|------------------------------------------------------------|--------------|----------|-------------|-------------------------|----------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|------------------------------|
| Co-ordinates |  |                          | 55 340087 mE<br>5479709 mN |                                                            | Drill type   |          | Auger       |                         | Hole commenced                                                                                                       |                    | 5 September 2000          |                              |
|              |  |                          |                            |                                                            | Drill method |          | Rotary      |                         | Hole completed                                                                                                       |                    | 5 September 2000          |                              |
| R.L.         |  |                          |                            |                                                            | Drill fluid  |          | Nil         |                         | Drilled by                                                                                                           |                    | Mr Shane Heawood          |                              |
| Inclination  |  |                          | Vertical                   |                                                            |              |          |             |                         | Logged by                                                                                                            |                    | Mr Andrew Ezzy            |                              |
| Bearing      |  |                          |                            |                                                            |              |          |             |                         | Checked by                                                                                                           |                    | Mr Adrian Waite           |                              |
| penetration  |  | support                  | water                      | notes                                                      | metres       |          |             |                         |                                                                                                                      |                    |                           |                              |
| 1 2 3        |  |                          |                            | samples, tests                                             | R.L.         | depth    | graphic log | classification symbol   | material                                                                                                             | moisture condition | consistency density index | structure, geology           |
|              |  |                          |                            | D Sample ID 1                                              |              |          |             | SP                      | SAND - fine to medium, dark brown and dark grey                                                                      | M                  | S L                       | Reworked Quaternary material |
|              |  | No Screen                | Bentonite                  | D Sample ID 2                                              |              | 0.5      |             | SP                      | SAND - fine to medium, brown, light and dark grey                                                                    | W                  | VS L                      | Reworked Quaternary material |
|              |  | 2.5 metre slotted screen | 7 mm Gravel                | D Sample ID 3<br>Major                                     |              | 1.0      |             | SP                      | SAND - fine, light brown-grey                                                                                        | W                  | VS VL                     | Quaternary windblown sand    |
|              |  |                          |                            | D Sample ID 4                                              |              | 1.5      |             | SP                      | SAND - fine, light yellow                                                                                            | W                  | VS VL                     | Quaternary windblown sand    |
|              |  |                          |                            | D Sample ID 5                                              |              | 2.0      |             | SM                      | SAND - fine, grey, silty                                                                                             | W                  | VS VL                     | Quaternary windblown sand    |
|              |  |                          |                            | D Sample ID 6                                              |              | 2.5      |             | SP                      | SAND - medium, grey                                                                                                  | W                  | VS VL                     | Quaternary beach sand        |
|              |  |                          |                            | D Sample ID 7                                              |              | 3.0      |             | SP                      | SAND - medium, grey, shell fragments                                                                                 | W                  | VS VL                     | Quaternary beach sand        |
|              |  | No Screen                | Back fill                  | D Sample ID 8                                              |              | 3.5      |             |                         |                                                                                                                      |                    |                           |                              |
|              |  |                          |                            |                                                            |              | 4.0      |             |                         | End of hole at 4.0 m<br>Pumped for 45 minutes at 12 L/m.<br>At end of pumping,<br>pH 7.4 and conductivity 790 µS/cm. |                    |                           |                              |
|              |  |                          |                            | Sample ID numbers refer to samples stored in MRT core shed |              |          |             |                         |                                                                                                                      |                    |                           |                              |

## Appendix 2

### Raw data collected for slug extraction tests

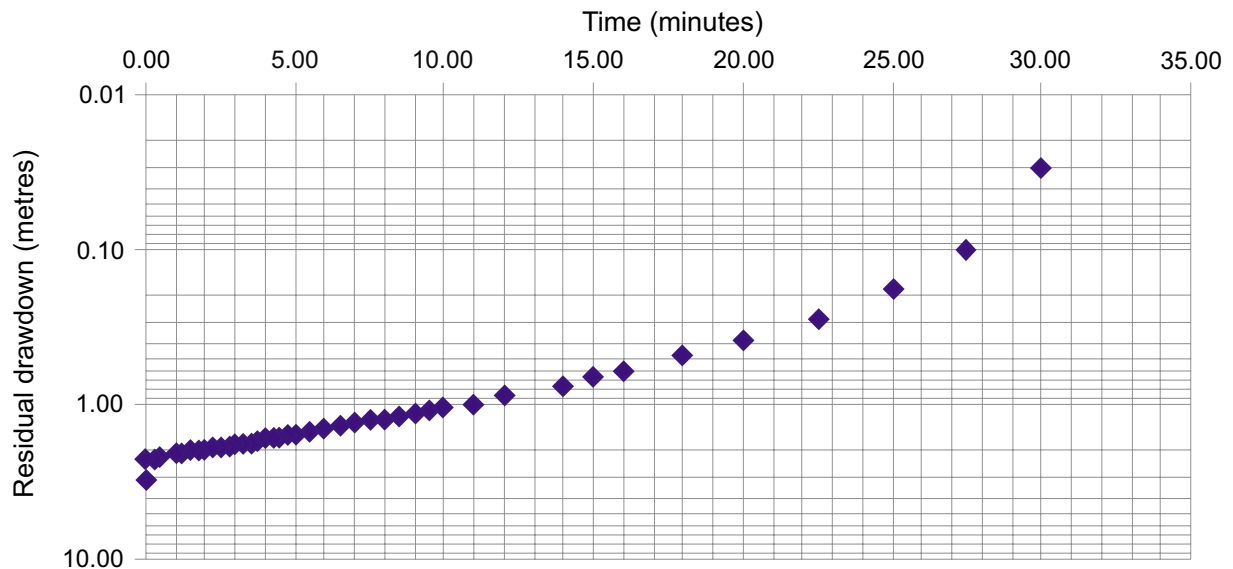
#### Smithton lagoons pump tests – slug extraction recovery data

Date 14/08/2001  
Bore SLL 2000/7  
TD 4.00 m  
Flow 1.6 l/m  
SWL 1.02 m

#### Recovery data

| Time | Residual drawdown | Measurement | Time  | Residual drawdown | Measurement |
|------|-------------------|-------------|-------|-------------------|-------------|
| 0.00 | 2.28              | 3.30        | 5.50  | 1.51              | 2.53        |
| 0.25 | 2.21              | 3.23        | 6.00  | 1.46              | 2.48        |
| 0.50 | 2.16              | 3.18        | 6.50  | 1.39              | 2.41        |
| 0.75 | 2.10              | 3.12        | 7.00  | 1.34              | 2.36        |
| 1.00 | 2.08              | 3.10        | 7.50  | 1.28              | 2.30        |
| 1.25 | 2.03              | 3.05        | 8.00  | 1.23              | 2.25        |
| 1.50 | 1.98              | 3.00        | 8.50  | 1.18              | 2.20        |
| 1.75 | 1.96              | 2.98        | 9.00  | 1.13              | 2.15        |
| 2.00 | 1.93              | 2.95        | 9.50  | 1.08              | 2.10        |
| 2.25 | 1.90              | 2.92        | 10.00 | 1.04              | 2.06        |
| 2.50 | 1.88              | 2.90        | 11.00 | 0.98              | 2.00        |
| 2.75 | 1.85              | 2.87        | 12.00 | 0.88              | 1.90        |
| 3.00 | 1.81              | 2.83        | 14.00 | 0.76              | 1.78        |
| 3.25 | 1.78              | 2.80        | 15.00 | 0.66              | 1.68        |
| 3.50 | 1.76              | 2.78        | 16.00 | 0.60              | 1.62        |
| 3.75 | 1.71              | 2.73        | 18.00 | 0.48              | 1.50        |
| 4.00 | 1.68              | 2.70        | 20.00 | 0.38              | 1.40        |
| 4.25 | 1.65              | 2.67        | 22.50 | 0.28              | 1.30        |
| 4.50 | 1.63              | 2.65        | 25.00 | 0.18              | 1.20        |
| 4.75 | 1.59              | 2.61        | 27.50 | 0.10              | 1.12        |
| 5.00 | 1.56              | 2.58        | 30.00 | 0.03              | 1.05        |

#### Recovery SLL 2000/7, 14 August 2001



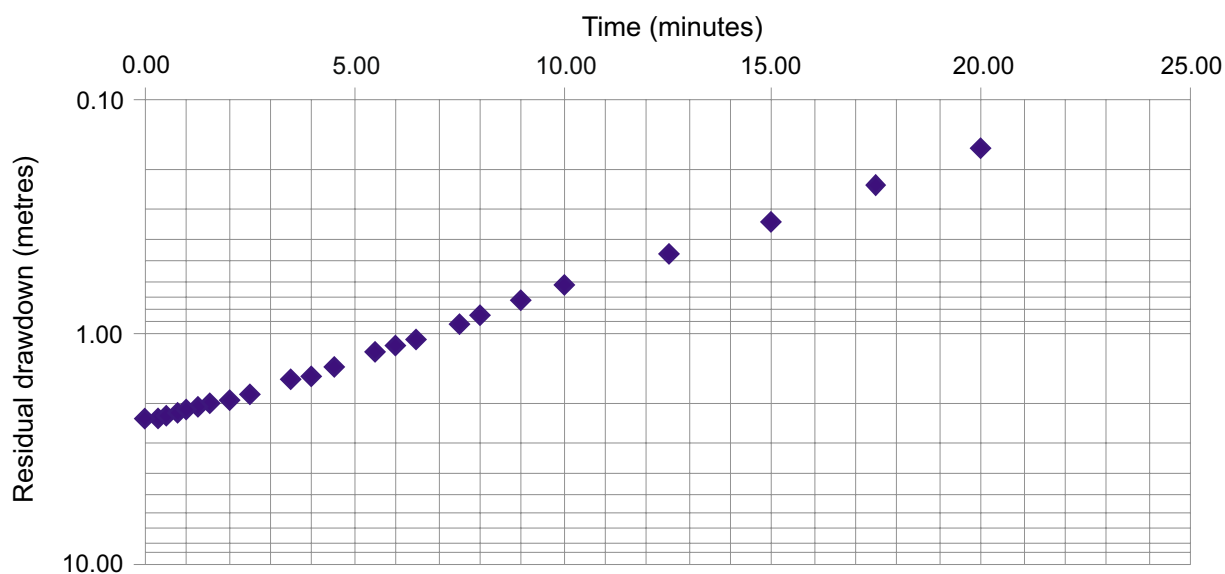
## Smithton lagoons pump tests – slug extraction recovery data

Date 14/08/2001  
 Bore SLL 2000/12  
 TD 4.00 m  
 Flow 4.0 l/m  
 SWL 1.62 m

### Recovery data

| Time  | Residual drawdown | Measurement |
|-------|-------------------|-------------|
| 0.00  | 2.38              | 4.00        |
| 0.25  | 2.36              | 3.98        |
| 0.50  | 2.30              | 3.92        |
| 0.75  | 2.24              | 3.86        |
| 1.00  | 2.18              | 3.80        |
| 1.25  | 2.08              | 3.70        |
| 1.50  | 2.03              | 3.65        |
| 2.00  | 1.96              | 3.58        |
| 2.50  | 1.83              | 3.45        |
| 3.50  | 1.60              | 3.22        |
| 4.00  | 1.53              | 3.15        |
| 4.50  | 1.40              | 3.02        |
| 5.50  | 1.20              | 2.82        |
| 6.00  | 1.13              | 2.75        |
| 6.50  | 1.08              | 2.70        |
| 7.50  | 0.93              | 2.55        |
| 8.00  | 0.85              | 2.47        |
| 9.00  | 0.73              | 2.35        |
| 10.00 | 0.63              | 2.25        |
| 12.50 | 0.46              | 2.08        |
| 15.00 | 0.33              | 1.95        |
| 17.50 | 0.23              | 1.85        |
| 20.00 | 0.16              | 1.78        |

### Recovery SLL 2000/12, 14 August 2001



## Appendix 3

### Analytical Services Tasmania — Laboratory reports



#### 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

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#### Laboratory Report

**Report No:** 13773 *Please quote this number when making enquiries about this report*  
**Submitted By:** Andrew Ezzy  
**Client:** Mineral Resources Tasmania  
**Site Description:** Smithton Sewage Lagoons  
**Received:** 03-Nov-00 **Client Order No:**  
**Report Date:** 01-Dec-00  
**Report To:** Andrew Ezzy  
**Address:** Gordons Hill Rd Rosny TAS 7018

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#### 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                  |



NATA endorsed test report.

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Samples analysed as received.

NATA Accreditation Number: 5589

  
Mike Johnson  
Manager

Page 1 of 4

Report No: 13773

Report Date: 01-Dec-00

| Method     | Analyte                     | Units / Sampled On :   | Lab.No.: 13089         | 13090          | 13091          | 13092          | 13093          |
|------------|-----------------------------|------------------------|------------------------|----------------|----------------|----------------|----------------|
|            |                             |                        | Sample Id.: SLL 2000/1 | SLL 2000/2     | SLL 2000/3     | SLL 2000/4     | SLL 2000/5     |
|            |                             |                        | 01/11/00 14:25         | 01/11/00 13:50 | 01/11/00 16:00 | 01/11/00 15:45 | 01/11/00 15:20 |
| 1001-Water | pH                          |                        | 7.0                    | 6.7            | 7.0            | 7.0            | 6.5            |
| 1002-Water | Conductivity                | µS/cm                  | 1920                   | 3700           | 2060           | 2180           | 1280           |
| 1004-Water | TDS                         | mg/L                   | 752                    | 1390           | 877            | 1260           | 851            |
| 1101-Water | Alkalinity CO <sub>3</sub>  | mg/L CaCO <sub>3</sub> | <1                     | <1             | <1             | <1             | <1             |
|            | Alkalinity HCO <sub>3</sub> | mg/L CaCO <sub>3</sub> | 730                    | 1410           | 779            | 672            | 455            |
| 1103-Water | Chloride                    | mg/L                   | 120                    | 110            | 140            | 380            | 110            |
|            | Fluoride                    | mg/L                   | 0.29                   | 0.40           | 0.29           | 0.27           | 0.09           |
|            | Sulphate                    | mg/L                   | 1.4                    | 290            | 2.7            | 11             | 4.8            |
| 1201-Water | Ammonia                     | µg-N/L                 | 89300                  | 250000         | 84400          | 800            | 1440           |
|            | Nitrate+Nitrite             | µg-N/L                 | 7                      | 8              | 6              | 4              | 12             |
|            | Nitrite                     | µg-N/L                 | 2                      | 4              | 2              | <2             | 7              |
|            | Ortho-P                     | µg-P/L                 | 132                    | 1330           | 5440           | 4              | 6              |

Report No: 13773

Report Date: 01-Dec-00

| Method     | Analyte                     | Units / Sampled On :   | Lab.No.: 13094         | 13095          | 13096          | 13097          | 13098          |
|------------|-----------------------------|------------------------|------------------------|----------------|----------------|----------------|----------------|
|            |                             |                        | Sample Id.: SLL 2000/6 | SLL 2000/7     | SLL 2000/8     | SLL 2000/9     | SLL 2000/10    |
|            |                             |                        | 01/11/00 14:50         | 01/11/00 10:40 | 01/11/00 11:25 | 01/11/00 09:10 | 01/11/00 10:05 |
| 1001-Water | pH                          |                        | 6.9                    | 7.0            | 7.1            | 6.7            | 7.0            |
| 1002-Water | Conductivity                | µS/cm                  | 1630                   | 2980           | 12900          | 3240           | 3740           |
| 1004-Water | TDS                         | mg/L                   | 960                    | 2010           | 8750           | 2910           |                |
| 1101-Water | Alkalinity CO <sub>3</sub>  | mg/L CaCO <sub>3</sub> | <1                     | <1             | <1             | <1             | <1             |
|            | Alkalinity HCO <sub>3</sub> | mg/L CaCO <sub>3</sub> | 697                    | 761            | 429            | 740            | 1300           |
| 1103-Water | Chloride                    | mg/L                   | 130                    | 320            | 4000           | 41             | 380            |
|            | Fluoride                    | mg/L                   | 0.07                   | 1.5            | 1.1            | 0.05           |                |
|            | Sulphate                    | mg/L                   | 1.0                    | 480            | 650            | 1400           | 140            |
| 1201-Water | Ammonia                     | µg-N/L                 | 23100                  | 837            | 406            | 12500          | 117000         |
|            | Nitrate+Nitrite             | µg-N/L                 | 8                      | 6              | 12             | 6              | 9              |
|            | Nitrite                     | µg-N/L                 | 3                      | <2             | 6              | 2              | 4              |
|            | Ortho-P                     | µg-P/L                 | 3                      | 7              | 13             | 4              | 12             |

Report No: 13773

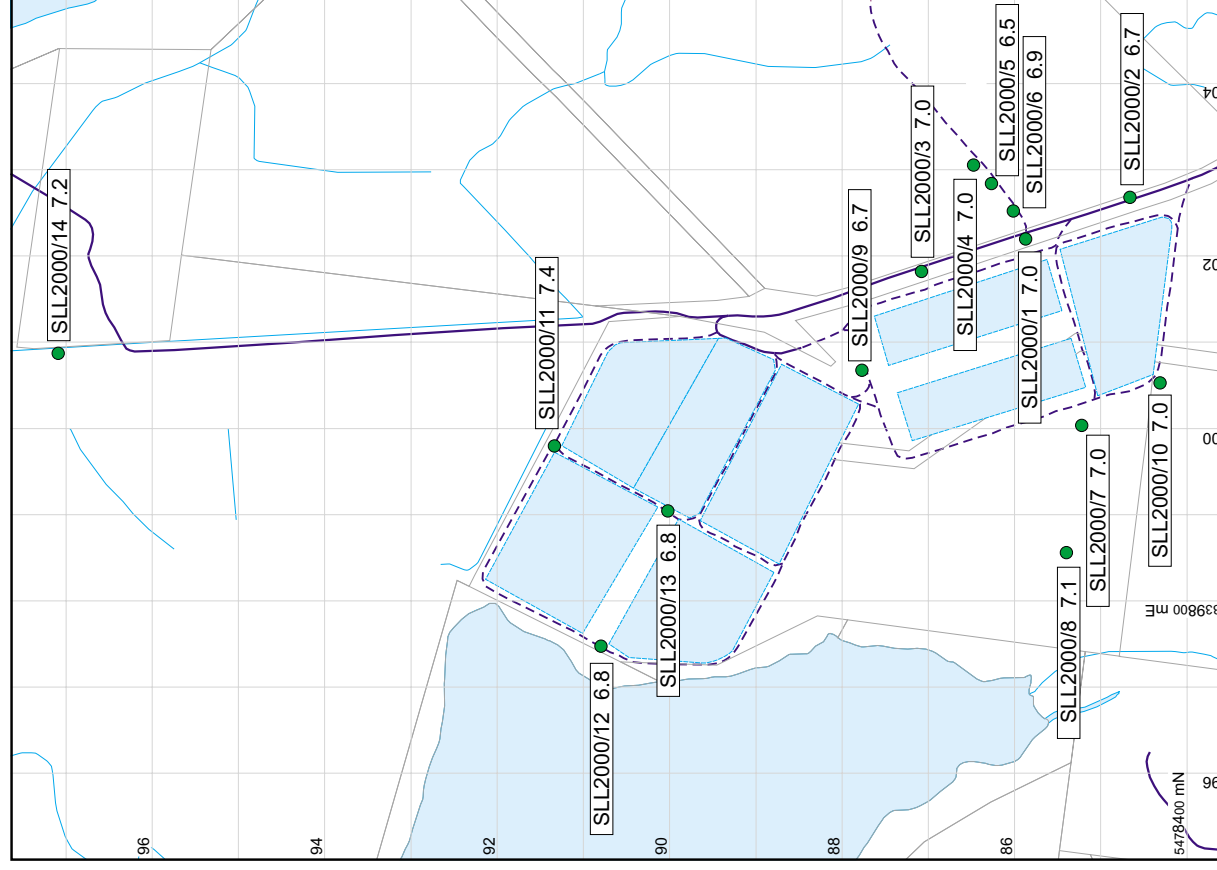
Report Date: 01-Dec-00

| Method     | Analyte                     | Units / Sampled On :   | Lab.No.: 13099          | 13100          | 13101          | 13102          |
|------------|-----------------------------|------------------------|-------------------------|----------------|----------------|----------------|
|            |                             |                        | Sample Id.: SLL 2000/11 | SLL 2000/12    | SLL 2000/13    | SLL 2000/14    |
|            |                             |                        | 01/11/00 12:10          | 01/11/00 12:40 | 01/11/00 13:25 | 01/11/00 16:30 |
| 1001-Water | pH                          |                        | 7.4                     | 6.8            | 6.8            | 7.2            |
| 1002-Water | Conductivity                | µS/cm                  | 1200                    | 7770           | 1440           | 747            |
| 1101-Water | Alkalinity CO <sub>3</sub>  | mg/L CaCO <sub>3</sub> | <1                      | <1             | <1             | <1             |
|            | Alkalinity HCO <sub>3</sub> | mg/L CaCO <sub>3</sub> | 312                     | 778            | 356            | 252            |
| 1103-Water | Chloride                    | mg/L                   | 160                     | 1600           | 200            | 26             |
|            | Sulphate                    | mg/L                   | 3.5                     | 300            | 18             | 14             |
| 1201-Water | Ammonia                     | µg-N/L                 | 16100                   | 24700          | 33200          | 295            |
|            | Nitrate+Nitrite             | µg-N/L                 | 7                       | 12             | 7              | 2900           |
|            | Nitrite                     | µg-N/L                 | 3                       | 6              | 3              | 5              |
|            | Ortho-P                     | µg-P/L                 | 2180                    | 5              | 31             | 10             |

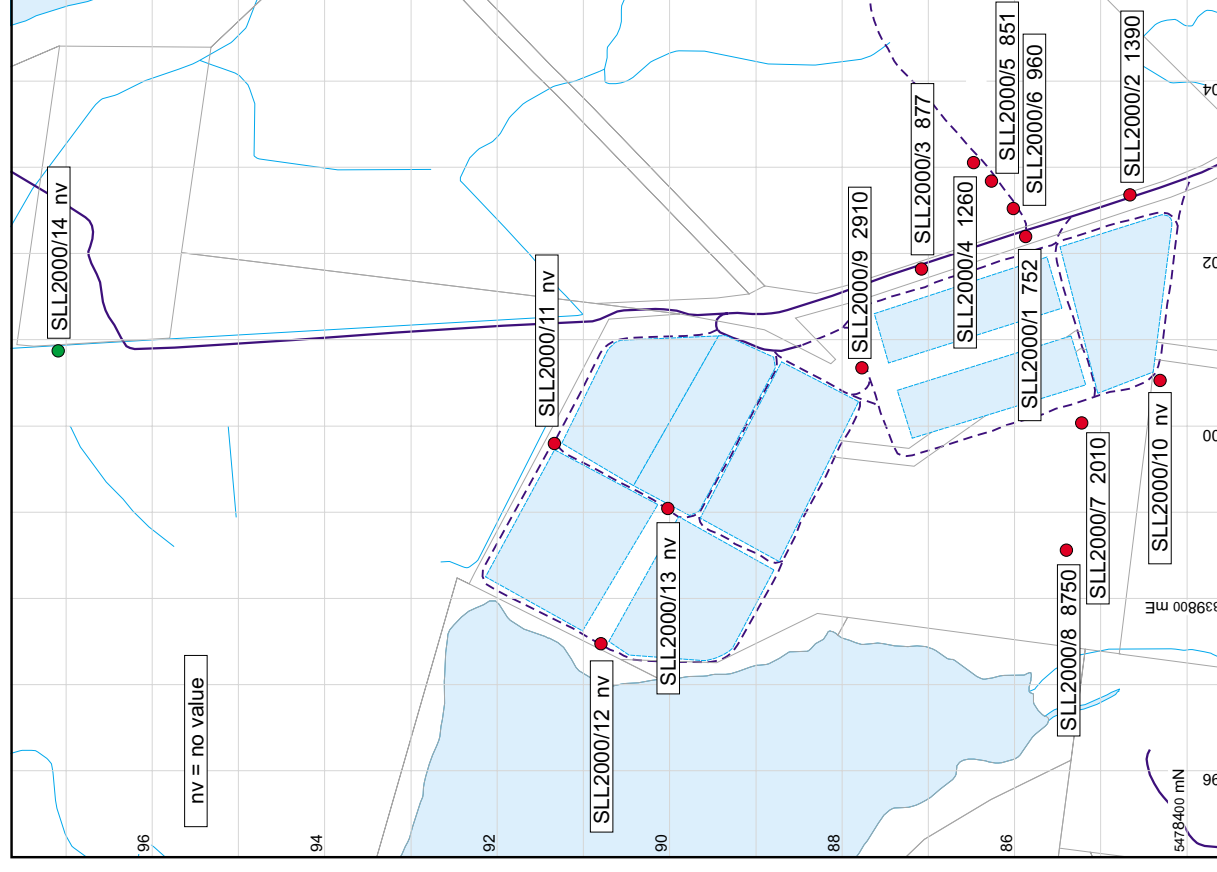
## **Appendix 4**

### **Analytical results on site maps**

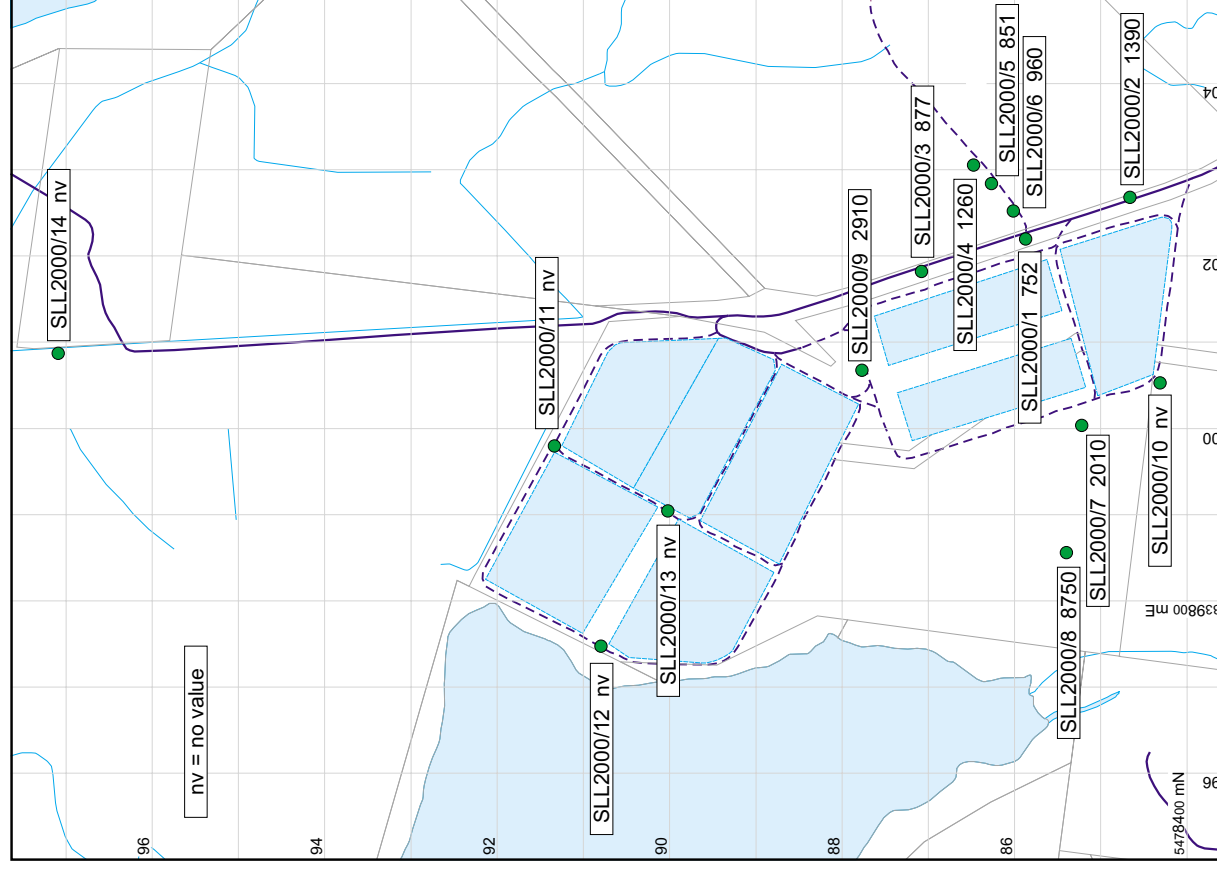
## Smithton sewage lagoons — November 2000 pH



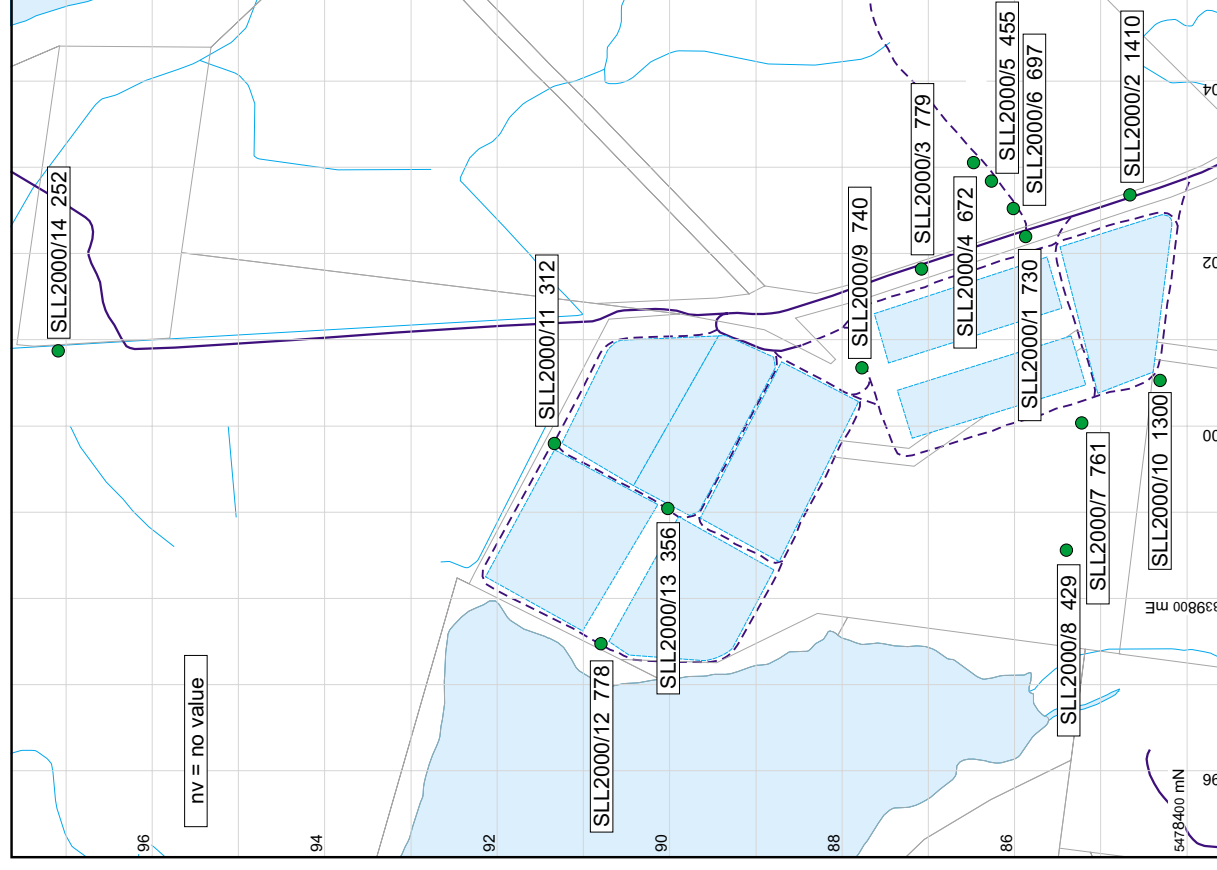
## Smithton sewage lagoons — November 2000 Conductivity (mg/L)



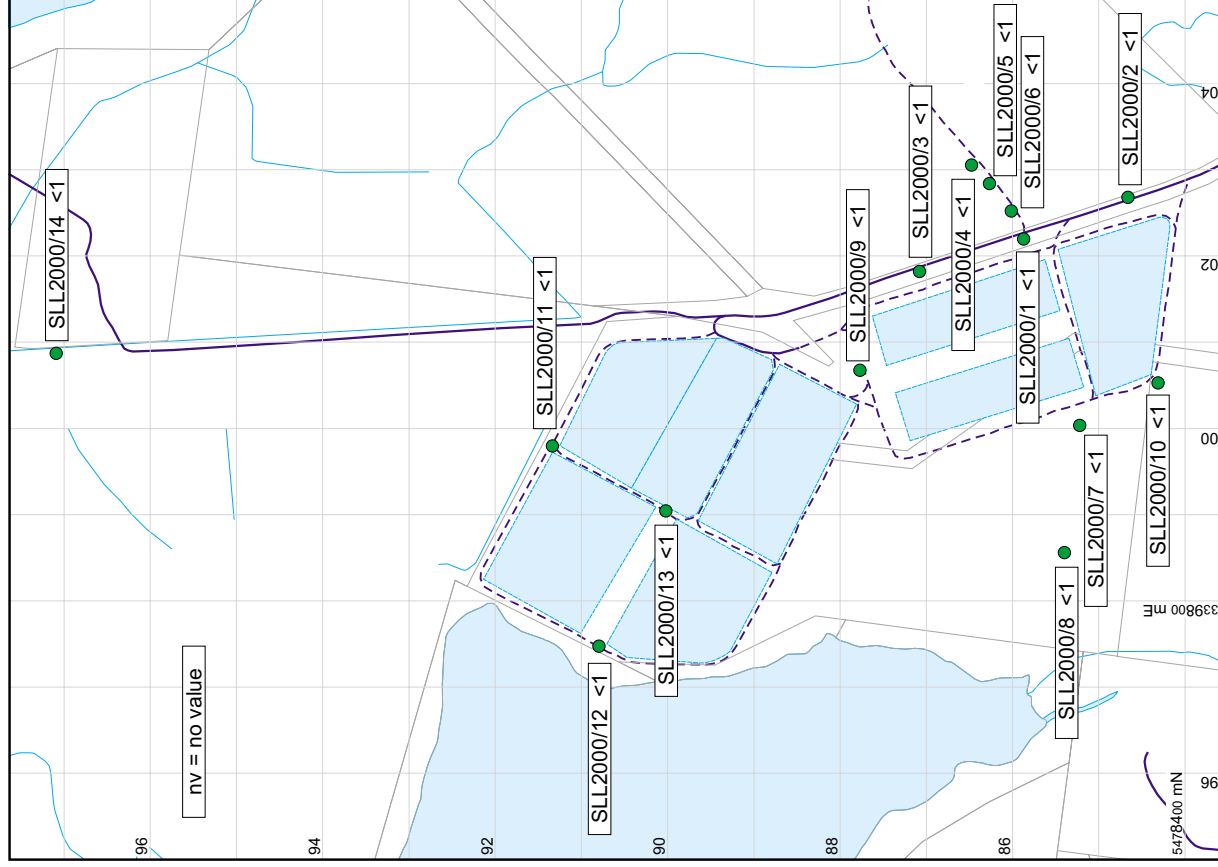
**Smithton sewage lagoons — November 2000**  
**TDS (mg/L)**



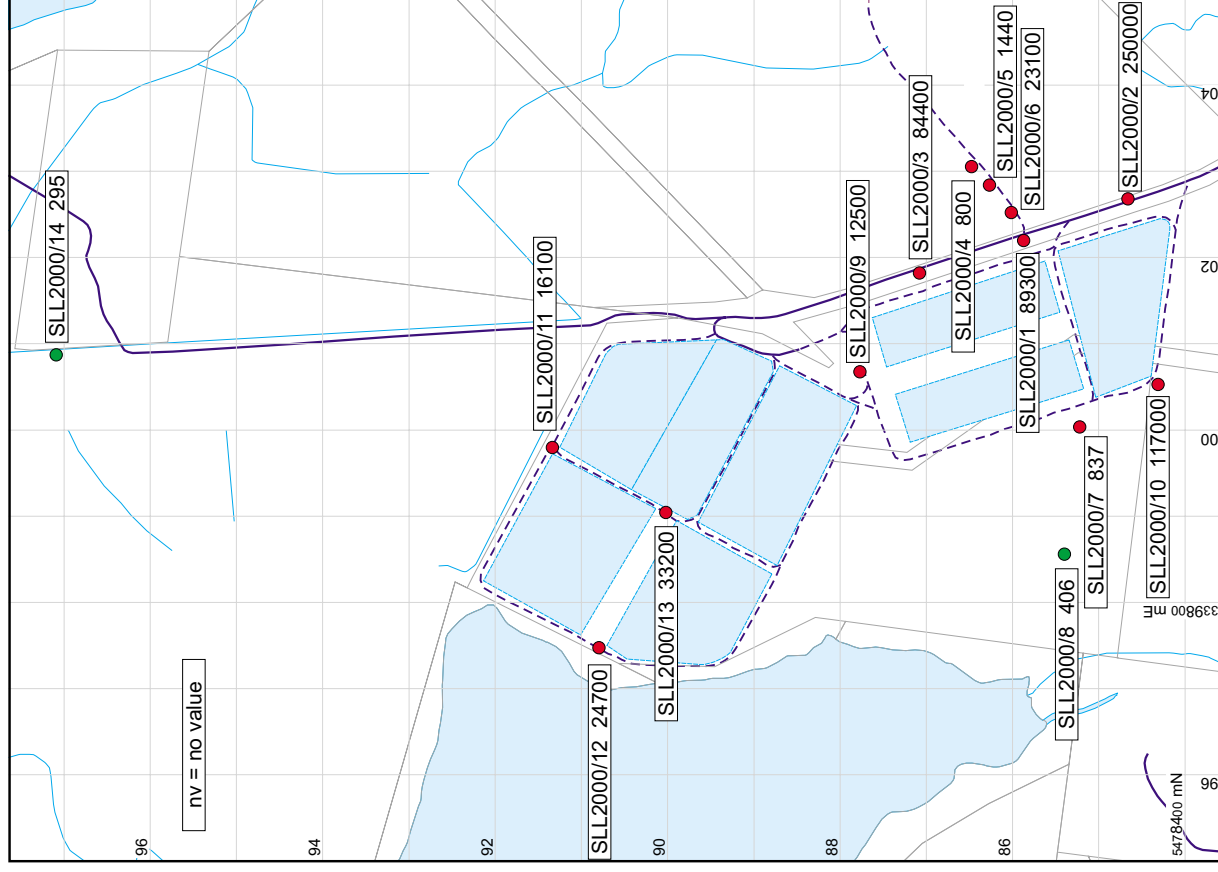
**Smithton sewage lagoons — November 2000**  
**Alkalinity  $\text{HCO}_3$  (mg/L  $\text{CaCO}_3$ )**



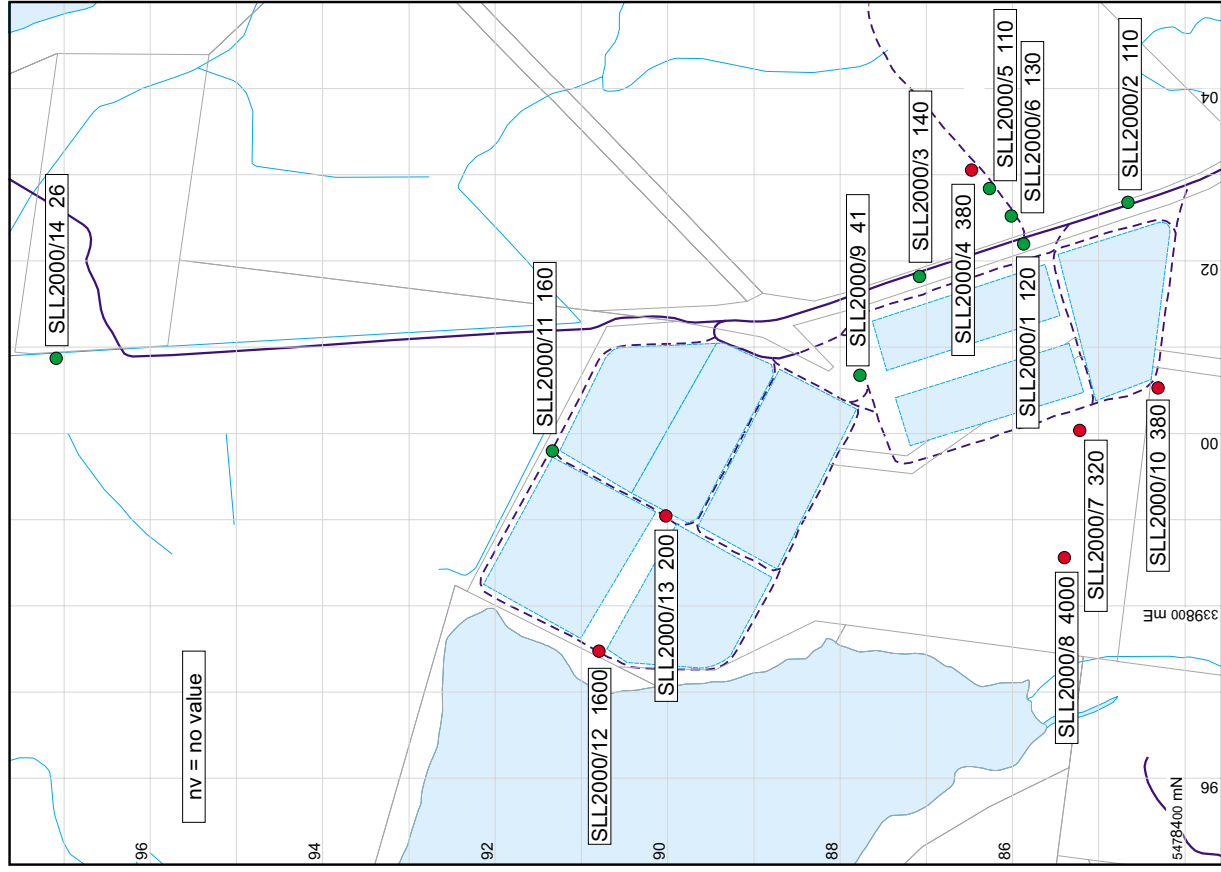
# Smithton sewage lagoons — November 2000 Alkalinity $\text{Co}_3$ (mg/L $\text{CaCO}_3$ )



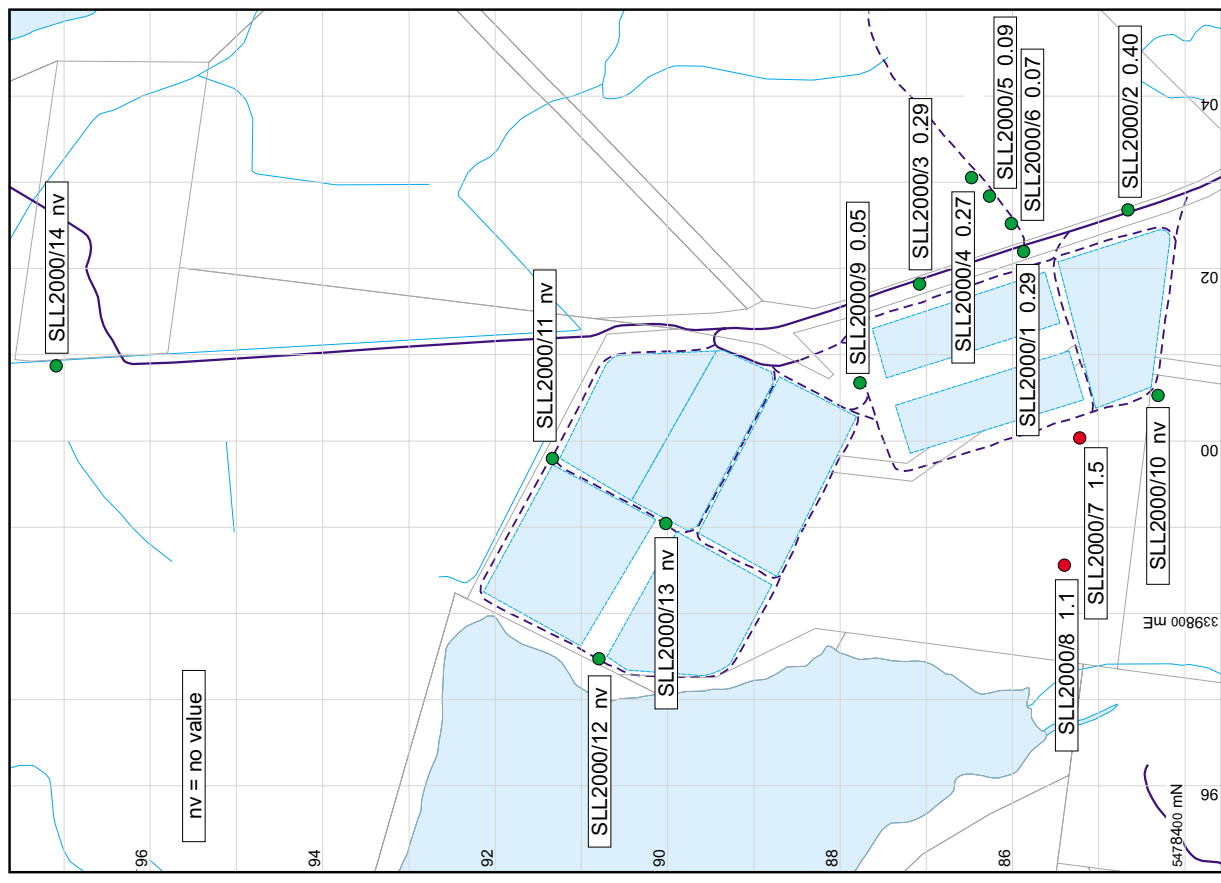
# Smithton sewage lagoons — November 2000 Ammonia ( $\mu\text{g-N/L}$ )



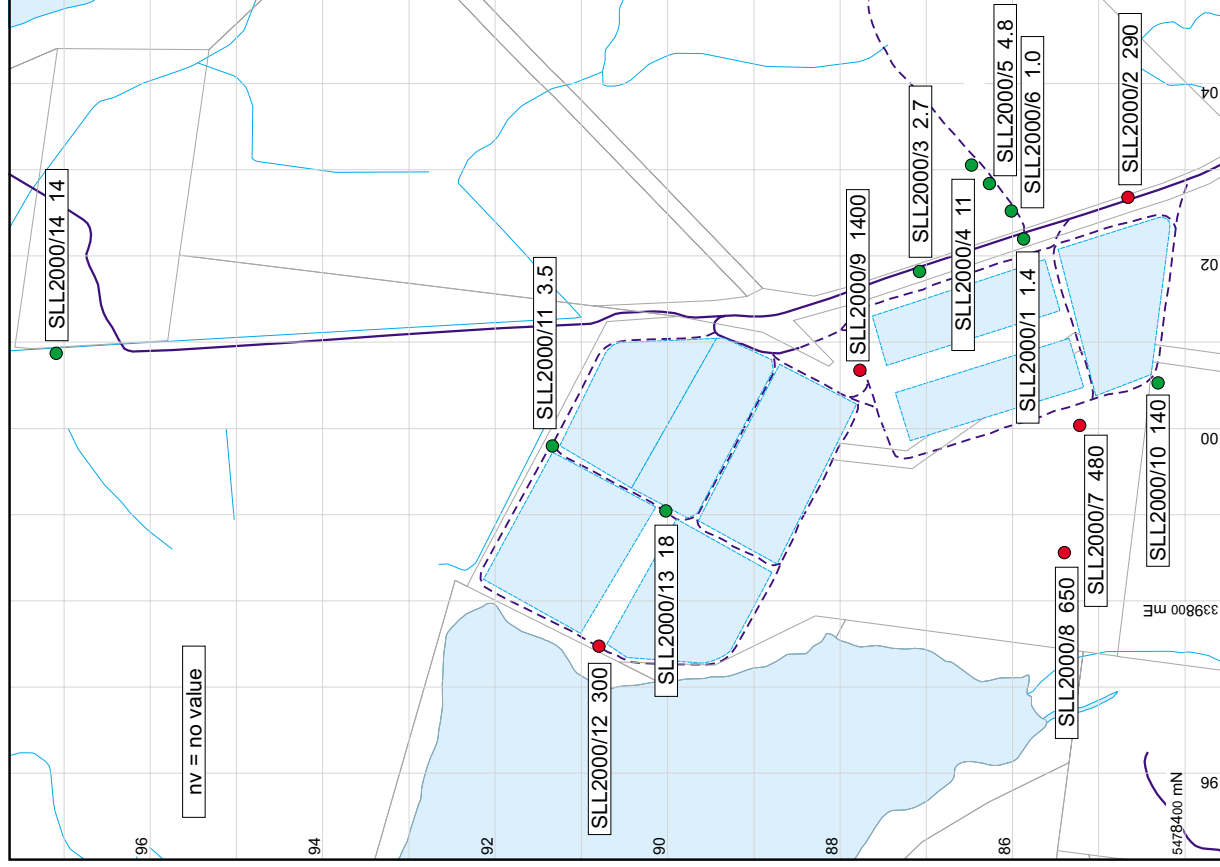
**Smithton sewage lagoons — November 2000**  
**Chloride (mg/L)**



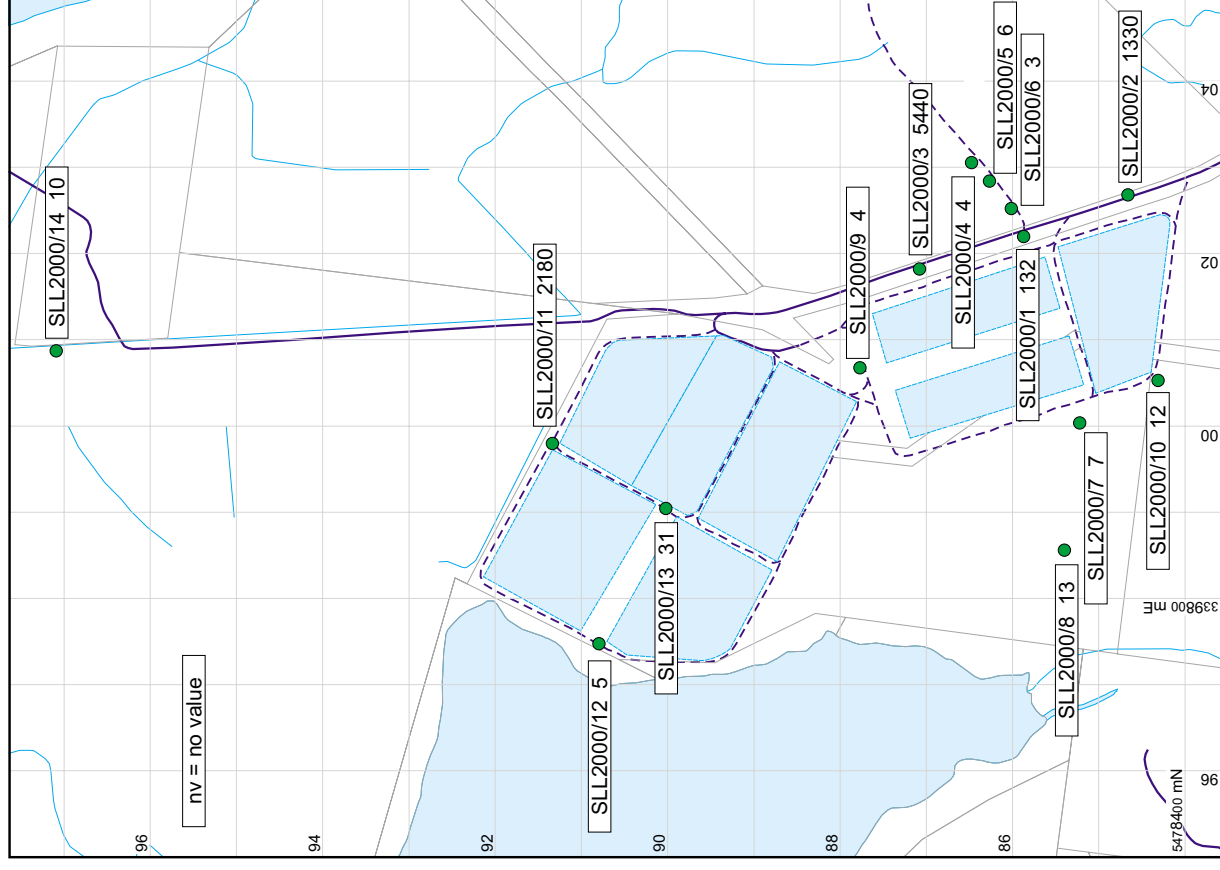
**Smithton sewage lagoons — November 2000**  
**Fluoride (mg/L)**



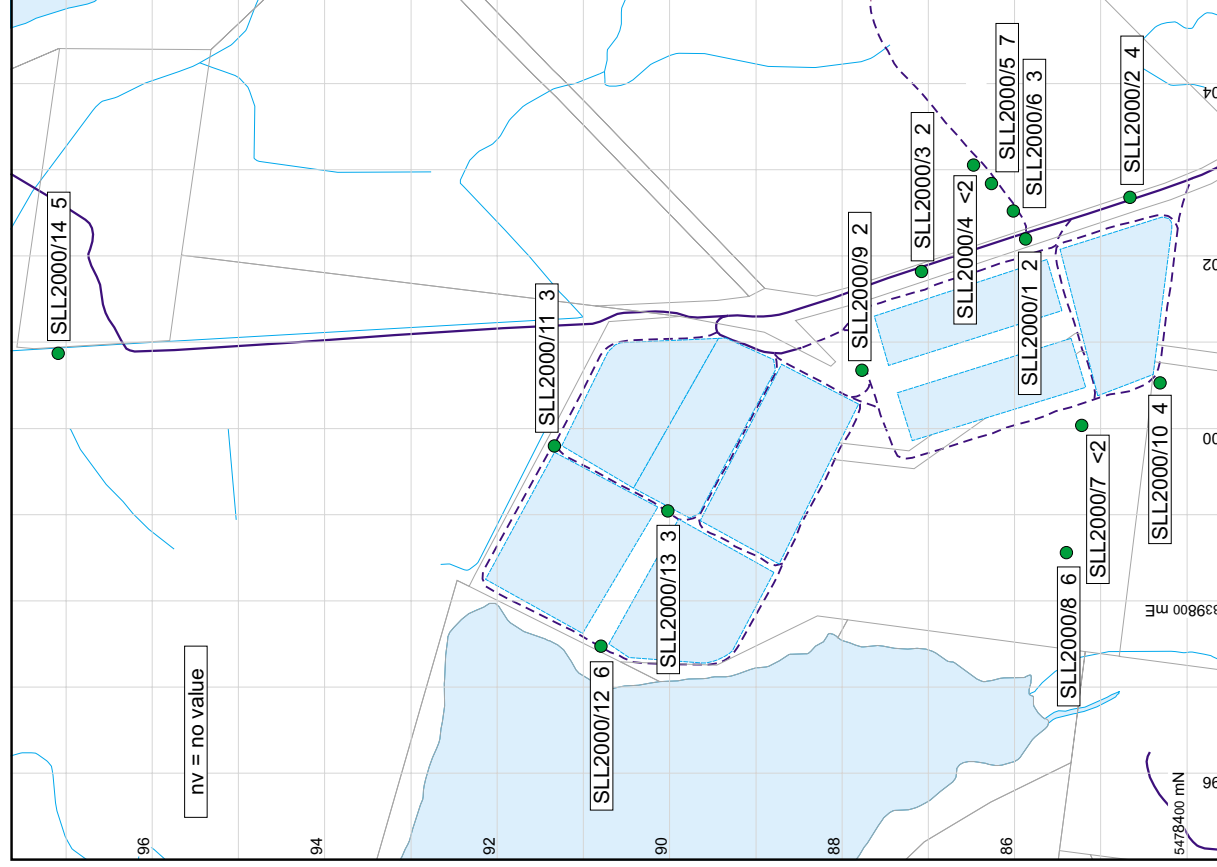
Smithton sewage lagoons — November 2000  
Sulphate (mg/L)



Smithton sewage lagoons — November 2000  
Ortho-P ( $\mu\text{g-P/L}$ )



**Smithton sewage lagoons — November 2000**  
**Nitrite ( $\mu\text{g-N/L}$ )**



**Smithton sewage lagoons — November 2000**  
**Nitrate + Nitrite ( $\mu\text{g-N/L}$ )**

