



## **Geotechnical, Contaminated Land and Soil Vapour Review of the Environmental Effects Statement**

**Edithvale and Bonbeach Level Crossings**  
Confidential Privileged Communication

Prepared for:  
Russell Kennedy Pty Ltd, on behalf of Kingston City Council  
Level 12, 469 La Trobe Street,  
Melbourne, Vic. 3000.

28 May 2018





## Distribution

### Geotechnical, Contaminated Land and Soil Vapour Review of the Environmental Effects Statement, Edithvale and Bonbeach Level Crossings

28 May 2018

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# Contents

<b>List of Acronyms</b> .....	<b>iii</b>
<b>1.0 Name and Address</b> .....	<b>1</b>
<b>2.0 Qualifications and Experience</b> .....	<b>2</b>
2.1 Qualifications.....	2
2.2 Accreditation.....	2
2.3 Professional Affiliations.....	2
2.4 Employment History.....	2
2.5 Experience .....	3
2.6 Expertise .....	3
2.7 Assistance .....	3
<b>3.0 Introduction</b> .....	<b>4</b>
3.1 Proposed Works .....	4
Edithvale.....	4
Bonbeach .....	4
3.2 Scope of this Assessment .....	4
<b>4.0 Limitations of the Report</b> .....	<b>5</b>
<b>5.0 Site Description, Hydrogeology &amp; Geology</b> .....	<b>6</b>
5.1 Site Descriptions .....	6
5.2 Site Geology.....	6
5.3 Site Hydrogeology.....	8
<b>6.0 Discussion</b> .....	<b>10</b>
6.1 Horizontal Drain.....	10
6.2 Contamination issues.....	11
6.3 Settlement of the Adjacent Ground .....	12
6.4 Hydraulic Conductivity Tests.....	14
6.5 Soil and Groundwater Vapours.....	14
6.6 Monitoring and Mitigation Measures .....	15
<b>7.0 Conclusions and Recommendations</b> .....	<b>16</b>
<b>8.0 Declaration</b> .....	<b>17</b>
<b>9.0 References</b> .....	<b>18</b>

## Appendix A: Curriculum Vitae



## List of Acronyms

Acronym	Definition	Acronym	Definition
<b>Environmental</b>		<b>Geotechnical</b>	
<b>ABC</b>	Ambient background concentration	<b>1H:2V</b>	Slope Ratio of 1 Horizontal to 2 Vertical
<b>ACL</b>	Added contaminant limit	<b>AHD</b>	Australian Height Datum
<b>ACM</b>	Asbestos containing material	<b>AMG</b>	Australian Map Grid
<b>AHD</b>	Australian Height Datum	<b>Base Course</b>	Upper Layer of the Pavement
<b>AMG</b>	Australian Map Grid	<b>CBR</b>	California Bearing Ratio (%)
<b>AS</b>	Australian Standard	<b>CFA</b>	Continuous Flight Auger
<b>AST</b>	Above ground storage tank	<b>Cu</b>	Co-efficient of uniformity (D60 / D10)
<b>ASS</b>	Acid Sulfate Soils	<b>CTCR</b>	Cement Treated Crushed Rock
<b>ANZECC</b>	Australian and New Zealand Environment and Conservation Council	<b>D60</b>	Diameter corresponding to 60% of the soil being finer
<b>BG</b>	Brighton Group	<b>DCP</b>	Dynamic Cone Penetrometer
<b>BH</b>	Borehole	<b>EC</b>	Electrical Conductivity
<b>BOD</b>	Biological Oxygen Demand	<b>Ed</b>	Design Action Effect
<b>BPEM</b>	Best Practice Environmental Management	<b>FoS</b>	Factor of Safety
<b>BTEX</b>	Benzene, toluene, ethylbenzene, xylenes	<b>fb</b>	Ultimate End Bearing Resistance
<b>CIS</b>	Coode Island Silt	<b>fm,s</b>	Ultimate Shaft Resistance
<b>CM</b>	Conceptual model	<b>GPS</b>	Global Positioning System
<b>COC</b>	Chain of custody	<b>h'</b>	D90 / D60
<b>CoPC</b>	Contaminant of potential concern	<b>h''</b>	D90 / D15
<b>CQAP</b>	Construction quality assurance plan	<b>HDPE</b>	High Density Polyethylene
<b>CSM</b>	Conceptual site model	<b>kPa</b>	Kilopascal
<b>CUTEP</b>	Clean up to the extent practicable	<b>LF</b>	Loading Factor
<b>DNAPL</b>	Dense non-aqueous phase liquid	<b>mbgl</b>	Metres Below Ground Level
<b>DO</b>	Dissolved oxygen	<b>MGA</b>	Map Grid of Australia
<b>DSE</b>	Department of Sustainability and Environment	<b>MPa</b>	Megapascal
<b>EC</b>	Electrical conductivity	<b>NATA</b>	National Association of Testing Authorities
<b>EIL</b>	Ecologically based investigation level	<b>PLI</b>	Point Load Index
<b>EES</b>	Environment Effects Statement	<b>Prime</b>	Application of a Primer to a Prepared Base



Acronym	Definition	Acronym	Definition
<b>EMP</b>	Environmental Management Plan	<b>Rd,g</b>	Design Geotechnical Strength
<b>EPA</b>	Environment Protection Authority (Victoria)	<b>Sub-Base Course</b>	Lower Layer of the Pavement
<b>ESL</b>	Ecological screening level	<b>Subgrade</b>	Foundation Material
<b>GME</b>	Groundwater monitoring event	<b>TDS</b>	Total Dissolved Solids (salinity of water)
<b>HIL</b>	Health-based investigation level	<b>UCS</b>	Unconfined Compression Strength
<b>HSL</b>	Health screening level	<b>ys</b>	Characteristic Surface Movement
<b>LEL</b>	Lower explosive limit	<b><math>\phi_g</math></b>	Geotechnical Strength Reduction Factor
<b>LFG</b>	Landfill gas		
<b>LNAPL</b>	Light non-aqueous phase liquid		
<b>LOR</b>	Limit of reporting		
<b>LTV</b>	Long term trigger values		
<b>m</b>	Metre		
<b>m<sup>3</sup></b>	Cubic metres		
<b>m AHD</b>	Metres Australian Height Datum		
<b>m bgl</b>	Metres below ground level		
<b>mg/kg</b>	Milligrams per kilogram		
<b>mg/L</b>	Milligrams per litre		
<b>MAH</b>	Monocyclic aromatic hydrocarbon		
<b>MoE</b>	Maintenance of Ecosystems		
<b>MSL</b>	Mean sea level		
<b>MW</b>	Monitoring well		
<b>NAPL</b>	Non aqueous phase liquids		
<b>NATA</b>	National Association of Testing Authorities		
<b>NEPC</b>	National Environment Protection Council		
<b>NEPM</b>	National Environment Protection Measure		
<b>NHMRC</b>	National Health and Medical Research Council		
<b>OCP</b>	Organochlorine Pesticides		
<b>OPP</b>	Organophosphate Pesticides		
<b>PAH</b>	Polycyclic aromatic hydrocarbons		
<b>PCB</b>	Polychlorinated Biphenyl		
<b>PCE</b>	Tetrachloroethene		



Acronym	Definition	Acronym	Definition
PCR	Primary contact recreation		
PID	Photo-ionisation detector		
PSH	Phase separated hydrocarbons		
QA	Quality assurance		
QA	Quaternary Aquifer		
QC	Quality control		
RAP	Remedial Action Plan		
RPD	Relative percentage difference		
SEPP	State Environment Protection Policy		
SEPP PMCL	State Environment Protection Policy (Prevention and Management of Contaminated Land)		
SEPP GoV	State Environment Protection Policy (Groundwaters of Victoria)		
SEPP WoV	State Environment Protection Policy (Waters of Victoria)		
STV	Short Term Trigger Values		
SVOC	Semi-volatile organic compound		
SWL	Standing water level		
TCA	Trichloroethane		
TCE	Trichloroethene		
TDS	Total dissolved solids		
TKN	Total kjeldahl nitrogen		
TOC	Total organic carbon		
TPH	Total petroleum hydrocarbons		
TRH	Total recoverable petroleum hydrocarbons		
UTAF	Upper Tertiary Aquifer Formation (Brighton Group)		
UEL	Upper explosive limit		
UK EA	United Kingdom Environment Agency		
USEPA	United States Environment Protection Agency		
UST	Underground storage tank		
µg/kg	Micrograms per kilogram		
µg/L	Micrograms per litre		
VOC	Volatile organic compound		



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<b>Acronym</b>	<b>Definition</b>	<b>Acronym</b>	<b>Definition</b>
<b>VRA</b>	Vapour intrusion Risk Assessment		
<b>VROM</b>	Netherlands Ministry of Housing		
<b>WHO</b>	World Health Organisation		

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## 1.0 Name and Address

My name and address details are:

John Philip Piper

Senior Principal

Senversa Pty Ltd

Level 6, 15 William Street

Melbourne Vic 3000





## 2.0 Qualifications and Experience

My qualifications, affiliations, accreditations and employment history are presented in the following sections. A copy of my Curriculum Vitae is presented in Appendix A.

### 2.1 Qualifications

My qualifications are:

- Bachelor of Engineering (Civil), University of Melbourne, 1976
- Master of Engineering Sciences, University of Melbourne, 1979

### 2.2 Accreditation

My accreditations are:

- Certified Practising Engineer
- Registered Building Practitioner, Registration No. EC-1027
- Registered Engineer, Queensland
- Environmental Auditor (Contaminated Land), EPA Victoria

### 2.3 Professional Affiliations

I am a Fellow of:

- Engineers Australia

I am a member of:

- College of Civil Engineers – NPER-3, Reg. No. 407724
- Australian Geomechanics Society, Victoria
- Australian Land and Groundwater Association (ALGA)

In addition, Senversa is a member of the Australian Contaminated Land Consultants Association (Vic)

### 2.4 Employment History

My employment history is:

2018 – now	Senversa, Senior Principal, Geotechnical, Environmental and Waste Engineering.
2011 – 2017	Cardno Victoria, Business Unit Manager / Senior Principal – Geotechnical, Environmental, Hydrogeological Consulting.
2006 – 2011	Lane Piper, Director/ Senior Principal – Geotechnical, Environmental, Hydrogeological Consulting.
1988 – 2006	Piper & Associates, Managing Director - Geotechnical & Environmental Assessments.
1981 – 1987	SoilMech, Engineering Manager – Geotechnical Investigations, Melbourne.
1979 – 1981	SoilMech, Project Engineer – Geotechnical Investigations, Melbourne.
1977 – 1978	Golder Associates, Soils Engineer, Victoria.



## 2.5 Experience

I have managed environmental, geotechnical, geological, hydrogeological, irrigation, geophysical and surveying projects incorporating multi-disciplined teams. I have specific expertise relating to slope stability for landslip and open cut mines, dams and embankments, multi-level basements, landfills, pavements, foundations, instrumentation and data acquisition systems, bridge abutments, pile groups and wastewater treatment plants. I have conducted and am conducting numerous environmental assessments including those for Environment Protection Authority Victoria (EPA Audits as well as being an EPA accredited auditor for environmental audits throughout Victoria.

With over 30 years' experience, I have conducted geotechnical and environmental assessments throughout Australia and overseas.

## 2.6 Expertise

I have been involved in the investigation and design of deep excavations and multi-level basements for multi-storey buildings in Victoria. In addition, I have conducted geotechnical investigations for bridges, roads and other civil infrastructure. I have been involved in the assessment and review of slope stability for road and railway embankments and cuttings throughout Victoria and the New South Wales. I have assessed geotechnical issues for rail bridges at various sites. I have conducted many investigations for quarries that involved slope stability in Langwarrin, Lang, Maldon, Tallandoon, Scoresby, Geelong and Mt Eliza. In addition, I have undertaken a stability assessment of many slope failures including road and rail cuttings, creek embankments and hillsides. I have conducted investigations throughout Victoria and particularly in the Shire of Yarra Ranges, Mornington Peninsula Shire, Cardinia Shire, Colac – Otway Shire, Surf Coast Shire and other municipalities for both Councils and private companies and am approved to do landslip assessments in these Shires. I have been engaged by Mornington Peninsula Shire to peer review other consultant's reports. I have completed a landslip susceptibility assessment for the entire Mornington Peninsula Shire which has been integrated into the Council EMO. I have lectured at RMIT on geotechnical matters, was an author of papers on slope stability at the Australian and New Zealand Geomechanics Conference in 1988 & 2012. I have received awards or been part of a team that received awards for projects in 1998, 2006, 2015 and 2016. I was the author of the Chapter on Quaternary sands in the Melbourne Area (Sand ridges and sheets) for Engineering Geology of Melbourne 1992.

I led the team involved in the unsuccessful bid for the Western Distributor project involving the geotechnical, contamination and hydrogeological assessment of the tunnels and portals. The portals had many similar issues facing these rail crossings.

I have conducted environmental assessments and statutory audits (S53X and S53V) for structures and developments throughout Victoria.

## 2.7 Assistance

I have been assisted in the preparation of this report by Mr Patrick Clarke, Senior Principal and Dr. Andrei Woinarski, Senior Associate at Senversa Pty Ltd.



## 3.0 Introduction

Senversa Pty Ltd was engaged by Russell Kennedy Pty Ltd on behalf of the Kingston City Council (Council) on 10th May 2018 to provide an expert opinion on specific issues in relation to the proceedings in the Panel Victoria and Advisory Committee in relation to the matter, relating to the proposed Edithvale and Bonbeach level crossings removal projects

### 3.1 Proposed Works

The two projects would involve the lowering of the Frankston railway line into two trenches under the roads, one at Edithvale Road, Edithvale and one at Station Street and Bondi Road, Bonbeach.

#### Edithvale

The Edithvale project is located predominantly within the railway reserve owned by VicTrack and extends from Lincoln Parade, Aspendale to Chelsea Road, Chelsea.

The trench would be constructed between Lochiel Avenue and Berry Avenue. It would be 1300 m in length, 14 m wide at the narrowest point, widening to 24m wide at the Edithvale Station. The rail track would be 8 m below the ground level at the lowest point at Edithvale Station and the maximum depth of excavation would be 14 m to allow for the underground infrastructure below the rail track to collect and divert rainwater from the trench. Decking above the rail trench would be provided for the new station building, car parking, and a sub-station. New pedestrian bridges would be constructed to provide access across the rail trench.

#### Bonbeach

The Bonbeach level crossing is also located predominantly within the existing rail reserve owned by VicTrack. The Bonbeach project extends from Chelsea Road, Chelsea to the Patterson River, Bonbeach.

The project involves the lowering of the rail track into a trench under Bondi Road while maintaining Bondi Road at the current road level. The trench would be constructed between Golden Avenue and The Glade. The trench would be 1200 m long and 14 m wide at the narrowest point and increase to 24 m at the new Bonbeach Railway station. Again, the rail track would be 8 m below the current ground surface at the lowest underground at Bonbeach Station and the maximum depth of excavation would be 14 m below current ground level to allow for the infrastructure to collect and divert rainwater from the trench.

Decking would be provided at about ground level for the new railway station building and car parking. New pedestrian bridges would be constructed for pedestrian access across the trench.

### 3.2 Scope of this Assessment

I understand the purpose of my assessment is to assist Council in satisfying itself that the work supporting the designs for the project is sound and the conclusions drawn are reasonable and appropriate in an email dated 10<sup>th</sup> May 2018.

Of particular concern is the potential mounding and lowering of groundwater levels associated with the project and related impacts including potential groundwater contamination movement. Specifically, the acknowledged mounding of the water table that is likely to occur on the hydraulically up-gradient side of the structure, particularly at the Edithvale site and the suggested engineering control to divert groundwater around the trenching structure and any opinion regarding the proposed groundwater diversion structure, recognising that the detail is not finalised as to its methodology.

This report will provide commentary on the issues of:

- Implications and practicality of groundwater re-distribution proposal.
- Settlement issues as a result of construction.
- Implications of the potential extraction of contaminated groundwater and soils.
- Vapour intrusion risk.



## 4.0 Limitations of the Report

In an associated separate expert report provided by Dr Andrei Woinarski of Senversa Pty. Ltd., the following matters are discussed:

- Hydrogeology, modelling and implications.
- Implications of water table drawdown with respect to acid sulphate soils.
- Salt water intrusion.
- Implications for the Edithvale swamp.

Neither report addresses or comments on the following issues:

- Impacts on ecology or biodiversity or foreshore ecosystems.
- Surface water issues.
- Land use.
- Noise and Vibration.
- Air quality.
- Landscape and visual effect.
- Effects on business or social issues.
- Aboriginal Cultural heritage.
- Historic Cultural Heritage.
- Impacts on stormwater runoff or disposal.
- Traffic issues and car parking.
- Any structural engineering issues.
- Any detailed geotechnical issues.

The EES reports contain considerable information, and references to reports and assessments that provided the basis for their conclusions but the reports have not been included such as the geotechnical and hydrogeological reports. Consequently, we are unable to fully assess the modelling and basis for the conclusion reached in the EES. Further information has now been provided (Coffey reports dated 5 July 2017, 8 June 2017 and 25 May 2018) at the time of writing this report, but has not been able to be assessed in this report to date. In any event, it is beyond the scope of our assessment to complete a comprehensive review.



## 5.0 Site Description, Hydrogeology & Geology

### 5.1 Site Descriptions

The proposed railway trenches are located on the Frankston railway line and run parallel to the coast.

The groundwater is recharged by the wetlands and rainwater and flows generally towards the coast although at Bonbeach the groundwater flow is more north to south towards the Patterson River as well.

The conceptual hydrogeological model is shown in Figure No 1 below

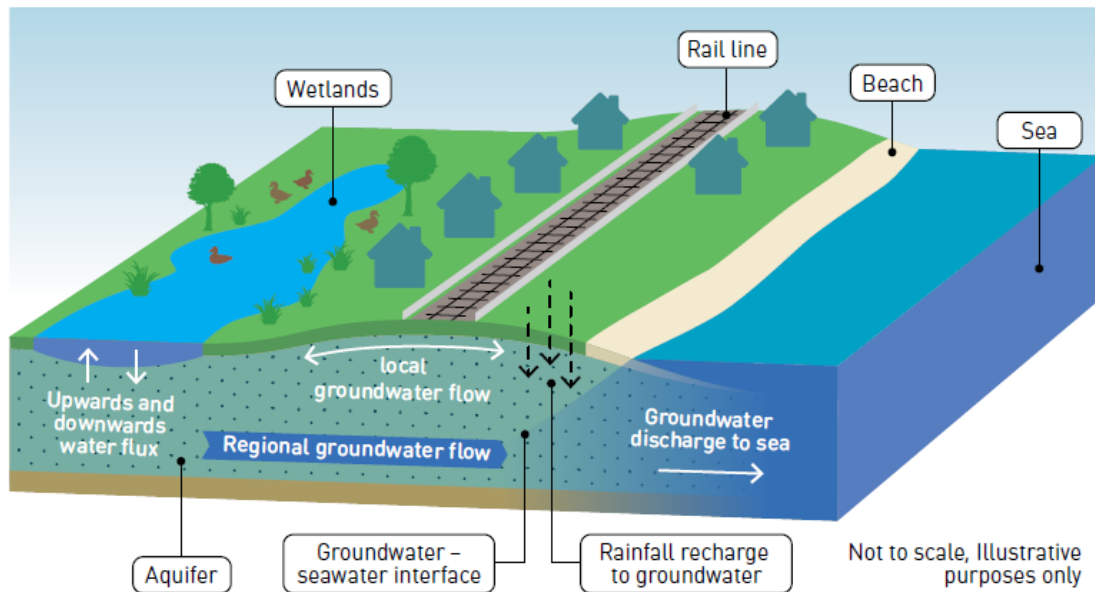


Figure 1: Conceptual Model of Groundwater Flow (after Chapter 5 of EES)

### 5.2 Site Geology

Based on the geological map of the area, the surface geology (See Figure No 3, Cranbourne 1:63,360) indicates Quaternary dunes of siliceous and calcareous sands overlying a Quaternary alluvium of peaty clay swamp deposits often quite soft. In figure No 2, Leonard (1979) geological survey report of the region also indicates that the shallow Quaternary deposits of aeolian sands overlying clay alluvium exist to a shallow depth. The Quaternary deposits are underlain by the Tertiary sands and clays known as the Brighton Group. The Brighton Group is then underlain by the Tertiary-aged Fyansford Formation which primarily consists of glauconitic silts and clays. In turn, the Fyansford Formation is underlain by the Tertiary-aged Older Volcanics, consisting of variably decomposed basalts and basaltic clays. The Older Volcanics are underlain at considerable depth by the Tertiary-aged Werribee Formation.

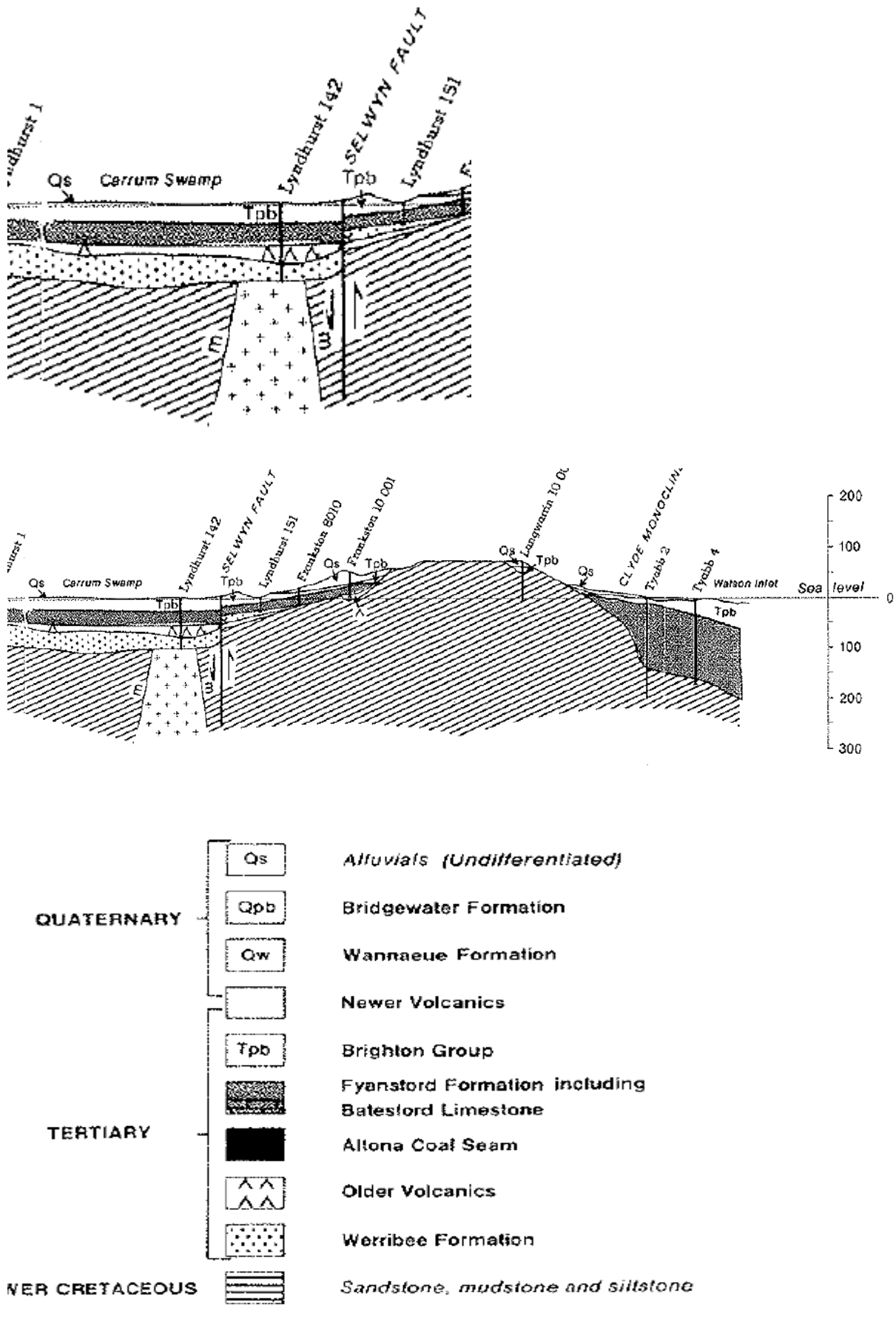


Figure 2: Geological Cross - Section (after Leonard, 1979)



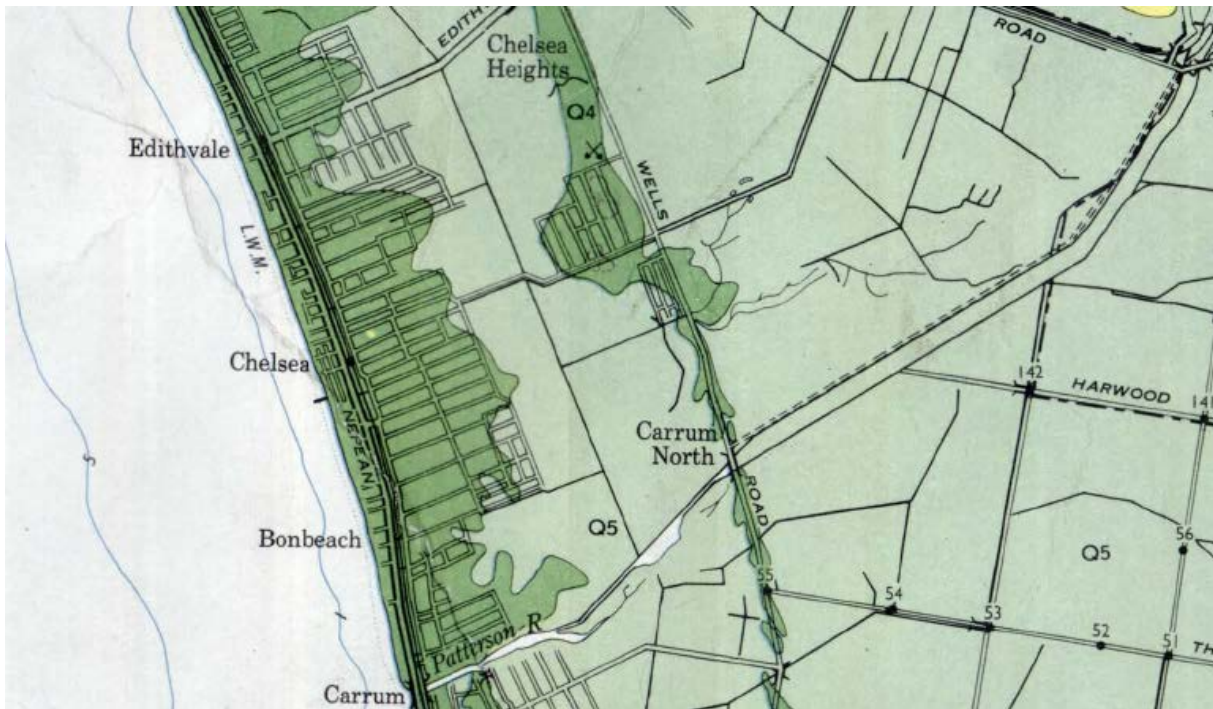


Figure 3: Excerpt from the Geological Map of the Area (Cranbourne, 1:63,360)

### 5.3 Site Hydrogeology

The hydrogeology is complex at the site consisting of, in some parts of the area, an unconfined, shallow water table in the Quaternary sediments and a number of confined and semi-confined aquifers in the Tertiary-aged formations that are discussed in the EES and basic aquifers and aquitards from the Chapter 5 in the EES (refer to Figure 4 from the EES reproduced below):

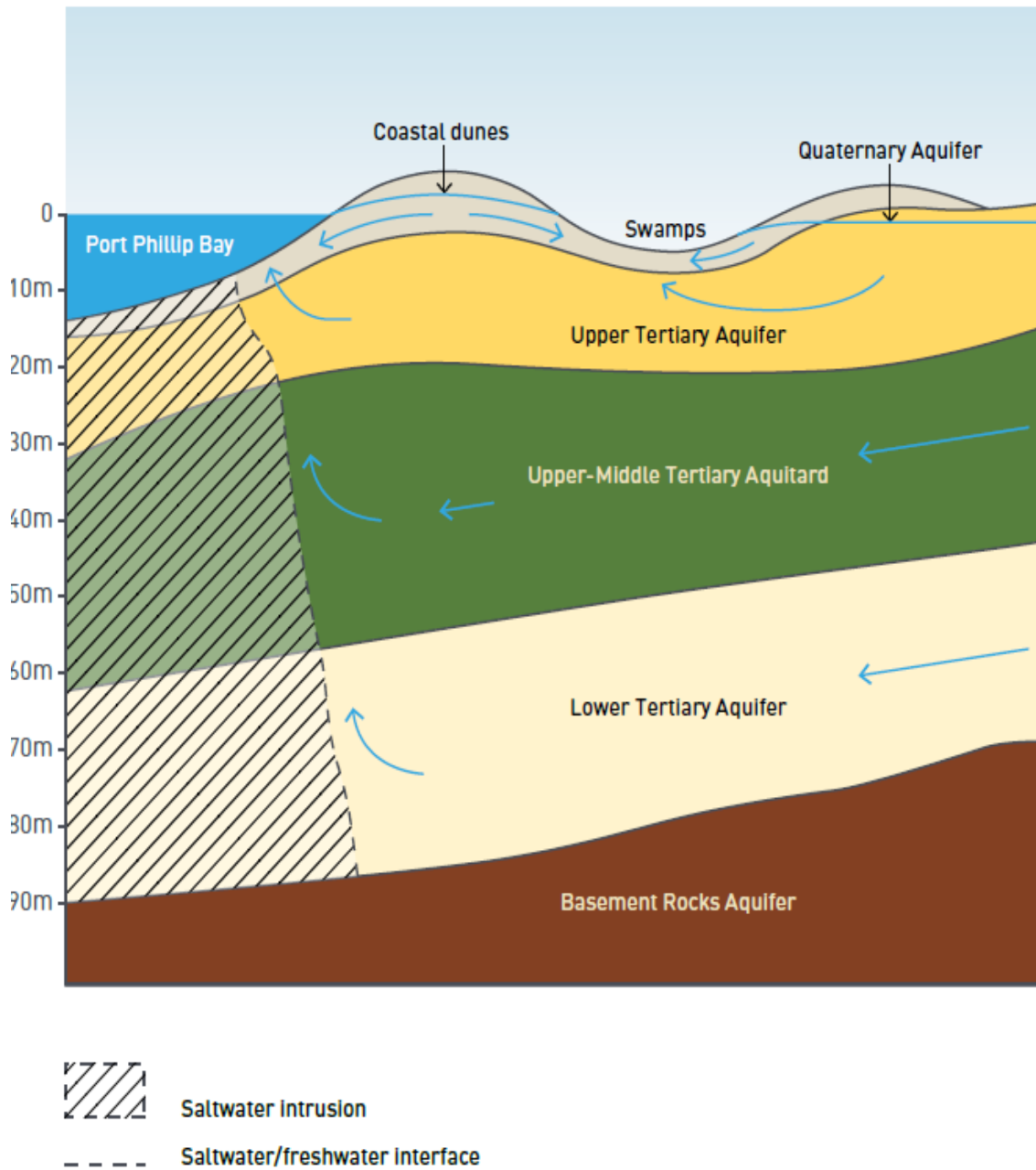


Figure 4: Aquifer Cross - Section at the Study area (Excerpt from EES)





## 6.0 Discussion

From our review of the reports, the following issues have been identified for further comments and discussion. The issues discussed below are:

- The suitability and practicality of the horizontal drain.
- Settlements of the adjacent Ground.
- Hydraulic Conductivity tests
- Soil Contamination Issues.
- Monitoring and Mitigation Measures.

Subject to further information and clarification, some of the issues may or not be of concern .

### 6.1 Horizontal Drain

It is proposed to place a horizontal drain, at about a reduced level (RL) of -2 m Australian Height Datum (m AHD), around the rail trench to allow the mounded groundwater on the inland side of the trench to drain around the structure to the downstream side of the trench. This drain is only proposed at Edithvale as the groundwater direction at Bonbeach will result in less mounding and is not considered to be an issue by the LXRA. The purpose of the horizontal drain is to reduce the mounding on the upstream side of the trench and reduce drawdown of the water table on the downstream side of the trench. The horizontal drain is discussed in detail in Technical Report A Section 3. It is not clear to us if the groundwater modelling assumes that the discharge will be uniform. Friction losses in the pipe are included in the model (Technical report A Groundwater Section 4.1.1).

The writer has concerns about the effectiveness or unintended impacts of the proposed horizontal drain due to:

1. Its length around the structure, some 1300m at Edithvale.
2. Its lack of grade.
3. Due to the lack of grade, the potential for the pipe to 'silt up' over time, reducing its effectiveness.
4. No allowance for clogging is allowed for the model, although LXRA consider that it is unlikely. Our experience in the area indicates that iron deposition can occur and as the drain can be exposed to air, biological clogging as occur, particularly with the proposed fine apertures into the drainage pipes.
5. The potential for settlement of the piled wall or surrounding ground or issues occurring during installation resulting in low spots along the drainage pipe can occur, creating a 'syphon' effect.
6. On the downstream side of the pipe, concentrated discharge of groundwater into the water table on the hydraulically down-gradient side of the trench. Preferential flow paths could occur due to many features. For example, backfill around a sewer trench can provide a preferential flow path, rendering the wide distribution of lateral recharge on the downstream side of the trench wall ineffective. The writer is unaware if such a feature is existing or even proposed.
7. Registered and unregistered groundwater extraction bores known to occur in the area, can result in distortion of the groundwater flows in the area.
8. The drain will act as a conduit to transfer contaminated groundwater to the north and south and could result in more rapid migration or wider distribution of groundwater dissolved contaminants and light non-aqueous phase liquid (LNAPL) that may be present along the alignment of the proposed structure.

In our opinion and based on the information provided, the proposed single horizontal drain should be further assessed during the detailed design stage. If it is adopted, a detailed engineering analysis will be required and analysis by a pipeline engineer.



Moreover, there are some other solutions that could be considered or in conjunction with the proposed horizontal drain are:

1. Multiple horizontal pipes take groundwater from selected upstream areas and be discharged on the downstream side of the rail trench.
2. The construction of a syphon pipes through the wall, down and across the rail trench. Whilst noting the maintenance issues could be addressed by construction of access points.
3. Upstream extractive groundwater bores pumping around or across the rail trench to an injection bore on the downstream side. It is recognised that this is only a short-term solution.

The writer agrees that a review of the proposed design of this system be undertaken by an appropriately experienced professional with an appropriate technical support team to ensure that the adopted design is robust and meets the design requirements. Redundancy in the system is suggested to ensure that reliance upon a single approach is avoided. The writer does not suggest that there are no engineering solutions that will achieve the design objective.

It is noted that Ross McFarlane<sup>1</sup> submission also raises issues about the effectiveness of the horizontal drain.

## 6.2 Contamination issues

The writer agrees with the EPA<sup>2</sup> comments about the time to prepare necessary approvals particularly with respect to the management and disposal of soil with emerging contaminants such as PFAS. In addition, to create a stable floor within the trenches to enable the construction of the basal floor slab of the tanked underpass, there is likely to be a need to extract groundwater from within the railway trenches during construction to below the maximum excavation depth. Therefore, there is likely to be a need to dispose of an amount of groundwater as well as soil impacted by contaminants including PFAS.

The soil extracted during construction will need to be disposed offsite in accordance with EPA guidelines and if they contain PFAS may need discussion with the EPA for off-site disposal.

To date, there does not appear to be a comprehensive assessment of the contaminants from surrounding industrial activities, both current and historical, in the near vicinity of the rail trenches at each of the sites or has not been provided to date. The general nature of surrounding land uses indicates that there are potential sources of groundwater contamination. It is suggested that further assessment of potential sources and specific contaminants be undertaken and assess the impacts of the rail trenches on these contaminants. The EPA and LXRA has also indicated the need for further assessment.

As stated in the earlier section, the horizontal drains can be a conduit to transfer dissolved contaminants within the groundwater or LNAPL over a distance of up to 600m. If the groundwater horizontal drain works as proposed, the horizontal drain may transmit contaminants in the groundwater from a contamination plume to other areas that might not be currently impacted by the plume(s) to date. Furthermore, if there is a preferential flow path at the ends of the trench, there is the possibility of rapid flow to the beach or other properties not affected to date. It is suggested that further site-specific assessment be undertaken of the contaminants in the region, including the groundwater flow velocity and direction. In Technical Report C Page 147, it is stated for Edithvale that "*it is almost certain that contaminant migration could occur as a result of altered groundwater flow paths, which would result in a localised, temporary and reversible loss of one or more beneficial uses of the environment*", but is proposed that the risk be reduced by the installation of a passive horizontal drain and other unknown measures. However, in certain circumstances, the drain could extend the groundwater plume.

Groundwater management, monitoring and mitigation measures are proposed by LXRA and will need to be included, See Section 6.6.

The "*installation of the cut off walls*" are proposed during construction to restrict groundwater inflow and allow the soils to be removed for the construction of the concrete base slab and railway

<sup>1</sup> Macfarlane R., Edithvale Wetlands, undated Submission to Edithvale Bonbeach Level Crossing Removal

<sup>2</sup> EPA Victoria, Edithvale – Bonbeach Level Crossing Submission, 1<sup>st</sup> May 2018



infrastructure. The LXRA comments that groundwater inflows both during construction into the trench will be about 600,000 litres per day, but could be between 50,000 and 1,900,000 litres based on a construction period for the excavation of 60 days. (Table 2, Technical Report A-Groundwater). However, in Technical Report C Section 9.2.3 that “*the pile walls would prevent groundwater entering the excavated area*” but between 20.8 and 21.7 ML of groundwater would need to be removed. The writer is unable to reconcile these differences in groundwater extraction unless it is considered that the groundwater includes porewater volumes in the soils. It is likely that much of this pore water will be removed with the soil removal rather than be all free groundwater as suggested in the EES. Groundwater will need to be extracted during construction and either injected hydraulically down-gradient or, if contaminated, will need to be treated and/or disposed to sewer. If the groundwater contains PFAS, early discussions with the EPA and the Water Authority may be required to organise disposal, potentially via a Trade Waste agreement.

It is proposed that the pile walls and the floor would be effectively impermeable (Technical Report A Groundwater Section 1.3.2). Whilst this can be achieved such that the structure is ‘tanked’ post construction, it is less likely during construction. However, any unexpected inflows could be addressed with the use of grouting during construction to reduce or eliminate any leaks through the piled wall and possibly grouting below the tanked floor prior to or during construction to reduce any up-flows.

### 6.3 Settlement of the Adjacent Ground

The EES considers settlement behind the rail trench retention system to occur from the reduction in the water level on the downstream side of the trench. For the Edithvale site, the maximum draw down is expected to be 1.5 m from the modelling, but in drought conditions, it is expected to fall to as low as sea level. It is understood that this could result in up to a 2 m drop of the water table. A much lesser fall is expected for the Bonbeach rail trench, provided that the predicted flow direction does not alter.

Whilst the writer agrees with this proposition of settlement from groundwater drawdown, there are additional items that could contribute to the settlements in addition to water drawdown. These are:

1. Lateral movement of the piled retention and cut-off wall, resulting in both horizontal and vertical movement behind the wall. Such movement is likely to occur if the retention system is designed for the ‘active’ condition. It is suggested that the retention system be designed for the ‘at rest condition’, if possible, or the lateral movements be reduced as far as practical.
2. Draw-down of the groundwater located within the Quaternary-aged aeolian silty sands and interdune swamp sediments can result in seepage forces and lead to densification of finer-grained sediments and subsequent settlement. It is likely that this effect has occurred in the past and so only minor settlement would be expected from this effect.
3. If construction of the retention system adopted the use of sheet piles or other driven piles, the vibrations can cause settlements of the ground. Such settlements are likely to be localised and only extend to within a few metres of the piling.

The writer agrees that the majority of the settlement will occur within the Quaternary soft clays. While the lower layers will also contribute depending on the area of the drawdown, these are likely to be very small. The thickness of the soft, compressible Quaternary layer will have major effect on the settlement. The LXRA has adopted a Young’s elastic modulus of 3MPa for the compressible layer, but no justification for this value is provided.

In support of the LXRA settlement predictions, the writer was involved in the construction of 3 test pads at the La Perouse housing development adjacent to the Patterson River and east of the Bonbeach rail trench between 2001 and 2006. (Piper & Associates, 2001 – 2005). The results of the settlements were measured over a period of 4 years. Whilst the loads are on the compressible layer are greater (~ 50 kPa) than the 1.5 m drop in water level expected from the groundwater draw down (up to 2m in a drought), the settlements are considerable for the test pads. Furthermore, in this instance the compressible layer thickness of 3 m is greater than the analysed thickness of 1.5 m adopted in the EES settlement predictions. It is understood that the thickness is typically 1.5 m at Edithvale and Bonbeach but can be up to 2 m. However, the writer has only been provided a few of the geotechnical borehole logs and no CPTu results to confirm these conclusions. Further information has been provided to the writer at the day of writing this report but at this time of writing this report, the writer has not had the opportunity to review the information provided..

The settlements of the 25 m x 25m test pads is shown below in Figure No. 5 overleaf.



Based on these settlement profiles, if the groundwater is drawn down by 1.5 m for a period of 90 days with a 1.5 m thick compressible layer, the expected settlement is 11mm which is similar to that predicted by the LXRA consultants. However, the settlements could be less if the compressible layer is over-consolidated or stiffer or thinner. If the period of draw down is more or less, so the settlements will be more or less respectively. If the groundwater is drawn down for a period of 400 days, the settlement prediction based on the La Perouse results will increase. The LXRA settlement predictions do not appear to allow for the compression of the underlying layers but it is acknowledged that they will be very small and should not materially change the settlement predictions.

The La Perouse settlements show that the majority of consolidation will occur fairly rapidly, so measures to prevent any groundwater level reduction is required within a relative short period. The monitoring and mitigation measures are required to be monitored closely during construction with any recharge bores installed and ready to be used if required. The monitoring of the groundwater is proposed and, if needed, the recharge bores be installed. If recharge bores are only installed when the trigger levels in the monitoring bores are exceeded, the time delay could result in additional distress to structures and underground services.

For a retaining wall designed for the active pressure, the settlements behind the wall are expected to be of up to 1 % of the depth of the excavation, decreasing to nil away from the structure at a distance of close to 2 times the depth of the excavation. For a 14 m deep excavation, the settlement will decrease but extend up to 28 m from the structure, and will decrease towards the edges of the rail trench as the excavation depth becomes less. Immediately behind the braced retention piles, the settlement can be expected to be up to 140 mm in the centre of the rail trench (Morgan J, 1989). If the structure can be designed for the 'at rest condition' or with additional bracing or tie backs, the settlements can be considerably reduced.

Settlement of the sands from seepage forces is likely to be small, but excessive settlements of the Quaternary sands have been known to occur in the sands in areas of fluctuating water table (Piper, 1992). Pile vibration from driven piles could increase these settlements but are likely to be quite localised and the logs provided indicate that the sands densities are very variable varying from very loose (N=3) to very dense (N=50). Some locations will settle more than others.

In conclusion and subject to detailed engineering design, the settlements behind the retention walls could be up to between 150 mm and 171 mm behind the retention piled wall and decrease to less than 10mm at a distance away from the structure. This distance will depend on a number of factors but the majority is likely to be less than 28m but some small settlement will occur up to 50m. The settlements will decrease towards the ends of the rail trench.

Many dwellings in this area may be designed for an S (slight) or M (moderate) site classification in accordance with AS2870.1 – 2011 or earlier versions, and therefore can be expected to accommodate a maximum characteristic surface movement of 20 mm and 40mm, respectively and a differential movement of about 10 mm and 20 mm respectively.

Dwellings would undergo distress if subjected to maximum settlements predicted close to the rail trench, but if dwellings are located at a distance away from the retaining walls by at least of 28m, the settlements will be much less and likely to not affect any dwellings unless the buildings are under stress. The writer is not aware if there are any structures within this vicinity. Furthermore, the settlements can be reduced to an acceptable level within the detailed design stage with appropriate engineering design. The settlements will depend on a number of factors, namely the distance of the dwelling or other structure sensitive to movement from the railway trench, the structural support, the bracing or retention system adopted, the depth, extent and period of groundwater draw down, the degree of over-consolidation and compressible of the Quaternary clay layer and the Brighton Group and the distance from the retention system.

It is suggested that further assessment and geotechnical modelling be undertaken during detailed design of the settlements behind the retention system to ensure that there is no distress to adjacent dwellings, structures, services or roads. However, based on the limited information provided to date and provided that there are no structures highly sensitive to settlement, it is unlikely that there will be any significant issues relating to settlement more than 28m from the structure and this distance potentially affected by settlements will decrease towards the north and south edges of the rail trench. It is acknowledged that the predicted settlements could be reduced to acceptable levels with appropriate design and construction

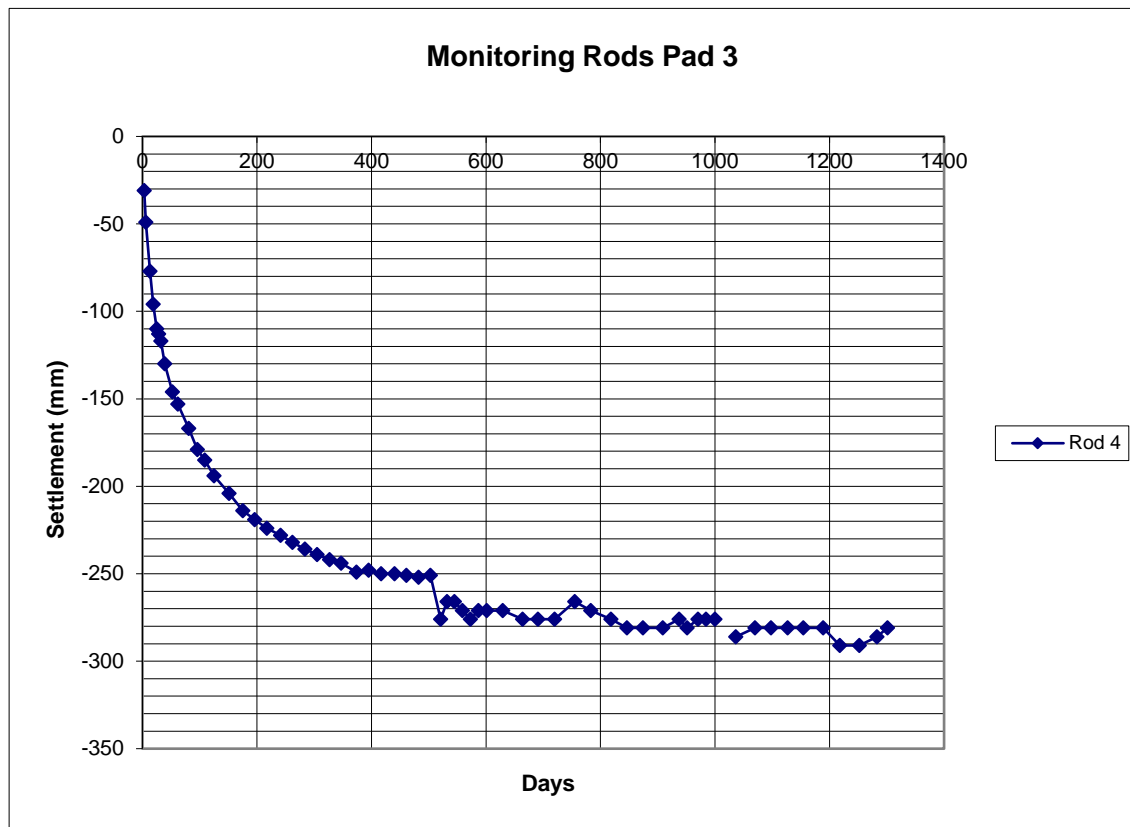


Figure 5: Settlement of the Test Pads, La Perouse Estate

## 6.4 Hydraulic Conductivity Tests

The groundwater report indicates that the hydraulic conductivity of the aquifers and aquitards were determined by performing both slug tests, rising/falling head tests and triaxial constant head permeability tests in the laboratory.

Whilst the slug tests are appropriate for the aquifers, it is also suggested that pump tests (if not already completed) be undertaken to assess the impacts of adjacent aquifers and also assess the impacts on the various aquifers.

There is a possibility that the aquitards permeability is being under-estimated, as the triaxial test will not assess the impacts of thin or fine, near horizontal sand layers. These thin sand layers can result in a horizontal hydraulic conductivity somewhat greater than the vertical permeability. The slug and falling head permeability tests can reflect this increase in the overall hydraulic conductivity

An assessment of the decreased vertical stress with the removal of the underlying soils within the railway trench can sometimes result in opening of the micro-fissures within the clay layers and increase the rate of flow upward. However, as the railway trench is to be 'tanked', it is unlikely to be an issue post construction.

The possibility of higher horizontal coefficient of permeability relative to the vertical coefficient of permeability should be assessed and included in the model (if not already done) and assess if an increase in the overall hydraulic conductivity in the aquitard will occur if the soils are to be partially de-stressed. These apply to the construction period only.

## 6.5 Soil and Groundwater Vapours

The writer was unable to identify any assessment of the risk to human health vapours from the ground or groundwater than are known to contain VOC's and hydrocarbons including benzene, toluene, ethylbenzene, xylenes (BTEX) associated with petroleum contamination and other volatile solvents (e.g. chlorinated solvents). In Section 9.2.8 (Risk CL57) Technical Report C does discuss the issue of vapours from groundwater and soil and recommends the need for a targeted soil and groundwater investigation. A targeted soil and groundwater investigation would be based on a detailed review of current and historical activities on the sites and surrounding properties.



The air quality assessment (Technical Report I) determines the potential impacts from construction activity (dust and vehicles), rail operations, and changed traffic movements from removal of the level crossings. Whilst the structure is tanked post construction, the risk to the health of the workers both during construction and access to the enclosed area below the track should be considered from the identified contaminants and if necessary, appropriate vapour venting and/or mitigation measures or occupation health procedures be included.

The writer agrees with the further assessment proposed and is not indicating that there is an unacceptable risk to human health and based on the provided data is to date the writer agrees that the risk to human health is unlikely but at least a qualitative vapour risk assessment should be undertaken with targeted soil vapour, soil and groundwater bores as proposed by LXRA.

## **6.6 Monitoring and Mitigation Measures**

A Groundwater Management and Monitoring Plan (EPR GW3, GW2) is proposed to be developed with clear trigger levels. Any mitigation measures involving either extraction or injection of groundwater, it would be prudent to install a number of groundwater extraction and more critically, injection bores at the commencement of construction to ensure that any mitigation measures can be expedited within a short period and not have to wait for approvals, registration and installation delays. The settlements of the La Perouse trial embankments show that any delays in groundwater re-injection (if needed) can result in greater settlements.

Monitoring would be required for:

- Groundwater levels and contaminant concentrations in the surrounding bores.
- Monitoring of groundwater and surface water discharged from the site.
- Monitoring of the vapours and dust within the trenches during construction.
- Assessment of the soils for offsite disposal (if not completed prior to excavation).



## 7.0 Conclusions and Recommendations

None of the identified issues would prevent the construction of the level crossings at Edithvale or Bonbeach and can be all addressed during the detailed design. It is suggested that the horizontal drain proposal for Edithvale be further assessed for its practicality and ensure that there are no unintended consequences.

The writer agrees with the EPA and LXRA proposal regarding an independent reviewer and independent EPA Environmental auditor appointed under Section 53 of the EPA act be appointed to ensure that the further assessment, identified mitigation and design issues are carried through into the design and through construction to ensure that the monitoring and any mitigation measures are implemented within a suitable time frame.





## 8.0 Declaration

I, John Piper, have made all inquiries I believe are desirable and appropriate based on the readily available information and that no matters of significance that I regard as relevant have, to my knowledge, been withheld from this report.





## 9.0 References

Leonard J.G., Preliminary Assessment of the Groundwater Resources in the Port Philip Region, Geological Survey report, No 66, 1979

Geological Survey, Cranbourne Geological Map, 1:63,360

Morgan J., Design Pressures and Lateral Movement Considerations for Temporary and Permanent Ground Support Systems, 1989.

Piper J., Quaternary Sands in the Melbourne Area (Sand ridges and sheets), Piper J.P., Engineering Geology of Melbourne, 1992



## Appendix A: Curriculum Vitae

## John P Piper

### Senior Principal

#### Qualifications & Certifications

B.E.(Civil), Melb

M.Eng.Sc., Melb



#### Career Profile

John is a Senior Principal Geotechnical Engineer. He commenced as an engineer with Golder Associates and then Soilmech, subsequently becoming engineering manager. In 1988, John began Piper & Associates and over 20 years conducted a wide variety of environmental and geotechnical assessments. In 2006, Piper & Associates merged with Lane Consulting to form Lane Piper which became Cardno Lane Piper in 2011.

He has a wide experience in all types of environmental assessments, having worked on environmental site assessments since 1992. His particular expertise is in environmental site assessment, remediation of industrial and commercial sites, landfill gas, wastewater treatment plants and landfills.

He is an EPA appointed environmental site auditor in Victoria and the Northern Territory. He has worked on projects across Australia and New Guinea. His clients have included local government, government departments, private developers, investors, financiers, land owners, mining and lawyers.

#### Expertise

Contaminated land assessments

Hydrogeology

Remediation

Landfill

Landfill gas and soil vapour assessment

#### Key Industry Sectors

Government – local and state

Private developers

Investors

Financiers

Land owners

#### Memberships

Member of the Organising Committee of the International Conference of Environmental Geotechnics, 2014

Australian Land & Groundwater Association (ALGA)

Aust. Geomechanics Society (Vic)

Australian Contaminated Land Consultants Association (Vic)

Victorian Building Registration

National Association of Testing Authorities

#### Professional Training and Development

- Environmental Auditor (Contaminated Land), EPA Vic,
- Certified Practising Engineer;
- NATA Signatory.
- Registered Building Practitioner;
- Fellow of the Institute of Engineers
- College of Civil Engineers - NPER-3.
- Registered Engineer, Queensland (RPEQ)



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## Project Experience

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### Significant Projects - Geotechnical

#### GEOTECHNICAL ADVICE FOR BUILDING FOUNDATIONS

- 21 -storey building, Southbank
- 10 storey apartment buildings, Abbotsford
- Multi storey buildings, Richmond
- Proposed large hospital extension, Bendigo
- Large Potato Storage Shed, Smithton, Tasmania.
- Redevelopment, Oak Towers Aged Care.
- Many other multi storey developments in St Kilda Road and in the city
- Numerous petrol service stations throughout Melbourne
- Four storey block of apartments. Camberwell
- 6-storey block of apartments, Port Melbourne
- 8-storey block of apartments, Richmond.
- 4-storey car showroom and offices, Burwood
- Tensioned membrane structures for schools and Melbourne University
- A.W.I. Factory, Geelong.
- Multi storey building with multiple level basement, Hawthorn
- Multi – storey School of Management, Melbourne University
- Site Classification for entire housing estates, Epsom Park, Berwick, Heatherton and others
- Elderly Persons development, Point Cook and other Aged Care facilities

#### GEOTECHNICAL INVESTIGATIONS FOR MARINE AND HARBOUR WORKS

- Bayside Development, Port Melbourne
- Off Loading Ramp for Oil Rig, Barry's Beach, Wharf Facilities, Corio.
- Harbour Improvements, Portland.
- Marina, Werribee.
- Geotechnical and Contamination Assessment, Gelibrand Pier, Williamstown

#### SLOPE STABILITY AND LANDSLIDES

- Landslip assessment and design of rehabilitation works of river embankment, Wastewater Treatment Plant, Wangaratta
- Landslip Risk Assessment of Cliff faces, Black Rock and Sandringham
- Assessment of Stability of Cliff Faces at Flinders, Sorrento, Dromana and others
- Risk Assessment of Road Cuttings, Alexandra Parade, Toorak
- Installation of Inclinometer Monitoring Bores, Sandringham & Black Rock
- Installation and Monitoring of the Inclinometers and Reporting of Results throughout Mornington Peninsula Shire
- Landslip Susceptibility Assessment for Mornington Peninsula Shire Council
- Landslip Assessment and Remedial Works at Ballar Creek, Mt. Eliza, and Hearn Creek, Mt. Martha,
- Stability Assessment of the Rehabilitation of very large Quarry, Geelong and smaller quarry at Tallandoon
- Assessment & Stabilisation of the Tanti Creek Bank, Mornington
- Housing developments within the Upper Yarra Ranges including giving evidence at VCAT
- Stabilisation of a Road Embankment Failures at Mt. Eliza, Flinders, McCrae, Upper Beaconsfield, Emerald and Dromana
- Assessment of Creek Embankments at a number of site in northern Victoria
- Stabilisation of 40 m high Open Cut Mine, Maldon.
- Failed Cuttings, Hallam and Cardinia
- Failed High Wall, Scoresby.
- Landslide, Portland.
- Geotechnical assessment and provision of Expert Evidence in Supreme Court Action, Davey's Bay, Mt Eliza



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## Project Experience

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- Stabilisation of Road Embankment, Flinders.
- Assessments of numerous landslips in the Dandenong Ranges, Mornington Peninsula, San Remo and northern Victoria

### BRIDGE FOUNDATIONS

- Bridge Overpass of Hume Highway, Kalkallo
- Pedestrian Bridge, Maribyrnong River
- Maribyrnong Railway Bridge Abutment.
- Road Bridge, Clifton Springs
- Traralgon-Maffra Road Bridge.
- South Eastern Arterial Road Link Bridges.
- Other Bridges at Warrnambool and Kerang.

### RECLAMATION AND LAND DEVELOPMENT

- Complex housing development on soft alluvium involving wick drains, surcharge, monitoring and foundation investigation, Carrum
- Rehabilitation and Landslip Assessment of Large Limestone Quarry, Fyansford
- Assessment of proposed housing development and filling, housing development, Fyansford
- Assessment of the implications of Filling of Sand Pit, Cheltenham & Oakleigh
- Settlement of Filling beneath Tennis Courts, East Doncaster.
- Stability Analysis of Reclaimed Land, Westgate Park.
- National Golf Club and Access Roads, Cape Schanck.
- Large housing development, Craigieburn, including 1 geotechnical and hydrogeological assessments of the site.
- Large housing development, Kalkallo
- Assessment of backfilling Quarry, Ferntree Gully

### ROADS, RAILWAYS AND AIRPORTS

- Numerous Pavements for sub-divisional roads and major arterial roads with Mechanistic Pavement Design for highly trafficked road, throughout Melbourne and Victoria
- Major Railway Stabling Yard, Calder Park
- Rigid Pavement, Leongatha
- Newport Training Centre.
- Pavement Testing and Evaluation, Portland Airport.
- Container Storage Pavements, Brooklyn.
- Forensic investigation of pavements, Craigieburn, Pakenham, Werribee,
- Geotechnical investigation and design of retaining walls for Failed Road, Upper Beaconsfield
- Assessment of slope instability of roads, Upper Beaconsfield
- Review of container terminal pavements, Botany Bay

### TUNNELS AND SHAFTS

- Fire Service Tunnel, Loy Yang.
- Underground Station, Werribee.
- Breakout Tunnel and Shaft, Werribee Trunk Sewer.
- Investigation for many underground power and cable services in the inner Melbourne area

### LARGE TANKS

- Water Tanks, GMH - Port Melbourne.
- Water Tanks, Bowater Scott, Box Hill.
- Water Tanks, A.M.I., Port Melbourne.
- Large Oil Tanks, BP, Spotswood
- Water Supply Tanks, Birrarung Marr



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## COMPUTER SOFTWARE & INSTRUMENTATION

- Development of Inclinometer Program.
- Development of Software for Data Acquisition System, Melton.
- Craigieburn Dam, Tasmania.
- Instrumentation of Penstock Well and Tunnel, Western Trunk Sewer.
- Instrumentation of Refinery Catchment Lake, Worsley, W.A.
- Instrumentation for Tailings Dam, Ok Tedi.
- Automatic Data Logging System, Malmsbury.
- Instrumentation of Pre-load embankment, Webb Dock

## Significant Projects - Enviro Geotechnics

- Geotechnical, Hydrogeological and Irrigation Assessments, Water Supply and Sewerage Works
- Main Central Irrigation Pump Station, Mildura
- Dam and Water Supply Bore, Marysville.
- Large BOOT scheme for wastewater treatment at Echuca and Rochester, including treatment plant, large 2GL winter storage, and pipeline
- Large Water Supply Dam, Foster.
- Ballarat to Bendigo 'Super' Pipeline
- Wimmera Mallee Pipeline Leg
- Macquarie Pipeline, Tasmania
- Pipeline Design and QA Assessments in New Zealand
- Pipeline Design Assessments in Gippsland and Merbein
- Sewer Scheme, Cape Paterson.
- Aerobic Sludge Lagoons, Kyabram, Horsham, Geelong, & Dandenong
- Chandler Rd., Outfall Sewer.
- Sewer Scheme, Metung
- Water Scheme, Candowie.
- Water Supply Dam, Dunkeld.
- Effluent Storage & Elevated Storage Melton.
- Investigation of Dam, Bulla & Bairnsdale.
- Trunk Sewer, Alexandra.
- Assessment of all dams for S-W Water
- Dam surveillance of a number of dams in Victoria
- Numerous sewerage treatment works throughout Victoria and southern NSW at Paynesville, Murchison, Boolarra, Bundalong, Yarrowonga, Toora, Girgarre, Avenel, Violet Town, Swan Hill, Nyah West, Ouyen, Skipton, Hopetoun, Minyip, Mildura, Stanhope-Rushworth, Tumut, Elmore, Lockington, Corryong and many others

## LANDFILLS

- Assessment of Landfill Liner, Deneliquin
- Construction QA of landfill liner, Tullamarine
- Concept Design of proposed Landfill, Dromana, McCrae
- Assessment of site suitability for landfill, Mornington Peninsula Shire
- Review of Liners, Sita Landfill Lyndhurst
- Large Landfill, Bellarine.
- CKD Landfill, Waurn Ponds
- Boral Landfill, Deer Park

## DAMS, WETLANDS AND EMBANKMENTS

- Geotechnical and Hydrogeological Advice, Wetlands
- Wetlands at numerous estates around Melbourne. Clients included developers, consultants and Melbourne Water
- Farm Dams, Flinders, Bulla and many other farm dams in Victoria.



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## Project Experience

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- Rehabilitation of Oval, Epsom Park
- Many Wastewater Re-Use Schemes throughout Victoria

### EXPERT EVIDENCE

- Provision of geotechnical expert evidence for the slope stability of cliff face, Gunnerson vs State of Victoria, Mornington Peninsula Shire Council
- Geotechnical Expert Evidence for landfill, T. Love vs State of Victoria
- Geotechnical Expert Evidence for Failed Building, Paynesville.
- Geotechnical Expert Evidence on construction and slope stability of Pool, Mt Eliza for Mornington Peninsula Shire Council.
- Geotechnical Expert Evidence of Fire Service Tunnel, Loy Yang
- Attendance at VCAT on many building and slope stability issues.
- Attendance at VCAT and expert evidence for drying beds, Mandalay Resources.

### Significant Projects - Environmental

#### ENVIRONMENTAL & RISK ASSESSMENTS

- Assessment and Remediation for Avendon Housing Estate resulting in 5 Environmental Certificates and 1 Statement of Environmental Audit
- Multi – Storey Apartment Building, Port Melbourne resulting in Statement of Environmental Audit
- Multi-Use Building, Richmond –Environmental and Human Health Risk assessment
- Apartments, Richmond resulting in a Certificate of Environmental Audit and review and inspection of vapour barrier and undertook a vapour risk assessment
- Numerous school sites around Melbourne involving Assessments, Remediation, Validation and Certificates of Environmental Audit
- Environmental Assessments resulting in Audits of Proposed Housing Estates, throughout Melbourne, including Alphington, Southbank, Deer Park, Cranbourne, Richmond and Lyndhurst
- Risk Assessment for Multi-storey Development over former service station, Southbank
- Many other environmental assessment (Phase 1 and 2) for previous service station sites, residential developments and industrial sites
- Environmental Due Diligence Assessment for future purchasers
- Underground storage tank 'pulls'
- Assessment of railway yards, Calder Park
- Assessment and successful re-classification of soil for offsite disposal, Docklands
- Assessment for a sub-division including landfill gas assessment

#### STATUTORY ENVIRONMENTAL AUDITS

- S53V Audit for Service Station, with offsite hydrocarbon plume, N. Brighton for major oil company
- S53V Audit for Wastewater Winter Storage, Mallacoota
- S53V Audit for Oil Depot, Mildura and review of Clean Up Plan for major oil company
- S53X Audit for proposed Crises Accommodation, St Kilda resulting in 2 Statements of Environmental Audit
- S53X Audit for industrial development, Maribyrnong
- S53X Audit for housing development Williamstown
- S53X Audit of industrial complex including remediation of fluoride plume, with chlorinated hydrocarbon plumes, CUTEP's, Braybrook with multiple Statements
- S53X Audit for old Depot, Dandenong
- S53X Audit for Service Station, St Albans
- S53X Audit for Apartment Abbotsford including groundwater CUTEP
- S53X Audit for Apartment Complex, North Melbourne
- S53V Audit for Verification and Construction of Landfill, Waurn Ponds
- S53V Audit for Landfill Construction, Bairnsdale
- S53V Audit for Landfill Construction, Bunting Road, Braybrook



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## Project Experience

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- S53V Audit for landfill gas, Wonthaggi

### EXPERT SUPPORT FOR STATUTORY ENVIRONMENTAL AUDITS

- Provided advice to the SA EPA on design and construction of clay liners
- Provided geotechnical advice to EPA approved Environmental Auditor for the Environmental Audit of the clay lining for the landfill at McIntosh Road, Sunshine
- Provided geotechnical and civil engineering advice to Auditor for Victrack platform immobilised fill encapsulation structure
- Provided advice for the removal and encapsulation of Cr (VI) contaminated soil and groundwater and support of the adjacent buildings for Environmental Auditor, Montague Street, South Melbourne
- Provided advice and assisted in the hydrogeological assessment for the S53V audit of the thickened tailings disposal proposal at Hazelwood power station.
- Provided leachability advice on the clay liner and tailings and environmental impact of the tailings disposal in the Audit to the new storage at Loy Yang power station at Traralgon.
- Advice for the audit of the clay capping of the Wingfield landfill, S.A.
- Provided advice for the clay capping of a Cranbourne landfill
- Assess the compliance of waste disposal system and in particular the drainage layer as part of a Supreme Court settlement for the SA EPA
- Provided expert advice on encapsulation structure for Victrack Spotswood, and Maribyrnong Defence
- Provided a major role in the Audit team that assessed the capping of the landfill and compliance with the guidelines for the Wingfield landfill for the SA EPA

### LANDFILLS

- Auditor landfill liner review and declaration, Waurn Ponds
- Assessment of Landfill Liner, Deneliquin
- Construction QA of landfill liner, Tullamarine
- Proposed Landfill, Dromana, McCrae
- Assessment of site suitability for landfill, Mornington Peninsula Shire
- Review of Liners, Sita Landfill Lyndhurst
- Large Landfill, Bellarine.
- Bolinda Road Landfill.
- Bio-sludge assessments
- LFG assessment, Amstel Golf Course, Cranbourne.
- Member of EPA consultative committee on landfills

### REMEDIATION

- Overall management of a \$15 million involving the assessment and remediation of 50 contaminated sites for a major oil company throughout Australia
  - UST Pull and Remediation of old service stations, Glen Waverley, Balwyn and others
  - Remediation of soil for burial grounds, Greenvale
  - Remediation of old fuel tank spillage, Abbotsford
  - Remediation of contaminated groundwater with MPVE and ISCO South Morang
  - Remediation of groundwater with MPVE, & ISCO, Footscray
  - Review of remediation scheme for service station LNAPL plume in response to EPA PAN, Ringwood E
  - Remediation field and laboratory trial, Pegasus Centre, Altona
  - Assessment and remediation of disused industrial and farm complex, including MPVE and ISCO, South Morang
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## Awards & Publications

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- "Stevensons Road Cranbourne Landfill - Lessons Learned and Pragmatic Methodology for Landfill Gas Assessment and Management in Australia" P.W. Gringinger, J. Piper, A.P. Lane (2014), Proceedings of 7th International Congress on Environmental Geotechnics, Melbourne, 10-14 November 2014. (Awarded best paper for that theme)
  - "Cranbourne Landfill - Some Insights From an Intensely Monitored Landfill Gas Case" P. Gringinger, A.P. Lane, J.P. Piper (2013), Proceedings of Clean Up 2013, 5th International Contaminated Site Remediation Conference, Melbourne, 15-19 September 2013.
  - "Effect of Vibration on Pile Uplift Capacity", Piper, J.P. (1981) International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, Missouri, USA.
  - "Analysis of Two Failed Excavated Slopes", Piper, J.P. (1988) Fifth Australasian Geomechanics Conference, Sydney
  - "GIS Assessment of Regional Landslide Susceptibility, Mornington Peninsula Shire", (2012) Piper J.P. & Slade D.B., 11th Australian and New Zealand Conference on Geomechanics
  - ACSEV Design Excellence Award (1998), Geotechnical Investigation And Analysis of Complex Piled Foundations For Long Timber Arch Bridge Over The Maribyrnong River
  - Environmental Excellence Awards for Koolamara Waters and Vaucluse estates
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