Desktop Environmental, Hydrological and Geotechnical Study Tarneit Precinct Structure Plan Area 90 Growth Areas Authority

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aurecon

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Executive summary

The Growth Areas Authority (GAA) is preparing a Precinct Structure Plan (PSP) for Area 90, comprised of approximately 1,112.97 hectares (ha) of land on thirty-four (34) separate properties in the Tarneit area in the City of Wyndham, Victoria, Australia. This assessment will inform the finalisation of the PSP in terms of suitability of nominated land uses. Historical research, document review, and site assessment activities were conducted during the weeks of 24 June 2011 and 1 and 8 July 2011.

The scope of works called for:

- A desktop review to determine previous land uses and implications for environmental contamination, hydrology and geology.
- A desktop review of soil, geological and hydrogeological conditions on the site.
- Review of Wetlands databases and sites of National Environmental Significance.
- Performance of a site inspection limited to publicly accessible areas of the site.

Site contamination

In general, the following past or present site activities, with the potential to cause soil or groundwater contamination, were identified in proximity to PSP Area 90:

- Properties where fuel storage and fuelling operations have occurred.
- Properties, including 865 Boundary Road and 716 Dohertys Road, where heavy equipment and farm equipment storage, utilization, and possibly maintenance, have occurred.
- The automobile salvage yard located at 716 Dohertys Road.
- Properties, including the market garden/nursery and reservoir enclosure at 860 Derrimut Road, where farming operations, possibly utilising fertilisers, pesticides, and herbicides, may have occurred.
- Material stockpiles consisting primarily of rock and soil.
- Structures where lead-based paint may have been used.

Recommendations for assessment of individual site properties based on use and potential for contamination are summarized in the report. Recommendations are made in accordance with the Victoria Department of Sustainability and Environment, *Potentially Contaminated Land, General Practice Note*, 2005.

Of the thirty-four (34) site properties, further assessment is recommended for nineteen (19) properties, with recommendations for environmental audits on two additional properties. In general, recommendations for assessment were made based on sensitive land use and the presence of structures where lead based paint may have been used. Non-intensive farming, the presence of heavy equipment or soil stockpiling was considered secondary indicators of the need for assessment in the case of sensitive land use. Environmental audits were recommended for the automobile salvage yard at 716 Dohertys Road and the market garden at 860 Derrimut Road, both properties considered at high potential for contamination based on past and present land use. Due to the limited nature of the site inspection, additional site properties may be recommended for assessment in the future based on receipt of additional information not available at the time of this assessment.

Intrusive sampling and analysis should be undertaken in accordance with National Environment Protection (Assessment of Site Contamination) Measure (1999 NEPM) and draft 2011 NEPM, Australian Standard (2005) *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1-2005), Australian

Standard (1999) *Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances* (AS 4482.2-1999) and Victoria Environment Protection Authority, Industrial Waste Resource Guidelines (IWRG) *Soil Sampling*, 2009. The results of the sampling and analysis would be compared with guideline values for protection of human health and the environment as well as waste disposal criteria (as applicable).

In addition, hazardous materials surveys should be carried out for structures identified for demolition or relocation. The surveys should address asbestos, lead-based paint, polychlorinated biphenyls in electrical fixtures, and hazardous materials storage. Should asbestos bearing materials be encountered during future investigations or construction, the testing, inspection and removal of asbestos materials are required by law to be undertaken by a suitably qualified and licensed asbestos specialist/removalist.

Geotechnical

A review of the Victoria Department of Primary Industries online GIS system indicates that PSP Area 90 has not been subjected to historical mining activity. In general the PSP Area is flat and soil cover is expected to be relatively thin. As such the risk of geotechnical hazards are considered low to moderate though a thorough understanding of the geological model will be required prior to development. The key geotechnical constraints that may affect the development of PSP Area 90 are:

- Differential settlement of overlying residual clay in localised areas of extremely weathered basalt.
- Shallow soil failure (soil creep, slumping, collapse) in areas of increased gradient.
- The presence of soft material encountered at depth may result in a bearing capacity or settlement hazard for any proposed foundations.
- Clay likely to be derived from basalt rock is likely to be subject to considerable shrinkage or swelling in response to change in moisture content. Highly expansive clay can cause unexpected ground movements that are able to damage to building foundations, structures and road infrastructure.
- Ephemeral creeks crossing the site may serve as drainage channels for storm water during flood events, resulting in the erosion of soft sediment and bedrock.

It is recommended that further geotechnical assessment is undertaken across the site to aid the design process. The purpose of the geotechnical assessment will be to undertake intrusive investigation to obtain information for the purposes of:

- Determining a better understanding of the sub-surface geological profile and hydrogeological conditions to develop an accurate geological model.
- Develop baseline geotechnical parameters to aid design, settlement and slope stability modelling (where required).
- Determine depth to rock head and degree of weathering within the upper layers of the bedrock.
- Determine the nature of factures and jointing within the underlying volcanic material.
- Determine the presence of voids within the underlying basalt material.

Hydrology and wetlands

Several ephemeral creeks are located in PSP Area 90, including Skeleton Creek and Dry Creek on the western half of the site and an unnamed ephemeral creek and Dohertys Creek on the eastern boundary of the site. Occasional small ponds are located along each of these creeks, which generally drain toward the south. The site is within the Werribee catchment although none of the creeks are major waterways for the catchment.

An Urban Floodway Zone (UFZ) is located at a minimum of 100 m either side of Skeleton Creek and Dry Creek. This area has been identified as having a greater risk of flooding. A permit is required to carry out works in this area and must be consistent with the local Floodplain Development Plan.

Groundwater beneath the site is present in two main aquifers, the upper Newer Volcanics aquifer, a fractured rock basalt aquifer, and a deeper regional aquifer within the Silurian aged formation. Groundwater depth for the majority of the site is believed to be between approximately 5 and 10 m, with small areas on the northern and eastern margins of the site with a depth between approximately 10 and 20 m. This suggests that groundwater is shallow enough for extraction but deep enough to pose no significant risk to construction.

The following recommendations are made regarding hydrology and wetlands:

- UFZs should remain free of any significant development as they are at risk of flooding.
- Flood modelling should be undertaken to determine hydrologic effects that any new developments will have on the existing creek system, in particular existing culvert and bridge flow capacities.
- Waterways, including Skeleton Creek and Dry Creek and associated low-lying areas will require feature surveys to provide detail of drainage patterns and inform planning for urban drainage systems.
- Drainage paths will need to be either maintained or diverted to ensure all areas are well drained during and after any development.
- Provision should be made in the precinct structure planning for protection of native vegetation along waterways, including Skeleton Creek with appropriate buffering from residential and other urban uses which could be achieved in conjunction with linear parks such as have been established for other developed areas along the Werribee River and tributaries.

1. Introduction

1.1 Background

The Growth Areas Authority (GAA) is preparing a Precinct Structure Plan (PSP) for Area 90, comprised of approximately 1,112.97 hectares (ha) of land on thirty-four (34) separate properties in the Tarneit area in the City of Wyndham, Victoria, Australia. This assessment will inform the finalisation of the PSP in terms of suitability of nominated land uses. Historical research, document review and site assessment activities were conducted during the weeks of 24 June 2011 and 1 and 8 July 2011.

1.2 Objectives

The overall objective of this desktop environmental, hydrological and geotechnical study is to identify the potential for ground contamination within the study area and the nature of likely contaminants to be encountered during detailed design and construction.

The key objectives of this assessment were to conduct a desktop study and site inspection to:

- Confirm suitability of properties for sensitive uses and what level of further assessment would be required to determine suitability of properties for sensitive uses in accordance with the Potentially Contaminated Land General Practice Note 2005 (eg. Environmental Audit, Site Assessment).
- Identify data gaps and outline future testing and more detailed investigations (if required).
- Provide a plan of the study area clearly showing which properties were included in the desktop study and which properties have low, medium and high potential for contamination.
- Prepare a report of findings that will be used to inform the design of precinct structure plans for the study area (in terms of suitability of land uses nominated for each location/area) and to identify key issues that should be addressed during the detailed design phase and construction.

1.3 Scope of work

1.3.1 Desktop review

A desktop review to evaluate current and previous land uses and implications for environmental contamination, hydrology and geology. The desktop review included:

- Assessment of historical aerial photography for the precinct and surrounding areas.
- Consultation with relevant agencies as required, including:
    - EPA for review of records including the ‘Priority Sites Registry’ and the list of issued ‘*Certificates and Statements of Environmental Audit*’.
    - Department of Sustainability and Environment, Port Phillip & Westernport Catchment Management Authority, Southern Rural water, City West Water and Melbourne Water for hydrographs, groundwater and drainage information and other relevant data.
- Soil, geology and hydrogeology conditions desktop review, including survey, mapping and other base data as available from relevant authority and agency data sets and maps. This is aimed at identifying potential shortcomings in data coverage.
- Review and summary of any previous reports or studies regarding environmental, geological or groundwater conditions, in or within the vicinity of the study area.
- Compilation of known groundwater borehole/well locations and testing results.
- Groundwater well databases.

- Review of Wetlands databases and sites of National Environmental Significance.
- Review of Australian Heritage Databases.
- Obtainment and analysis of current titles for all properties in the study area.
- Historical title search of any properties where further historical land use information is needed to establish potential for contamination.
- Victoria Department of Primary Industries online GIS system.

1.3.2 Site inspection

Aurecon performed a site inspection of the study area, evaluating properties from existing roadways and publicly accessible areas. At the Client's request, no on-site inspection of properties within PSP Area 90 was performed. The site inspection was conducted once the desktop review had been completed and was used to focus on-site observations.

1.3.3 Reporting

Based on the findings of this desktop assessment, Aurecon prepared this report including the following:

- Summary of findings and recommendations of the desktop review and site inspection for each discipline area (environmental, hydrology and geotechnical assessment).
- Issues summary and resultant recommendations for management and/or remediation in terms of environmental contamination, geology/geotechnical and hydrology/groundwater.
- Outline of any future testing and more detailed investigations if recommended.
- Evaluation (to the extent practicable within limitations) of the suitability of properties for sensitive uses and what level of further assessment would be required to determine suitability of properties for sensitive uses in accordance with the *Potentially Contaminated Land General Practice Note 2005* (eg Environmental Audit, Site Assessment).
- A plan of the study area clearly showing which properties were included in the desktop study and which properties have low, medium and high potential for contamination.
- Clear and concise drawings/maps, to illustrate existing conditions and support report as required.

It should be noted that this report is a limited desktop assessment of the site and no sampling was performed for this assessment.

1.4 Legislative requirements and relevant assessment guidelines

The scope of work for this desktop environmental, hydrological and geotechnical assessment of the site has been performed in general accordance with requirements outlined in the following documents:

- Victoria Environmental Protection Act 1970
- State Environment Protection Policy (SEPP), *Groundwaters of Victoria*, December 1997, No. S160.
- State Environment Protection Policy (SEPP), *Prevention and Management of Contaminated Land*, June 2002, No. S95.
- State Environment Protection Policy (SEPP), *Waters of Victoria*, October 2004, No. S210.
- Victoria Environment Protection Authority, Industrial Waste Resource Guidelines, *Sampling and Analysis of Waters, Wastewaters, Soils and Wastes*, June 2009, IWRG701.

- Victoria Environment Protection Authority, Industrial Waste Resource Guidelines, *Soil Sampling*, June 2009, IWRG702.
- Australian and New Zealand Guideline for the Assessment and Management of Contaminated Sites, published by Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC), January 1992.
- *Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds*, AS 4482.1-2005, Standards Australia.
- *Guide to the sampling and investigation of potentially contaminated soil, Part 2: Volatile substances*, AS 4482.2-1999, Standards Australia.
- National Environment Protection (Assessment of Site Contamination) Measure, 1999.
- National Environment Protection (Assessment of Site Contamination) Measure, draft 2011.
- Environmental Protection Authority, *A Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes*, March 2000, Publication 441.
- Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- Flora and Fauna Guarantee Act 1988 (FFG).
- Native Vegetation Management Framework 2002 (NVMF).
- Wildlife Act 1975.

1.5 Limitations

Aurecon Australia Pty Ltd (ABN 54 005 139 873) has prepared this report (the "Report") for the exclusive use of GAA (the "Client"), regulatory authorities, Auditors and others approved by the Client for the purpose of desktop environmental, hydrological, and geotechnical study for PSP Area 90.

The Report must be read in light of:

- The limited readership and purposes for which it was intended.
- Its reliance upon information provided to Aurecon by the Client and others which has not been verified by Aurecon and over which Aurecon has no control.
- The limitations and assumptions referred to throughout the Report.
- The cost and other constraints imposed on the Report (such as limited site access).
- Other relevant issues which are not within the scope of the Report.

Subject to the limitations referred to above, Aurecon has exercised all due care in the preparation of the Report and believes that the information, conclusions, interpretations and recommendations of the Report are both reasonable and reliable.

Aurecon makes no warranty or representation to the Client or third parties (express or implied) in respect of the Report, particularly with regard to any commercial investment decision made on the basis of the Report. Use of the Report by the Client or third parties shall be at their own risk and extracts from the Report may only be published with permission of Aurecon.

This disclaimer must accompany every copy of the Report, which is an integral document and must be read in its entirety.

2. Site Description

2.1 Location and description

The site is comprised of thirty-four (34) separate properties totalling approximately 1,112.97 ha in area and designated as PSP Area 90 in the Tarneit area in the City of Wyndham, Victoria, Australia. Site properties are summarized in Table 2-1.

Table 2-1. Site property details

No.	Address	Legal description	Area (Ha)**
119662	Boundary Road TARNEIT VIC 3029	V 11139 F 643 L 1 TP 317992 Tarneit Parish	42.72
119663	Boundary Road TARNEIT VIC 3029	V 8922 F 593 L 1 TP 425066 Tarneit Parish	8.63
120769	Derrimut Road TARNEIT VIC 3029	L 2 LP 208740 Tarneit Parish L 1 PS 541880 Truganina Parish L 2 PS 541880 Truganina Parish L 3 PS 541880 Tarneit Parish and 4 more	305.78
120770	690 Derrimut Road TARNEIT VIC 3029	V 6765 F 869 CA F Sec 21 Tarneit Parish	39.22
120771	Derrimut Road TARNEIT VIC 3029	CA G Sec 22 Tarneit Parish	44.76
120772	860 Derrimut Road TARNEIT VIC 3029	CA F SEC 22 PSH TAR	57.32
122499	Leakes Road TARNEIT VIC 3029	L 1 LP 97350 Tarneit Parish	47.79
126786	725 Boundary Road TRUGANINA VIC 3029	V 9042 F 583 CA 5 Sec 26 Truganina Parish	64.89
126787	865 Boundary Road TRUGANINA VIC 3029	P CA 6 Sec 26 Truganina Parish	32.85
127600	716 Dohertys Road TRUGANINA VIC 3029	V 9633 F 192 L 2 LP 148428 Truganina Parish	8.10
127601	755 Dohertys Road TRUGANINA VIC 3029	V 10842 F 954 L 1 PS 522330 Truganina Parish	2.67
127602	775 Dohertys Road TRUGANINA VIC 3029	V 5840 F 854 L 1 TP 368988 Truganina Parish	4.04
127603	779 Dohertys Road TRUGANINA VIC 3029	L1 LP208740 PSH TRU	0.81
127604	778 Dohertys Road TRUGANINA VIC 3029	PT SEC 26 PSH TRU	0.20
129604	Leakes Road TRUGANINA VIC 3029	V 10703 F 119 L 2 PS 416888 Truganina Parish	11.99
133200	Woods Road TRUGANINA VIC 3029	PT CA3 SEC 15 TRUGANINA	2.60
133201	80 Woods Road TRUGANINA VIC 3029	V 10703 F 118 L 1 PS 538853 Truganina Parish	52.79
133203	121-127 Woods Road TRUGANINA VIC 3029	PT CA6 SEC 15 TRUGANINA	1.63
133204	170 Woods Road TRUGANINA VIC 3029	V 10046 F 135 L 1 TP 94992 Truganina Parish	0.20
133205	171 Woods Road TRUGANINA VIC 3029	V 10593 F 753 L 1 PS 440905 Truganina Parish	0.57
133206	181 Woods Road TRUGANINA VIC 3029	V 10593 F 754 L 2 PS 440905 Truganina Parish	3.49

No.	Address	Legal description	Area (Ha)**
133209	267 Woods Road TRUGANINA VIC 3029	CA 4 Sec 26 Truganina Parish	42.94
133210	Woods Road TRUGANINA VIC 3029	V 9633 F 191 L 1 LP 148428 Truganina Parish	56.58
133211	283 Woods Road TRUGANINA VIC 3029	V 1264 F 604 L 1 TP 545338 Truganina Parish	12.20
172350	Dohertys Road TRUGANINA VIC 3029	V 10842 F 955 L 2 PS 522330 Truganina Parish	55.62
176695	Leakes Road TRUGANINA VIC 3029	V 9692 F 231 L 1 TP 109182 Truganina Parish V 9692 F 231 L 2 TP 109182 Truganina Parish V 9692 F 231 L 3 TP 109182 Truganina Parish	2.26
178077	Boundary Road TRUGANINA VIC 3029	V 10613 F 812 L 1 TP 23043 Truganina Parish	0.46
179481	Woods Road TRUGANINA VIC 3029	V 9689 F 656 L 1 TP 109117 Truganina Parish	0.85
181533	Dohertys Road TRUGANINA VIC 3029	CA 2045 Truganina Parish	0.34
181534	Dohertys Road TARNEIT VIC 3029	CA 2015 Tarneit Parish	0.35
181536	Leakes Road TRUGANINA VIC 3029	CA 2044 Truganina Parish	0.06
181537	Leakes Road TARNEIT VIC 3029	CA 2014 Tarneit Parish	0.08
187432	Woods Road TRUGANINA VIC 3029	V 10037 F 611 L 1 PS 302714 Truganina Parish	104.09
187433	Woods Road TRUGANINA VIC 3029	V 6765 F 868 P CA 3 Sec 26 Truganina Parish	104.09

2.2 Site features

The properties that comprise the site are generally agriculture in nature, with some limited residential and commercial usage. The site is bound to south by Leakes Road; to the west by Derrimut Road, to the north by Boundary Road, and to the east by agricultural land. Site location and features are presented on Figure 1 in Appendix A.

2.3 Surrounding land use

The Truganina area is characterized by generally flat and rolling plains used primarily for non-intensive agricultural purposes such as livestock grazing and livestock feed production. The land uses directly adjacent to the site are as follows:

- West – Derrimut Road, across which is dry land agricultural land with farm residences and other structures located immediately west of Derrimut Road
- North – Boundary Road, across which is dry land agricultural land with farm residences and other structures located immediately north of Boundary Road
- East – Dry land agricultural land and fallow fields with several isolated small structures between Dohertys Road and Boundary Road
- South – Leakes Road, across which is a mixture of residential and some dry land agricultural land

2.4 Proposed land use

This desktop study is part of the pre-planning process for PSP Area 90, with land uses to be decided in the future. For purposes of the risk assessment, Aurecon has considered all potential land use categories listed in the Land SEPP and Groundwater SEPP.

2.5 Topography

The topography of the site slopes gently toward the south across the site from approximately 54 m above mean sea level (MSL) on the northern margin to approximately 35 m above MSL on the southern margin.

2.6 Geology

The Melbourne sheet (SI 55-5) in the 1:250,000 Geological Map Series 1997 (Vandenberg, 1997) indicates that the geology of PSP Area 90 is predominantly Pleistocene Quaternary to Miocene Neogene basalts of the Newer Volcanic Group with minor scoria and ash (tholeiitic to alkaline). The map indicates that the geology on the site also includes Holocene Quaternary fluvial alluvium, gravel, sand and silt confined to existing rivers and streams. The southern portion of PSP Area 90 is overlain by Pleistocene Quaternary Aeolian dune deposits consisting of sand, clay and calcareous sand. Site geological information is presented on Figure 2 in Appendix A.

2.7 Soil characteristics

The Digital Atlas of Australian Soils (NRIC 1991), based on *Atlas of Australian Soils, Sheets 1 to 10* (Northcote *et al.* 1960-68) identifies the soils beneath PSP Area 90 to be Sodosols [SO] classification.

Sodosols are a soil order of the Australian Soil Classification (Isbell, 2002) with an abrupt or clear change in texture at the B2 horizon. The B2 horizon in sodosols is sodic and not strongly acidic. These soils are often brightly coloured and has a pH of 5.5 (water) or greater in the upper B2 horizon.

The regional soil landscape is characterised by dark brown and reddish brown sodosols formed above basalt. Regional surface soils are generally shallow (10 cm or less) and are reasonably friable dark brown to dark greyish brown silty or fine sandy clay loams, to light clays. Basalt stones and boulders may be present at the surface. The subsoils are generally dark brown, dark reddish brown or dark greyish brown medium to heavy clays that are sodic and moderately to strongly alkaline. With depth, the soils become paler in colour and often have pale yellowish grey and yellowish brown mottles. Soft calcium carbonate (lime) concretions generally occur at about 50 to 80 cm depth. Small fragments of weathered basalt to stones of variable size generally occur before 1 m depth. These soils are mainly classified as Red Sodosols using the Australian Soil Classification (Mayer and Martin, 1979; Sargeant, 1998). A regional soil landscape map is presented on Figure 2 in Appendix A.

2.8 Acid sulphate soils

The Digital Atlas of Australian Soils (NRIC 1991), based on *Atlas of Australian Soils, Sheets 1 to 10* (Northcote *et al.* 1960-68), indicates that PSP Area 90 has an extremely low probability of being at risk from Acid Sulphate Soils.

2.9 Historical mining activity

A review of the Victoria Dept. Primary Industries online GIS system indicates that PSP Area 90 has not been subjected to historical mining activity.

2.10 Expected geological conditions

Based on the available information, the following geological conditions are expected:

- Thin layer of topsoil or fill (in vicinity of historical earthworks and structures).
- Residual silt and clay soil derived from underlying volcaniclastic material.
- Bedrock comprising basalt with areas of minor scoria and ash belonging to the Newer Volcanic Group.

In addition to the general subsurface profile, a review of aerial photography indicates a number of dry river or stream channels that may indicate the presence of localised pockets of soft, unconsolidated alluvial sediments that are not shown as being present on the geological map.

2.11 Key geotechnical constraints

A summary of the key geotechnical constraints that may affect the development of PSP Area 90 is presented below in Table 2-2.

Table 2-2 Summary of key geotechnical constraints

Constraints	Discussion
Settlement of proposed road formations and structures	Quaternary alluvial clay and silt deposits are typically poorly consolidated and un-lithified so may settle if unsupported or overloaded. The presence of localised un-engineered fill material may also result in a differential settlement hazard. Dependent on the state of weathering, localised areas of extremely weathered basalt may result in differential settlement of overlying residual clay.
Slope stability	Although the PSP area is relatively low gradient, steeper slopes are noted in close proximity to surface water bodies. Weathered alluvial or residual material can be susceptible to shallow soil failure (soil creep, slumping, collapse) in areas of increased gradient.
Bearing capacity	Low bearing capacity within soft clay material or unconsolidated alluvial material can result in a loss of stability or potential collapse of structures during the construction phase of the development. The presence of soft material encountered at depth may result in a bearing capacity or settlement hazard for any proposed foundations. Although basalt bedrock is relatively competent the bearing capacity may be significantly reduced it is vesicular or has been subject to significant weathering processes.
Shrink-swelling	Clay likely to be derived from basalt rock is likely to be moderately to highly reactive, and subject to considerable shrinkage or swelling in response to change in moisture content. Highly expansive clay can cause unexpected ground movements that are able to damage to building foundations, structures and road infrastructure.
Erosion	A number of ephemeral creeks are located across the site (generally oriented north to south). It is possible that, during flood events, these creeks could serve as drainage channels for storm water, resulting in the erosion of soft sediment and bedrock.

In general, PSP Area 90 is flat and soil cover is expected to be relatively thin. As such the risk of geotechnical hazards are considered low to moderate though a thorough understanding of the geological model will be required prior to development.

2.12 Hydrology and hydrogeology

2.12.1 General site assessment

Information regarding hydrology of the site and surrounding area is based solely on a desktop study. No chemical or groundwater elevation evaluation of groundwater was performed for this assessment.

The western section of the site is generally steeper than the eastern section, with more prominent creeks. Skeleton Creek runs from Boundary Road south to Leakes Road. Two branches of Dry Creek converge into a single creek on property no. 122499 and continue southeast until joining with Skeleton Creek. Skeleton Creek and Dry Creek are ephemeral with a few areas of ponding, particularly near culverts at road crossings.

A shallow, unnamed ephemeral creek is located on property no. 120769, west of Woods Road, between the north-centre and the southeast corner of the property. Dohertys Creek is located near the eastern site boundary, from near Dohertys Road south to Leakes Road. Although ephemeral in nature, several small ponds are located along the course of the creek.

There are three culverts crossing beneath Boundary Road, a single span bridge crossing on Derrimut Road, two new single span bridge crossings on Leakes Road, two culverts beneath Dohertys Road and a single span bridge crossing on Dohertys Road.

2.12.2 Surface water assessment

The site is within the Werribee catchment although none of the creeks are major waterways for the catchment. The creeks are fed from catchments in the north, flowing to the south where the larger flows are located. No water level data for these creeks were available from Melbourne Water.

A Planning Map (Planning Maps Online, 1996-2011) showing Zones for planning is presented in Appendix A. This shows that there is an Urban Floodway Zone (UFZ) at a minimum of 100 m either side of Skeleton and Dry Creeks. This area has been identified as having a greater risk of flooding. A permit is required to carry out works in this area and must be consistent with the local Floodplain Development Plan.

Drainage paths have been determined for the area from the contour plan. The drainage paths are areas of likely surface water flows during rainfall events and appropriate drainage infrastructure will be required to manage these flows if developing in these areas. Drainage paths are depicted on the drainage path map presented in Appendix A.

2.12.3 Groundwater assessment

Groundwater beneath the site is present in two main aquifers, the upper Newer Volcanics aquifer, a fractured rock basalt aquifer, and a deeper regional aquifer within the Silurian aged formation. The Newer Volcanics aquifer system is complex and generally consists of several superimposed basalt flows often separated by clay and silt aquitards (Leonard, 1992). The aquifer ranges from 30 m to 120 m in thickness and is generally unconfined to semi-confined. Due to the varying characteristics of different basalt flows, salinity and yield in the Newer Volcanics aquifer can be highly variable over short distances.

No groundwater level information was available for the boreholes located on the site. The closest borehole to the site for which groundwater level data was available was borehole B93705, located approximately 1.61 kilometres (km) west of the western site boundary, at the intersection of Tarneit Road and Boundary Road. This borehole shows a groundwater depth of 11.16 m below ground level. A general snapshot of groundwater depths in the area is shown in Figure 2-1.

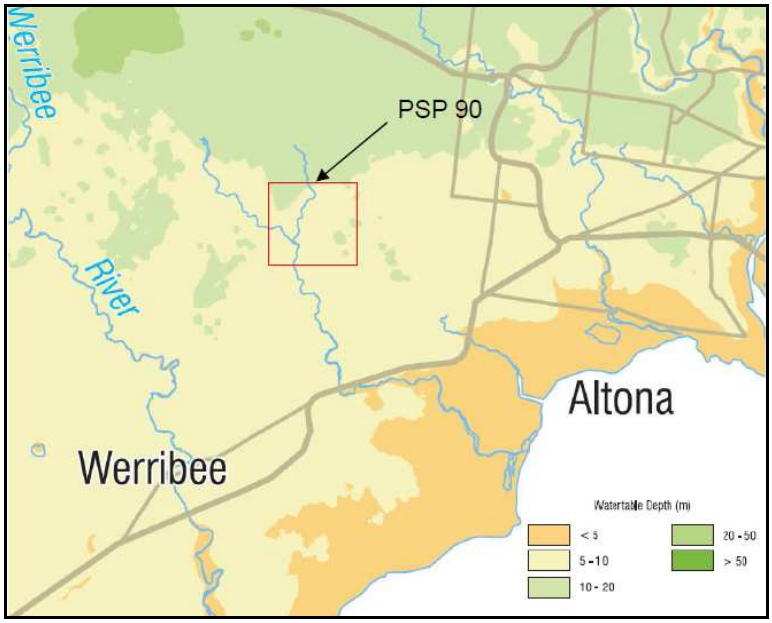

Figure 2-1 – Watertable depths (Watertable Depth, DSE)

2.12.4 Groundwater resources and usage

The Victorian Water Resources Data Warehouse identified thirty (30) registered boreholes within 1.0 km of the site. Borehole usage was primarily domestic and agricultural water supply with a small number of extractive industries boreholes. The registered boreholes are summarized in Table 2-3. According to available data, groundwater in PSP Area 90 varies depending on topography and is generally located between 5 and 10 m below the ground surface, except on the northern and eastern margins of PSP Area 90 where it may be located between 10 and 20 m below ground surface. This suggests that groundwater is shallow enough for extraction but deep enough to pose no significant risk to construction.

Table 2-3 Registered groundwater bores in vicinity of the site

Bore ID	Distance and direction from site	Bore Depth (m)	Registered Use
On Site			
96910	Eastern margin	37	Groundwater
96915	Eastern central margin	Not stated	Groundwater
96911	North central	27.43	Groundwater
96913	North central	16.76	Groundwater
96912	Central	21.34	Groundwater
330361	Southern margin	51.82	Extractive industries
330364	Southern margin	243	Coal
96959	Central	30.48	Domestic and stock water
93717	Northwest corner	Not stated	Groundwater
93714	West central	13.72	Groundwater

Bore ID	Distance and direction from site	Bore Depth (m)	Registered Use
93737	West central	15.24	Stock and poultry water
93724	West central	Not stated	Groundwater (abandoned)
Off Site			
93764	0.05 km west	17	Domestic and stock water
93725	0.10 km west	Not stated	Groundwater (abandoned)
59427	0.06 km north	28.96	Groundwater
59460	0.13 km north	Not stated	Groundwater (abandoned)
59423	0.18 km north	21.34	Groundwater
59456	0.28 km northeast	Not stated	Groundwater (abandoned)
330360	0.06 km north	80.16	Extractive industries
59426	0.18 km north	30.48	Groundwater
59425	0.06 km north	24.38	Groundwater
329270	0.10 km northwest	57.91	Extractive industries
59486	0.84 km northwest	50	Stock and poultry water
59457	0.89 km northwest	Not stated	Groundwater (abandoned)
93711	0.52 km west	30.48	Groundwater
93727	0.89 km west	Not stated	Groundwater (abandoned)
93713	0.37 km west	13.72	Groundwater
93770	0.51 km west	28.5	Domestic water
329269	0.93 km west	79.27	Extractive industries
93715	0.45 km south	33.53	Groundwater

2.13 Wetlands

2.13.1 General

The desktop review of wetlands data bases and sites of National Environmental Significance has made reference to the report on the Assessment of the GAA Investigation Area in Melbourne's West Section D – Biodiversity and Net Gain, prepared by Biosis Research, March 2010 (hereafter referred to as Section D Report). The assessment was based on information in the Flora Information System (FIS) and Atlas of Victoria Wildlife (AVW), both 2007 versions; Birds Australia database 1998-2008; Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) online database for the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act Protected Matters Search Tool. As such, these are the wetland databases available for review.

Additional data was also made available by GAA in MapInfo format which was more specific to the precinct area and which has allowed refinement of the actual extent of wetland areas.

2.13.2 Relevant legislation

The Section D Report presents a detailed overview of biodiversity legislation and government policy which provides the context for this review. In summary, legislation relevant to the review of wetland databases and sites of National Environmental Significance is referred to throughout this report and includes the following:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Flora and Fauna Guarantee Act 1988* (FFG)
- *Native Vegetation Management Framework 2002* (NVMF)
- *Wildlife Act 1975*

2.13.3 Wetland ecological vegetation classes

Ecological Vegetation Classes (EVCs) are the basic mapping units used for biodiversity planning and conservation assessment at landscape, regional and broader scales in Victoria. They are derived from large-scale forest type and plant community mapping. Each EVC represents one or more plant (floristic) communities that occur in similar types of environments. As well as representing plant communities, EVCs can be used as a guide to the distribution of individual species and groups of species.

Four types of wetland EVC have been identified within PSP Area 90, occurring to a very limited extent, and are presented on Figure 3 in Appendix A. These include Plains Sedgy Wetland (EVC 647), Brackish Wetland (EVC 656), Plains Grassy Wetland (EVC 125) and Aquatic Herbland (EVC 653). A brief description of each of these EVCs, including extractions from the Section D Report and revised information on distributions is given below.

Plains Sedgy Wetland (EVC 647)

Plains Sedgy Wetland (EVC 647) comprising 0.68 hectares was identified occurring in small patches mainly along Skeleton Creek in PSP Area 90. Plains Sedgy Wetland generally ccurs in seasonally wet depressions on volcanic and sedimentary plains, typically associated with fertile, silty, peaty or heavy clay paludal soils. Vegetation is primarily sedgy-herbaceous vegetation, sometimes with scattered or fringing eucalypts or tea-tree/paperbark shrubs in higher rainfall areas. A range of aquatic herbs can be present, and species-richness is mostly relatively low to moderate, but higher towards drier margins.

Brackish Wetland (EVC 656)

Brackish Wetland (EVC 656) comprising 0.91 hectares was identified in one small patch along Skeleton Creek, within PSP Area 90. Brackish Wetland is a treeless EVC dominated by sedges and herbs that are generally indicative of saline conditions. True halophytic species such as samphires, if present, only occur with very low cover. Brackish Wetland generally ccurs in estuaries and along poorly defined drainage lines or associated with shorelines of brackish lakes. The patches within Section D are highly modified, with the small indigenous herbs including Streaked Arrow-grass *Triglochin striata* and Salt Sand-spurrey *Spergularia marina* dominating the vegetation cover.

Plains Grassy Wetland (EVC 125)

Plains Grassy Wetland (EVC 125) comprising 4.01 hectares was identified in PSP Area 90. This EVC occurs on the heavy black to grey clays found in swampy drainage lines and seasonally waterlogged wet depressions surrounded by Plains Grassland. The characteristic ground cover is dominated by grasses, small sedges and (in relatively intact examples) forbs. The vegetation is typically species-rich on the outer verges but is usually species-poor in the wetter central areas. Plains Grassy Wetland found in the rain shadow regions to the west of Melbourne can contain dominant grasses including

Brown-back Wallaby-grass *Austrodanthonia duttoniana*, Weeping Grass, *Microleana stipoides* and Kangaroo Grass.

Aquatic Herbland (EVC 653)

Aquatic Herbland (EVC 653) comprises 0.04 hectares in PSP Area 90. It is described as herbland of permanent to semi-permanent wetlands, dominated by sedges (especially on shallower verges) and/or aquatic herbs. It occurs on fertile paludal soils, typically heavy clays beneath organic accumulations.

2.13.4 Conservation significance of wetland EVCs

The Native Vegetation Management Framework 2002 (NVMF) defines conservation significance (Very High, High, Medium and Low) at the bioregional level. For a patch of native vegetation as defined by the NVMF, the habitat score is used to determine conservation significance. Any patches with a Habitat Score of 40/100 or more have Very High conservation significance.

All wetland EVCs within PSP Area 90 are rated as endangered. All patches of Plains Grassy Wetland are rated as Very High conservation significance, with Plains Sedgy Wetland and Brackish Wetland rated as High conservation significance (See Section D Report, Appendix 4). Conservation significance of the patches of Aquatic Herbland has not been determined.

Site condition as it pertains to the Habitat Score, showing areas of High to Very High conservation significance is presented in Figure 4 in Appendix A.

Net gain assessments will need to be undertaken for each type of wetland EVC having regard to conservation significance, under the Native Vegetation Management Framework 2002. Appropriate offsets will need to be identified in consideration of “like for like” requirements, if clearing of these areas is proposed.

2.13.5 Key Ecological Areas for wetlands

Two Key Ecological Areas have been identified in the Section D assessment but these are outside PSP Area 90. In general, the areas of Section D assessed support a relatively low proportion (about 25%) of remnant native vegetation and much of this is in poor condition.

2.13.6 Potential for identifying additional wetland areas

A number of areas within and around the Section D assessment area were not subject to on-ground mapping due to access restrictions. However, these areas are not located within PSP Area 90.

2.13.7 Conclusions of wetlands review

It is clear that the areas of wetland EVCs and listed ecological communities are generally small, highly fragmented and disturbed although some parts may still be relatively intact.

PSP Area 90 contains four wetland EVCs of various sized patches. All wetland EVCs within PSP Area 90 are rated as endangered. Generally the areas of wetland EVC are relatively small. Only the Plains Grassy Wetland EVC is rated with Very High conservation significance and this has the largest areal extent of just over four hectares. The other wetland EVC areas are rated as High conservation significance and cover areas of less than one hectare. In view of the Very High conservation significance of some of the wetland EVCs, Ministerial consent will most likely be required, if native vegetation clearing is proposed.

Two Key Ecological Areas have been identified in the Section D assessment but these are outside PSP Area 90. In general, the areas of Section D assessed support a relatively low proportion (about 25%) of remnant native vegetation and much of this is in poor condition.

3. Records review

3.1 Search of public records

3.1.1 Certificates of title

Land ownership records were reviewed to obtain evidence of previous land uses on the various parcels of land as the occupation of land owners is often included. While an occupation does not necessarily denote land use for a property, it can give a good indication of potential land use.

Current titles

Current certificates of title for all site properties were requested from the Department of Sustainability and Environment (DSE). Crown allotment land for which titles could not be obtained is listed in Table 3-1. Review of current title information found no ownership entries of environmental concern. Copies of current certificates of title are presented in Appendix B.

Table 3-1 Crown allotment land

Property	Street Address	Location	Area (ha)
133200	Woods Road TRUGANINA VIC 3029	PT CA3 SEC 15 TRUGANINA	2.60
133203	121-127 Woods Road TRUGANINA VIC 3029	PT CA6 SEC 15 TRUGANINA	1.63
181533	Dohertys Road TRUGANINA VIC 3029	CA 2045 Truganina Parish	0.34
181534	Dohertys Road TARNEIT VIC 3029	CA 2015 Tarneit Parish	0.35
181536	Leakes Road TRUGANINA VIC 3029	CA 2044 Truganina Parish	0.06
181537	Leakes Road TARNEIT VIC 3029	CA 2014 Tarneit Parish	0.08

Historic titles

Historic certificates of title were obtained from DSE for any properties for which historic title documentation was deemed to be of use, based on past or present usage of the property. Historic titles were requested for the properties listed in Table 3-2.

Table 3-2 Significant site title information

Property	Street Address	Historical Usage	Total Area (ha)
127600	716 Dohertys Road TRUGANINA VIC 3029	Scrapyard and automobile salvage	8.10
120772	860 Derrimut Road TARNEIT VIC 3029	Market garden	57.32
126787	865 Boundary Road TRUGANINA VIC 3029	Farm with heavy equipment	32.85

Review of historic title information found no ownership entries of environmental concern. Copies of historic certificates of title are presented in Appendix B.

3.1.2 Environmental Protection Authority

A search of Victoria EPA records, including the Priority Sites Registry and the list of issued Certificates and Statements of Environmental Audit, was performed to identify subject site or vicinity properties that have been listed as having been issued a cleanup notice or pollution abatement notice (relative to land and/or groundwater) or undergone a statutory environmental audit. Although no locations were identified on PSP Area 90, the search revealed the following relevant results:

- Rose Grange Estate Audit Areas 1A, 1B and 2, Corner Derrimut and Leakes Road Tarneit, Environmental Audit Certificate (CARMS no.54864-1,-2,-3)
- Chilean Club of Victoria, 99 Palmers Road – EPA Priority Sites Registry

Rose-Grange Estate Audit Areas 1A, 1B and 2

Audit Areas 1A, 1B and 2, an area of approximately 6.224 ha located immediately south of property no. 120769, across Leakes Road, comprised the former area of the Werribee Gun Club. The former use of the site as a shooting range was the principal source of contamination at the site. The Audit Areas comprise a portion of a larger property owned by Rose Grange Pty Ltd., a wholly owned subsidiary of Dennis Family Corporation (DFC). Previous environmental investigations of the property had reportedly determined that the western portion of the property had been impacted by activities associate with use by the Werribee Gun Club. Based on this information, Mr. Martin Williams of the DFC requested an environmental audit of the property on 10 February 2004. Three Environmental Audits, covering various portions of the property, were subsequently performed.

The Werribee Gun Club occupied the site from approximately 1980 to 1995. A detailed soil investigation conducted by Golder Associates Pty Ltd. (Golder) in August 2003 identified numerous clay fragments and lead contamination distributed across the surface of the site. Verification sampling, remedial soil excavation and validation sampling was conducted in June 2004 by Meinhardt Infrastructure and Environment Pty Ltd (Meinhardt). In August 2004 delineation sampling and stockpile sampling was conducted by Meinhardt. On 28 November 2005, DFC requested that the Audit Site be subdivided into separate Audits for the purposes of staging the Audit Site development.

Between January and August 2006, Meinhardt excavated contaminated soil and performed validation sampling in Audit Areas 1A, 1B and 2. Final inspections of the Audit Areas were performed between 14 February 2006 (Area 1A) and 27 June 2007 (Area 2) and Certificates of Environmental Audit for each of the Areas were subsequently issued.

Due to the nature of the soil contamination, primarily lead and manganese, the location of the Audit Areas hydraulically downgradient of PSP Area 90 and the current status of the Audit Areas, this property is not believed to pose a significant environmental concern to PSP Area 90.

Chilean Club of Victoria

The Chilean Club of Victoria, located at 99 Palmers Road, approximately 1.6 km east and crossgradient of PSP Area 90, is listed on the Victoria EPA Priority Sites Register. According to the Register, the Chilean Club of Victoria requires ongoing management due to inert solid waste dumped on the property. Due to the nature of the contamination and distance from PSP Area 90, this property is not believed to pose a significant environmental concern to PSP Area 90.

3.1.3 Local government records

The Wyndham City Council does not maintain a contaminated site register and requests for specific properties of interest based on review of historic aerial photographs or observations made during the site visit provided no information regarding potential on site or vicinity property contamination. Copies of relevant correspondence are provided in Appendix C.

3.1.4 Other government records

WorkSafe Victoria was contacted on 27 June 2011 regarding Dangerous Goods Licenses for site properties and responded that a Letter of Authorisation would be required from each property owner before a record search for that property could be conducted. Letters of Authorisation from the site property owners have not been, and are not anticipated to be, requested for this desktop study and the lack of data regarding Dangerous Goods Licenses is considered to be a data gap.

3.1.5 Aerial photographs

Aerial photographs dating back to 1974 were obtained from United Photo and Graphics in Blackburn, Victoria and from Google Earth™ and reviewed to obtain information on the historic use and development of the site. A listing of the aerial photographs reviewed is presented in Table 3-3. Table 3-4 summarizes notable observations from each photograph. Copies of the historical aerial photographs are presented in Appendix D of this report.

Table 3-3 Aerial photographs reviewed

Date	Identification	Scale	Source
26/06/1974	Melbourne Mapsheet 7822	1:30000	United Photo and Graphics
09/03/1984	Census Melbourne SJ 55-5 CAD/C 2720	1:40000	United Photo and Graphics
11/01/1993	Melbourne Colour Survey Run 27W 001-044	1:15000	United Photo and Graphics
14/03/2004	Unknown	Unknown	Google Earth™
19/04/2006	Unknown	Unknown	Google Earth™
16/12/2009	Unknown	Unknown	Google Earth™
01/02/2010	Unknown	Unknown	Google Earth™

Table 3-4 Aerial photograph review summary

Aerial Photograph	Comments
1974	The building currently located at 716 Dohertys Road (property no. 127600) is evident with no surrounding automobile salvage yard. The main building currently located at 725 Boundary Road and the Evans House heritage site is evident on property no. 126786. Additional primarily residential farm structures are evident on property nos. 127602, 120770, 172350, 187432 and 120769. Non-intensive farming is evident on property nos. 120769 and 120771. The remainder of the site consists of fallow land, pasture land or dry land non-intensively cultivated farmland. Skeleton Creek is evident bisecting the site from north to south with Dry Creek evident on the western site margin intersecting Skeleton Creek on property no. 120770. Several residential and farm structures are evident immediately west of the site, across Derrimut Road.
1984	Non-intensive farming is evident on property no. 120769. A small structure is evident at 755 Dohertys Road (property no. 127601). Additional residential and farm structures are evident immediately west of the site, across Derrimut Road.

Aerial Photograph	Comments
1993	Additional buildings are evident on property no. 127601 and small structures are evident at 779 Dohertys Road (property no. 127603), 170 Woods Road (property no. 133204, 80 Woods Road (property no. 133201), property no. 119663 and several locations on property no. 133210. Non-intensive farming is evident at 755 Dohertys Road (property no. 127601), 775 Dohertys Road (property no. 127602) and on property nos. 172350, 120770 and 126786. Scrap automobiles and other debris are evident at 716 Dohertys Road (property no. 127600). Non-intensive farming is evident on the eastern half of property no. 120769. Additional residential and farm structures are evident immediately west of the site, across Derrimut Road and southwest, across Leakes Road.
2004	Additional scrap automobiles and other material is evident at 716 Dohertys Road (property no. 127600). Residential structures are evident at 170 Woods Road (property no. 133204), 171 Woods Road (property no. 133205), 181 Woods Road (property no. 133206), 283 Woods Road (property no. 133211) and the Robertson Farm heritage site (HO28) on property no. 120771. Additional structures are evident along Woods Road and Dohertys Road on property no. 133210. Non-intensive farming is evident at 267 Woods Road (property no. 133209) and property nos. 187432 and 187433. Farm structures and equipment is evident at 267 Woods Road (property no. 133209) and 865 Boundary Road (property no. 126787) A large, circular bunded dry reservoir and a number of small buildings and vehicles are evident at 860 Derrimut Road, on the western half of property no. 120772. Residential development is evident south of the site, across Leakes Road.
2006	The small structure formerly evident on the Robertson Farm heritage site (HO28) on property no. 120771 is no longer evident. Additional commercial farm development is evident at 860 Derrimut Road (property no. 120772). Additional residential development is evident south of the site, across Leakes Road. Possible fruit trees evident at 171 Woods Road (property no. 133205). No other significant changes from the 2004 photograph are evident.
2009	Glass houses characteristic of nursery or market gardening activities are evident at 860 Derrimut Road (property no. 120772). An additional structure is evident at 80 Woods Road (property no. 133201). Additional residential development is evident south and southwest of the site, across Leakes Road. No other significant changes from the 2006 photograph.
2010	No significant changes from the 2009 photograph.

3.1.6 Australian heritage databases

A search of Australian heritage databases was performed to located sites of historic significance on the site. The following heritage databases were searched:

- Wyndham Planning Scheme – Heritage Overlay (sites of National, State, regional and local significance)
- Victoria Heritage Register/Database
- Royal Historical Society Victoria

- Australian Heritage Database
- Australian Heritage Photographic Library
- Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Communities)
    - Includes; Protected areas, Commonwealth Heritage Places, World Heritage Properties, National Heritage Places

The Sands and McDougall Directories of Victoria published between the mid 19th century and 1974 show Tarneit listed as a rural area with no occupancy details. From the Municipal Directory of Victoria up until the 21st century Tarneit was described as a general agricultural district on the Werribee Plains. A total of seven specific heritage sites were identified on PSP Area 90 and are summarized in Table 3-5.

Table 3-5 Heritage site summary

Name	Location	Map Reference	Property No.	Description
Evans House (former)	725 Boundary Road, Truganina, Wyndham	HO11	126786	The house and immediate setting
Robertson Farm Complex	Derrimut Road, Tarneit, Wyndham	HO28	120771	Site enclosed by stone wall.
Early stone hut and yard	Derrimut Road, Tarneit, Wyndham (Lot 2 LP208740)	HO29	120769	The extent of the ruins.
Wine cellars	Derrimut Road, Tarneit, Wyndham (Lot 2 LP208740)	HO30	120769	
Truganina Township and cemetery	Corner of Dohertys Road and Woods Road, Truganina	HO39	133203, 133204, 127602	Cemetery reserve, ARP Hall, oak tree and stone walls of former church site.
Skeleton Creek Water Reserve and water holes.	Woods Road, Truganina, Wyndham	HO119	133200	Water hole, water reserve and stone walls and remnants of bluestone building.
House (ruin)	267 Woods Road, Truganina, Wyndham	HO120	133209	Ruined building and immediate surrounds.

The review also found references to unspecified locations along Leakes Road and Derrimut Road with no information specific to the site. Locations of heritage sites are presented on Figure 3 in Appendix A and copies of documents relevant to the heritage search are presented in Appendix C.

No evidence was found that historic land use on heritage sites located on PSP Area 90 represents a significant environmental concern to the Area or would have any adverse impact, other than potential preservation requirements, on the potential for development of PSP Area 90.

3.1.7 Previous reports and documents

Two Limited Phase 2 Contaminated Land Environmental Site Assessment (ESA) Reports and one Limited Subsurface Soil Assessment Report for two properties, produced by Golder Associates Pty Ltd as part of assessment activities for the preferred alignment of Section 2 of the Regional Rail Link project, were reviewed for this assessment.

Parcel 9633/683, Tarneit Road

A Limited Subsurface Soil Assessment Report for Site LC30_2039 on Tarneit Road in Tarneit, prepared by Golder Associates Pty Ltd. and dated 5 July 2011 (Golder 2011a) was reviewed. The site consists of an approximately 44.62 ha property located on the east side of Tarneit Road. The area of assessment is located approximately 1.61 km west and crossgradient of PSP Area 90.

According to the report, a Phase 1 ESA of the property was performed by Golder in August 2010. Subsequent to the Phase 1 ESA, two shallow soil samples were collected from the southwest corner of the property, using a hand auger, to assess the environmental quality of shallow sub-surface soils due to historic long term agricultural land use. The soil samples were analysed for a wide range of metals, petroleum compounds, volatile organic compounds (VOC), phenols, polychlorinated biphenyls (PCBs), and pesticides.

Laboratory results were compared to National Environment Protection (Assessment of Site Contamination) Measure (1999 NEPM) human health and ecological guideline standards and the New South Wales Department of Environment, Climate Change and Water (DECCW) Guidelines for Assessing Service Station Sites. Reported analyte concentrations did not exceed applicable 1999 NEPM Health Investigation Levels (HILs) for residential use (HIL-A), commercial/industrial use (HIL-F), Ecological Investigation Levels (EILs) or DECCW guideline values in either sample. Based on the results of the Limited Subsurface Soil Assessment, this site is not believed to represent a significant environmental concern to PSP Area 90.

Property No. 172350

A Limited Subsurface Soil Assessment Report for Site LC26_2024 on Dohertys Road in Truganina, prepared by Golder Associates Pty Ltd. and dated 5 July 2011 (Golder 2011a) was reviewed for this assessment. The property consists of an approximately 55.62 ha property (property no. 172350) located on the south side of Dohertys Road and the east side of Woods Road. This property is located within PSP Area 90.

According to the report, a Phase 1 ESA of the property was performed by Golder in August 2010. Subsequent to the Phase 1 ESA, two shallow soil samples were collected from the northern margin of the property, using a hand auger, to assess the environmental quality of shallow sub-surface soils due to historic long term agricultural land use. The soil samples were analysed for a wide range of metals, petroleum compounds, VOC, phenols, PCBs, and pesticides.

Laboratory results were compared to 1999 NEPM human health and ecological guideline standards and DECCW Guidelines for Assessing Service Station Sites. Reported analyte concentrations did not exceed applicable 1999 NEPM HIL-A, HIL-F, EIL or DECCW guideline values in either sample. Based on the results of the Limited Subsurface Soil Assessment, this site is not believed to represent a significant environmental concern to PSP Area 90.

595 Derrimut Road

A Limited Phase 2 Contaminated Land Environmental Site Assessment (ESA) Report for Site LC29_2031 at 595 Derrimut Road in Tarneit, prepared by Golder Associates Pty Ltd. and dated 6 July 2011 (Golder 2011b) was reviewed for this assessment. The site at 595 Derrimut Road consists of an approximately 40.50 ha property located on the west side of Derrimut Road, immediately west of PSP Area 90. The closest area of assessment is located on the southeast corner of the property, immediately west and crossgradient of PSP Area 90.

According to the report, a Phase 1 ESA of the property was performed by Golder in June 2010. Golder recommended performance of a Phase 2 ESA to characterise soil quality in areas of storage of fuels and other chemicals and to characterise the backfill of a former dam on the southeast corner of the property. The limited Phase 2 ESA was performed by Golder in April 2011 and consisted of excavating five test pits and collecting soil samples.

Eight soil samples were collected from the surface and as deep as 1.5 m below ground level using a hand auger and analysed for a wide range of metals, petroleum compounds, VOC, phenols, PCBs, and pesticides. Laboratory results were compared to 1999 NEPM human health and ecological guideline standards and the DECCW Guidelines for Assessing Service Station Sites.

No reported analyte concentrations in any sample exceeded applicable 1999 NEPM HIL-A, HIL-F or DECCW guideline values. Soil samples from each of the test pits marginally exceeded applicable 1999 NEPM EILs for one or more metals. However, these exceedences may be the result of natural mineralisation and were believed by Golder not to represent an unacceptable risk to the environment of the site.

Based on the results of the Phase 2 ESA, this site is not believed to represent a significant environmental concern to PSP Area 90.

830 Leakes Road

A Limited Phase 2 Contaminated Land Environmental Site Assessment (ESA) Report for Site LC30_2038 at 830 Leakes Road in Tarneit, prepared by Golder Associates Pty Ltd. and dated 7 July 2011 (Golder 2011c) was reviewed for this assessment. The property at 830 Leakes Road consists of an approximately 44.62 ha property located on the north side of Leakes Road, approximately 0.81 km, west, and crossgradient of PSP Area 90. This property adjoins Parcel 9633/683 to the south and the area of assessment closest to the site is approximately 1.16 km west of PSP Area 90.

According to the report, a Phase 1 ESA of the property was performed by Golder in July 2010. Golder recommended performance of a Phase 2 ESA to characterise soil quality in areas of storage of various waste and process materials and to characterise the backfill of a former dam on the property. The limited Phase 2 ESA was performed by Golder in April 2011 and consisted of excavating five test pits and collecting soil samples.

Soil samples were collected from the near surface soil and as deep as 2.2 m below ground level and analysed for a wide range of metals, petroleum compounds, VOC, phenols, PCBs, and pesticides. Laboratory results were compared to 1999 NEPM human health and ecological guideline standards and DECCW Guidelines for Assessing Service Station Sites.

Except for one soil sample with a reported manganese concentration marginally exceeding the applicable 1999 NEPM HIL-A guideline value for residential sites, no reported analyte concentration exceeded applicable 1999 NEPM guideline values for residential or commercial/industrial (HIL-F) properties. Soil samples from four of the test pits marginally exceeded applicable 1999 NEPM EILs for one or more metals. However, these exceedences may be the result of natural mineralisation and were believed by Golder not to represent an unacceptable risk to the environment of the site.

Based on the results of the Phase 2 ESA, the distance of the site from PSP Area 90 and the groundwater gradient in the vicinity of PSP Area 90, this site is not believed to represent a significant environmental concern to PSP Area 90.

3.2 Summary of historic contamination potential

The historical data search including the aerial photograph review provided limited information regarding potential historical source areas on the site. Specific land use patterns including the automobile salvage yard at 716 Dohertys Road, the market garden at 860 Derrimut Road and various dry land farming activities, including equipment fuelling and maintenance operations, provide the potential for on-site sources of contamination. In addition, the lack of availability of aerial photographs dated prior to 1974 limited our ability to evaluate the historic uses of the site prior to 1974.

The potential for off-site sources of contamination migrating to the site via sub-surface pathways such as groundwater also exists. The nature, extent and mobility of any potential contamination depend on the type of activities that have historically been undertaken in the context of the local geological and hydrogeological environments.

4. Site inspection

4.1 General

A site walkover was performed by Jacqueline McLeod on 1 July 2011. No access to site properties was granted for this desktop study and the site inspection was therefore limited to what was visible from adjacent roadside areas. Aerial photographs and other sources were used to identify specific sites where land use may need investigation. Select site photographs are presented in Appendix D.

4.2 Significant issues

Significant issues noted during the site walkover are summarized below:

- Fuel storage and fuelling operations have occurred and may be occurring on an unknown number of individual rural holdings.
- Heavy equipment and farm equipment is stored, utilized, and possibly maintained on a number of site properties (eg 865 Boundary Road and 716 Dohertys Road).
- A large automobile salvage yard is present on the eastern margin of the site, immediately north of Dohertys Road (eg 716 Dohertys Road).
- Farming operations where fertilisers, pesticides, and herbicides may have been used and where faecal coliforms may be present from livestock waste.
- A market garden (eg 860 Derrimut Road) with a large, bunded, reservoir enclosure, believed to be dry, is located on the western margin of the site, adjacent to Derrimut Road.
- Material stockpiles consisting primarily of rock and soil present on a number of properties potentially contain contaminated materials where sites may have formerly been used for private waste disposal.
- Waterways, including Skeleton Creek and Dry Creek and associated low-lying areas subject to flooding are present on the site.
- Heritage sites, including the Truganina Cemetery and residences of historic interest are present on portions of the site.

4.3 Key concerns

The key concerns with respect to contamination are anticipated to be the potential impacts associated with contaminants in soil and groundwater, in particular for site construction workers who may be in direct contact with potentially contaminating materials. Additionally, there is potential for on site and off site impacts to the environment resulting from the mobilisation of contamination at the potential areas of concern from surficial run off during rainfall events and/or through the sub-surface, particularly during construction when the areas identified would be disturbed. Soil contamination also has the potential to be mobilised through the generation of dust during construction at each of the potential areas of concern.

As described earlier in this report, other concerns relate to geotechnical and wetlands constraints. An intrusive site-specific geotechnical investigation is required to fully identify geotechnical constraints for development. There are wetlands, watercourses, and heritage sites present across PSP Area 90 that will require consideration during future development.

5. Environmental risk assessment

5.1 Introduction

The environmental risk assessment is based on a contaminant (source) – pathway – receptor methodology whereby:

Contaminant (Source):	A substance that has the potential to cause harm to environmental receptors. In a broader sense sources can include particular ground conditions, for example redundant footings in the ground, which have the potential to impact on redevelopment proposals.
Pathway:	The route by which the source is brought into contact with the receptor. This can include the transport of contamination via water (surface and groundwater), wind borne dust, vapours, excavation and deposition.
Receptor:	Human beings, other living organisms, physical systems and built structures that could be affected by the source. A receptor will only be affected if a pathway from the source to the receptor is present. Groundwater and surface water systems can be considered as receptors in their own right as their quality is regulated by statutory bodies, as well as being pathways for contaminant migration to other receptors.

The source-pathway-receptor relationship allows an assessment of potential environmental risk to be determined, based on the nature of the source, the degree of exposure of a receptor to a source and the sensitivity of the receptor. On this basis an assessment is made of the environmental liabilities associated with the risk. These can be expressed for example, in terms of additional costs associated with site redevelopment or remedial measures, the potential for costs, fines or penalties imposed for breaches of environmental legislation or third party claims, and loss of land value.

The identified potential environmental liabilities with regard to contamination have been evaluated with respect to the potential impacts on:

- surface water bodies.
- groundwater.
- sensitive sites and ecosystems.
- construction and maintenance workforce.
- current and future site users.
- current and future adjacent site users.

5.2 Contaminants of concern

Sources of potential contamination were identified on the site and the following contaminants may potentially be present:

- Petroleum hydrocarbons; ie, total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene and xylenes (BTEX); and polycyclic aromatic hydrocarbons (PAH).
- Heavy metals, in particular lead and chromium.
- Fertilisers, insecticides, fungicides and herbicides.
- Arsenic, organochlorines, organophosphates, synthetic pyrethroids.

- Asbestos.
- Volatile and semi-volatile organic hydrocarbons.

5.3 Exposure pathways

The potential pathways for contaminant exposure to both people and the environment are interwoven and include:

- Site drainage and underground service pits, vaults and conduits.
- Release through the air (particularly if disturbed during demolition and excavation).
- Groundwater.
- Direct contact with soil (which can lead to dermal absorption).
- Soil vapour inhalation.
- Nearby watercourses.

The potential exists for the migration of contaminants onto the site from contamination sources via groundwater and/or drainage. Airborne release and soil vapour can result from demolition and excavation activities, and dermal absorption can occur via direct contact with contaminated material.

Contaminated soil can reach off site locations during transportation or movement of stockpiles.

The dispersal and migration of chemical contaminants resulting from inputs associated with the contaminants of concern will generally be controlled by sub surface conditions (eg soil type and moisture content) along with physical and chemical properties of individual contaminants and weather.

Other factors that may impact the movement and migration of contaminants on the site include:

- Erosion of disturbed and cleared areas that contribute to sediment transport and deposition.
- Natural erosion of undisturbed soils along waterways and other areas that contribute to sediment transport and deposition.
- Stripping of topsoil material.
- On-site movement of light vehicles and machinery that will contribute to shallow soils being disturbed.
- The presence of drainage culverts forming preferential migration pathways down gradient of identified Areas of Environmental Concern (AECs).
- Rainfall conditions.

5.4 Potential receptors

Potential receptors identified on the site and in the surrounding areas include:

- Residential properties on and off site.
- Agricultural properties on and off site.
- Construction workers.
- Watercourses on and off site.
- Groundwater.

Potential receptors and pathways from identified sources are summarized in Table 5-1.

Table 5-1 Potential receptors and pathways

Receptor	Pathway
Site Users	Dermal Contact, Ingestion and Inhalation
Adjacent Site Users	Dermal Contact, Ingestion and Inhalation
Future site users (including site workers during development)	Dermal Contact, Ingestion and Inhalation
Groundwater	Leaching from soils, transport in perched groundwater
Surface Water	Transport in perched groundwater, surface run-off
Ecosystems – Flora and Fauna	Uptake through soil, direct contact
Buried Services	Chemical Attack, Vapour Migration

5.5 Risk assessment

A qualitative risk assessment was conducted considering the sources of potential contamination identified above, and the series of potential receptors identified, together with linking pathways. These linkages are summarised in Table 5-2, where the associated contamination risk is assessed for a given source on a particular receptor. This assessment also takes account of specific chemicals of concern or groups of similar chemicals of concern. It is implicit that where a source has been identified during the desktop study, it has been included within the list, conversely, where the findings of the desktop study have not encountered a potential source it has not been included unless there is good reason to suspect that it may be present, but is as yet unidentified.

In Table 5-5, a two stage assessment has been carried out based on the identified sources, pathways and receptors. Initially, the column designated as 'Potential Consequence of Source - Receptor Linkage', gives an indication of the sensitivity of a given receptor to a particular source or contaminant of concern under consideration. It is a worst case classification and is based on full exposure via the particular linkage being examined. The derivation of the classes used to rank this particular aspect is presented in Table 5-2.

Table 5-2 Derivation of risk classes

Classification	Human Health	Ground/Surface Water	Ecological	Built Environment
Severe	Irreversible damage to human health	Substantial pollution of sensitive water resources	Significant change to the number of one or more species or ecosystems.	Irreparable damage to buildings, structures or the environment.
Moderate	Non permanent health effects to humans	Substantial pollution of non-sensitive water resources or small scale pollution	Change to population densities of non-sensitive species.	Damage to sensitive buildings, structures or the environment.
Mild	Slight short term health effects to humans	Slight pollution to non-sensitive water resources	Some change to population densities but with no negative effects on the function of the ecosystem.	Easily repairable effects of damage to buildings or structures.

Classification	Human Health	Ground/Surface Water	Ecological	Built Environment
Negligible	No measurable health effects to humans	Insubstantial pollution to non-sensitive water resources	No significant changes to population densities in the environment or in any ecosystem.	Very slight non-structural damage or cosmetic harm to buildings or structures.

Subsequently, in the column entitled 'Likelihood of Source-Receptor Linkage', an assessment is made of the probability of the selected source and receptor being linked by the identified pathway. This assessment is ranked based on site-specific conditions as follows:

- Very unlikely 0 to 5%
- Unlikely 5 to 45%
- Possible 45 to 55%
- Likely 55 to 95%
- Almost Certain 95 to 100% (ie impact noted during the investigation)

The 'Risk Classification' column is an overall assessment of the actual risk, which considers the likely effect on a given receptor, taking account of both of the previous rankings (ie consequence and likelihood). The risk classifications are assigned using the following consequence/likelihood matrix.

Table 5-3 Consequences/likelihood matrix

Negligible:	The presence of the identified source does not give rise to the potential to cause significant harm.
Low:	It is possible that harm could arise to a designated receptor from an identified source though this is likely to be mild.
Moderate:	It is possible that harm could arise to a specific receptor, but it is unlikely that such harm would be significant.
High:	A designated receptor is likely to experience significant harm from an identified source without remedial action.
Very High:	There is a high probability that severe harm to a designated receptor could arise from an identified source without appropriate remedial action.

On this basis, the overall risk is ranked as follows:

Table 5-4 Overall risk matrix

Potential Consequence	Likelihood				
	Very Unlikely	Unlikely	Possible	Likely	Almost Certain
Severe	Low	Low	Moderate	High	Very High
Moderate	Negligible	Low	Moderate	Moderate	High
Mild	Negligible	Low	Low	Moderate	Moderate
Negligible	Negligible	Negligible	Negligible	Low	Low

Based on the results of the site walkover, desktop study and our understanding of the future land uses described in the Precinct Structure Plan, the overall likelihood or risk of contamination being encountered on the site during construction is considered to be low to moderate. However, the likelihood or risk of contamination being encountered at specific locations on the site due to the presence of potentially contaminating sources is considered to be moderate to high. A breakdown of the likelihood or risk of contamination being encountered in soil and/or groundwater on the site has been presented in presented in Table 5-5.

Table 5-5 Qualitative risk assessment, PSP Area 90

Source / Contaminating Activity	Contaminant	Critical Receptor	Pathway	Potential Effect	Potential Consequence of Source-Receptor Linkage	Likelihood of Source-Receptor Linkage	Risk Classification
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Likely	**High**
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Human (Adjacent Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Very Unlikely	**Low**
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Unlikely	**Low**
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Surface Water	Perched Groundwater Flow, Surface run-off	Surface Water Contamination	Moderate	Unlikely	**Low**
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Mild	Unlikely	**Low**
Automotive salvage yard (716 Dohertys Road)	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Possible	**Low**

Source / Contaminating Activity	Contaminant	Critical Receptor	Pathway	Potential Effect	Potential Consequence of Source-Receptor Linkage	Likelihood of Source-Receptor Linkage	Risk Classification
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Human (Adjacent Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Very Unlikely	**Low**
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Unlikely	**Low**
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Surface Water	Perched Groundwater Flow, Surface run-off	Surface Water Contamination	Moderate	Unlikely	**Low**
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Mild	Unlikely	**Low**
Equipment storage and maintenance	Heavy metals, TPH, BTEX, PAH, solvents, asbestos	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Possible	**Low**
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Moderate	Possible	**Moderate**

Source / Contaminating Activity	Contaminant	Critical Receptor	Pathway	Potential Effect	Potential Consequence of Source-Receptor Linkage	Likelihood of Source-Receptor Linkage	Risk Classification
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Human (Adjacent Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Unlikely	**Low**
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Possible	**Moderate**
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Surface Water	Perched Groundwater Flow, Surface run-off	Surface Water Contamination	Moderate	Possible	**Moderate**
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Moderate	Unlikely	**Los**
Fuelling operations and fuel storage	Heavy metals, TPH, BTEX, PAH	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Possible	**Low**
Market Gardens and Glass Houses	Heavy metals, pesticides, herbicides	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Market Gardens and Glass Houses	Heavy metals, pesticides, herbicides	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**

Source / Contaminating Activity	Contaminant	Critical Receptor	Pathway	Potential Effect	Potential Consequence of Source-Receptor Linkage	Likelihood of Source-Receptor Linkage	Risk Classification
Market Gardens and Glass Houses	Heavy metals, pesticides, herbicides	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Unlikely	**Low**
Market Gardens and Glass Houses	Heavy metals, pesticides, herbicides	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Mild	Possible	**Low**
Market Gardens and Glass Houses	Heavy metals, pesticides, herbicides	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Very Unlikely	**Negligible**
Soil/rock stockpiling	Heavy metals, pesticides, herbicides, TPH, PAH	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Unlikely	**Low**
Soil/rock stockpiling	Heavy metals, pesticides, herbicides, TPH, PAH	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Unlikely	**Low**
Soil/rock stockpiling	Heavy metals, pesticides, herbicides, TPH, PAH	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Unlikely	**Low**
Soil/rock stockpiling	Heavy metals, pesticides, herbicides, TPH, PAH	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Mild	Possible	**Low**
Soil/rock stockpiling	Heavy metals, pesticides, herbicides, TPH, PAH	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Unlikely	**Low**

Source / Contaminating Activity	Contaminant	Critical Receptor	Pathway	Potential Effect	Potential Consequence of Source-Receptor Linkage	Likelihood of Source-Receptor Linkage	Risk Classification
Farming activities (including effluent pits, livestock dips, offal pits, etc.)	Heavy metals, pesticides, herbicides, fertilisers, TPH, PAH, faecal coliforms	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Farming activities (including effluent pits, livestock dips, offal pits, etc.)	Heavy metals, pesticides, herbicides, fertilisers, TPH, PAH, faecal coliforms	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Farming activities (including effluent pits, livestock dips, offal pits, etc.)	Heavy metals, pesticides, herbicides, fertilisers, TPH, PAH, faecal coliforms	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Possible	**Moderate**
Farming activities (including effluent pits, livestock dips, offal pits, etc.)	Heavy metals, pesticides, herbicides, fertilisers, TPH, PAH, faecal coliforms	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Moderate	Unlikely	**Low**
Farming activities (including effluent pits, livestock dips, offal pits, etc.)	Heavy metals, pesticides, herbicides, fertilisers, TPH, PAH, faecal coliforms	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Unlikely	**Low**

Source / Contaminating Activity	Contaminant	Critical Receptor	Pathway	Potential Effect	Potential Consequence of Source-Receptor Linkage	Likelihood of Source-Receptor Linkage	Risk Classification
Structures (including possible septic tanks)	Lead, asbestos, hazardous materials, pesticides, herbicides, faecal coliforms	Human (Current Site Users)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Structures (including possible septic tanks)	Lead, asbestos, hazardous materials, pesticides, herbicides, faecal coliforms	Human (Future Site Users including construction workers)	Dermal Contact, Ingestion, Inhalation	Toxic, Carcinogenic, Hazardous to Human Health	Severe	Possible	**Moderate**
Structures (including possible septic tanks)	Lead, asbestos, hazardous materials, pesticides, herbicides, faecal coliforms	Groundwater	Permeation through Soil Profile	Groundwater Contamination	Moderate	Possible	**Moderate**
Structures (including possible septic tanks)	Lead, asbestos, hazardous materials, pesticides, herbicides, faecal coliforms	Flora and Fauna	Leaching and uptake	Toxic, phytotoxic	Mild	Possible	**Low**
Structures (including possible septic tanks)	Lead, asbestos, hazardous materials, pesticides, herbicides, faecal coliforms	Services/ Infrastructure	Permeation through Soil Profile	Physical and chemical damage to structures	Mild	Very Unlikely	**Negligible**

6. Summary

6.1 Site contamination

Review of the collected data indicates that the site has historic and current land use activities that have the potential to cause residual contamination in soils, surface water and groundwater. Specific potentially contaminating activities and potential areas of concern that were identified in proximity to PSP Area 90 include:

- Properties where fuel storage and fuelling operations have occurred.
- Properties, including 865 Boundary Road and 716 Dohertys Road, where heavy equipment and farm equipment storage, utilization, and possibly maintenance, have occurred.
- The automobile salvage yard located at 716 Dohertys Road.
- Properties, including the market garden/nursery and reservoir enclosure at 860 Derrimut Road, where farming operations, possibly utilising fertilisers, pesticides, and herbicides, may have occurred and where faecal coliforms may be present from livestock waste.
- Material stockpiles consisting primarily of rock and soil.
- Structures where lead-based paint may have been used.

6.2 Geotechnical

Limited geotechnical data are available for the site. The geology of PSP Area 90 is predominantly Pleistocene Quaternary to Miocene Neogene basalts of the Newer Volcanic Group with minor scoria and ash (tholeiitic to alkaline). The map indicates that the geology on the site also includes Holocene Quaternary fluvial alluvium, gravel, sand and silt confined to existing rivers and streams. The southern portion of PSP Area 90 is overlain by Pleistocene Quaternary Aeolian dune deposits consisting of sand, clay and calcareous sand. The key geotechnical constraints that may affect the development of PSP Area 90 are:

- Differential settlement of overlying residual clay in localised areas of extremely weathered basalt.
- Shallow soil failure (soil creep, slumping, collapse) in areas of increased gradient.
- The presence of soft material encountered at depth may result in a bearing capacity or settlement hazard for any proposed foundations.
- Clay likely to be derived from basalt rock is likely to be subject to considerable shrinkage or swelling in response to change in moisture content. Highly expansive clay can cause unexpected ground movements that are able to damage to building foundations, structures and road infrastructure.
- Ephemeral creeks crossing the site may serve as drainage channels for storm water during flood events, resulting in the erosion of soft sediment and bedrock.

6.3 Hydrology

Two ephemeral creeks, Skeleton Creek and Dry Creek, are located on the western half of the site. An unnamed ephemeral creek is located near the centre of the site and ephemeral Dohertys Creek is located along the eastern boundary of the site. Occasional small ponds are located along each of these creeks, which generally drain toward the south. The site is within the Werribee catchment although none of the creeks are major waterways for the catchment.

There is an UFZ at a minimum of 100 m either side of Skeleton Creek and Dry Creek. This area has been identified as having a greater risk of flooding. A permit is required to carry out works in this area and must be consistent with the local Floodplain Development Plan.

Groundwater beneath the site is present in two main aquifers, the upper Newer Volcanics aquifer, a fractured rock basalt aquifer, and a deeper regional aquifer within the Silurian aged formation. Groundwater depth for the majority of the site is believed to be between approximately 5 and 10 m, with small areas on the northern and eastern margins of the site with a depth between approximately 10 and 20 m. This suggests that groundwater is shallow enough for extraction but deep enough to pose no significant risk to construction.

The Victorian Water Resources Data Warehouse identified 30 registered boreholes within 1.0 km of the site. Borehole usage was primarily domestic and agricultural water supply with a small number of extractive industries boreholes.

6.4 Wetlands

It is clear that the areas of wetland EVCs and listed ecological communities are generally small, highly fragmented and disturbed although some parts may still be relatively intact.

PSP Area 90 contains four wetland EVCs of various sized patches. Generally the areas of wetland EVC are relatively small. Only the Plains Grassy Wetland EVC is rated with Very High conservation significance and this has the largest areal extent of just over four hectares. The other wetland EVC areas are rated as High conservation significance and cover areas of less than one hectare. These areas will need to be assessed with respect to whether they constitute a patch of native vegetation, under the Native Vegetation Management Framework and considered under the three step approach to net gain. In view of the Very High conservation significance of some of the wetland EVCs, Ministerial consent will most likely be required, if native vegetation clearing is proposed.

6.5 Heritage sites

A search of Australian heritage databases was performed to locate sites of historic significance on the site. A total of seven specific heritage sites were identified on PSP Area 90 and included structures, ruins, a cemetery, and a reservoir.

7. Recommendations

7.1 Contamination

Based upon our environmental desktop evaluation and a review of the publicly available information, we note that potential for site contamination may exist and as such further site investigations should be conducted for the subject site known as PSP Area 90 in the City of Wyndham, Victoria, Australia. Recommendations for future assessment of individual site properties based on use and potential for contamination are summarized in Table 7-1 and indicated on Figure 5 presented in Appendix A. Recommendations are made in accordance with the Victoria Department of Sustainability and Environment, *Potentially Contaminated Land, General Practice Note*, 2005.

Of the thirty-four (34) site properties, further assessment is recommended for 19 properties, with recommendations for environmental audits on two additional properties. In general, recommendations for assessment were made based on sensitive land use and the presence of structures where lead based paint may have been used. Non-intensive farming, the presence of heavy equipment or soil stockpiling was considered secondary indicators of the need for assessment in the case of sensitive land use. Environmental audits were recommended for the automobile salvage yard at 716 Dohertys Road and the market garden at 860 Derrimut Road, both properties considered at high potential for contamination based on past and present land use. Due to the limited nature of the site inspection, additional site properties may be recommended for assessment in the future based on receipt of additional information not available at the time of this assessment.

Intrusive sampling and analysis should be undertaken in accordance with 1999 and draft 2011 NEPM, AS 4482.1-2005, AS 4482.2-1999 and Victoria Environment Protection Authority, Industrial Waste Resource Guidelines *Soil Sampling*, 2009. The results of the sampling and analysis would be compared with guideline values for protection of human health and the environment as well as waste disposal criteria (as applicable).

In addition, hazardous materials surveys should be carried out for structures identified for demolition or relocation. The surveys should address asbestos, lead-based paint, polychlorinated biphenyls in electrical fixtures, and hazardous materials storage. Should asbestos bearing materials be encountered during future investigations or construction, the testing, inspection and removal of asbestos materials are required by law to be undertaken by a suitably qualified and licensed asbestos specialist/removalist.

7.2 Geotechnical

It is recommended that further geotechnical assessment is undertaken across the site to aid the design process. The purpose of the geotechnical assessment will be to undertake intrusive investigation to obtain information for the purposes of:

- Determining a better understanding of the sub-surface geological profile and hydrogeological conditions to develop an accurate geological model.
- Develop baseline geotechnical parameters to aid design, settlement and slope stability modelling (where required).
- Determine depth to rock head and degree of weathering within the upper layers of the bedrock.
- Determine the nature of factures and jointing within the underlying volcanic material.
- Determine the presence of voids within the underlying basalt material.

Figure 7.1 in Appendix F (Look, 2007) provides a model to derive suitable intrusive investigation dependent on likely geological conditions and proposed structure. It is expected that all investigation within PSP Area 90 be categorised as *GC1* or possibly *GC2* where larger commercial structures may be required as part of the design.

7.3 Hydrology and wetlands

- UFZs should remain free of any significant development as they are at risk of flooding.
- Flood modelling should be undertaken to determine hydrologic effects that any new developments will have on the existing creek system, in particular existing culvert and bridge flow capacities.
- Waterways, including Skeleton Creek and Dry Creek and associated low-lying areas will require feature surveys to provide detail of drainage patterns and inform planning for urban drainage systems.
- Drainage paths will need to be either maintained or diverted to ensure all areas are well drained during and after any development.
- Provision should be made in the precinct structure planning for protection of native vegetation along waterways, including Skeleton Creek with appropriate buffering from residential and other urban uses which could be achieved in conjunction with linear parks such as have been established for other developed areas along the Werribee River and tributaries.

Table 7-1 Assessment recommendations by property, PSP Area 90

Property No.	Address	Legal description	Area (Ha)**	Historic Activities	Contamination Potential	
					Sensitive Uses	Other Uses
119662	Boundary Road TARNEIT VIC 3029	V 11139 F 643 L 1 TP 317992 Tarneit Parish	42.72	Grazing, non-intensive farming	Low - C	Low - C
119663	Boundary Road TARNEIT VIC 3029	V 8922 F 593 L 1 TP 425066 Tarneit Parish	8.63	Grazing, non-intensive farming, structures	Medium - B	Medium - C
120769	Derrimut Road TARNEIT VIC 3029	L 2 LP 208740 Tarneit Parish L 1 PS 541880 Truganina Parish L 2 PS 541880 Truganina Parish L 3 PS 541880 Tarneit Parish and 4 more	305.78	Non-intensive farming, structures	Medium - B	Medium - C
120770	690 Derrimut Road TARNEIT VIC 3029	V 6765 F 869 CA F Sec 21 Tarneit Parish	39.22	Non-intensive farming, structures	Medium - B	Medium - C
120771	Derrimut Road TARNEIT VIC 3029	CA G Sec 22 Tarneit Parish	44.76	Non-intensive farming, structures	Medium - B	Medium - C
120772	860 Derrimut Road TARNEIT VIC 3029	CA F SEC 22 PSH TAR	57.32	Market garden, glass houses, structures	High - A	High - B
122499	Leakes Road TARNEIT VIC 3029	L 1 LP97350 Tarneit Parish	47.79	Non-intensive farming	Low - C	Low - C
126786	725 Boundary Road TRUGANINA VIC 3029	V 9042 F 583 CA 5 Sec 26 Truganina Parish	64.89	Non-intensive farming, structures	Medium - B	Medium - C
126787	865 Boundary Road TRUGANINA VIC 3029	P CA 6 Sec 26 Truganina Parish	32.85	Soil stockpiles, heavy equipment, tanks, structures	Medium - B	Medium - C
127600	716 Dohertys Road TRUGANINA VIC 3029	V 9633 F 192 L 2 LP 148428 Truganina Parish	8.1	Automobile scrapyard, heavy equipment, structures	High - A	High - B

Property No.	Address	Legal description	Area (Ha)**	Historic Activities	Contamination Potential	
					Sensitive Uses	Other Uses
127601	755 Dohertys Road TRUGANINA VIC 3029	V 10842 F 954 L 1 PS 522330 Truganina Parish	2.67	Non-intensive farming, heavy equipment, tanks, structures	Medium - B	Medium - C
127602	775 Dohertys Road TRUGANINA VIC 3029	V 5840 F 854 L 1 TP 368988 Truganina Parish	4.04	Non-intensive farming, structures	Medium - B	Medium - C
127603	779 Dohertys Road TRUGANINA VIC 3029	L1 LP208740 PSH TRU	0.81	Structures	Medium - B	Medium - C
127604	778 Dohertys Road TRUGANINA VIC 3029	PT SEC 26 PSH TRU	0.2	Presumed past residential, no present structures	Low - C	Low - C
129604	Leakes Road TRUGANINA VIC 3029	V 10703 F 119 L 2 PS 416888 Truganina Parish	11.99	Non-intensive farming	Low - C	Low - C
133200	Woods Road TRUGANINA VIC 3029	PT CA3 SEC 15 TRUGANINA	2.6	Past structures, no present structures	Low - C	Low - C
133201	80 Woods Road TRUGANINA VIC 3029	V 10703 F 118 L 1 PS 538853 Truganina Parish	52.79	Non-intensive farming, structures	Medium - B	Medium - C
133203	121-127 Woods Road TRUGANINA VIC 3029	PT CA6 SEC 15 TRUGANINA	1.63	Cemetery	Low - C	Low - C
133204	170 Woods Road TRUGANINA VIC 3029	V 10046 F 135 L 1 TP 94992 Truganina Parish	0.2	Structures	Medium - B	Medium - C
133205	171 Woods Road TRUGANINA VIC 3029	V 10593 F 753 L 1 PS 440905 Truganina Parish	0.57	Non-intensive farming, structures	Medium - B	Medium - C
133206	181 Woods Road TRUGANINA VIC 3029	V 10593 F 754 L 2 PS 440905 Truganina Parish	3.49	Non-intensive farming, structures	Medium - B	Medium - C

Property No.	Address	Legal description	Area (Ha)**	Historic Activities	Contamination Potential	
					Sensitive Uses	Other Uses
133209	267 Woods Road TRUGANINA VIC 3029	CA 4 Sec 26 Truganina Parish	42.94	Non-intensive farming, soil stockpiles, heavy equipment, tanks, structures	Medium - B	Medium - C
133210	Woods Road TRUGANINA VIC 3029	V 9633 F 191 L 1 LP 148428 Truganina Parish	56.58	Non-intensive farming, structures	Medium - B	Medium - C
133211	283 Woods Road TRUGANINA VIC 3029	V 1264 F 604 L 1 TP 545338 Truganina Parish	12.2	Non-intensive farming, structures	Medium - B	Medium - C
172350	Dohertys Road TRUGANINA VIC 3029	V 10842 F 955 L 2 PS 522330 Truganina Parish	55.62	Non-intensive farming, structures	Medium - B	Medium - C
176695	Leakes Road TRUGANINA VIC 3029	V 9692 F 231 L 1 TP 109182 Truganina Parish V 9692 F 231 L 2 TP 109182 Truganina Parish V 9692 F 231 L 3 TP 109182 Truganina Parish	2.26	Non-intensive farming	Low - C	Low - C
178077	Boundary Road TRUGANINA VIC 3029	V 10613 F 812 L 1 TP 23043 Truganina Parish	0.46	Undeveloped	Low - C	Low - C
179481	Woods Road TRUGANINA VIC 3029	V 9689 F 656 L 1 TP 109117 Truganina Parish	0.85	Non-intensive farming	Low - C	Low - C
181533	Dohertys Road TRUGANINA VIC 3029	CA 2045 Truganina Parish	0.34	Grazing	Low - C	Low - C
181534	Dohertys Road TARNEIT VIC 3029	CA 2015 Tarneit Parish	0.35	Grazing	Low - C	Low - C
181536	Leakes Road TRUGANINA VIC 3029	CA 2044 Truganina Parish	0.06	Grazing	Low - C	Low - C
181537	Leakes Road TARNEIT VIC 3029	CA 2014 Tarneit Parish	0.08	Grazing, non-intensive farming	Low - C	Low - C

Property No.	Address	Legal description	Area (Ha)**	Historic Activities	Contamination Potential	
					Sensitive Uses	Other Uses
187432	Woods Road TRUGANINA VIC 3029	V 10037 F 611 L 1 PS 302714 Truganina Parish	104.09	Non-intensive farming, structures	Medium - B	Medium - C
187433	Woods Road TRUGANINA VIC 3029	V 6765 F 868 P CA 3 Sec 26 Truganina Parish	104.09	Non-intensive farming, structures	Medium - B	Medium - C

Notes:
A - requires an environmental audit
B - requires a site assessment
C – no assessment required under Section 12(2)(b) and Section 60(1)(a)(iii) of the Planning and Environment Act 1987

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Appendix A
Figures

Appendix A

Figure 1 – Aerial Map
Figure 2 – Geotech Map
Figure 3 – Environment and Heritage
Figure 4 – Vegetation Quality
Figure 5 – Potential Land Contamination
Planning Map
Drainage Path Map

Appendix B
Certificates of Title

Appendix B

Certificate of Title

Appendix C
Regulatory Records Documentation

Appendix C

Regulatory Records Documentation

Appendix D
Aerial Photographs

Appendix D

Aerial Photographs

Appendix E
Site Photographs

Appendix E

Site Photographs

Appendix F
Figure 7.1 Geotechnical Category of Investigation (Look, 2007)

Appendix F

Figure 7.1