Appendix E

Inland Waters Technical Memorandum (Emerge Associates 2019)

TECHNICAL MEMORANDUM

Environmental Factor: Inland Waters

Lot 102 Farrall Road, Midvale

PROJECT NUMBER	EP16-009	**DOC. NUMBER**	EP16-009(21)--094A ASC
PROJECT NAME	Movida Estate, Midvale	**CLIENT**	Peet Stratton Pty Ltd
AUTHOR	ASC	**REVIEWER**	
VERSION	A	**DATE**	21/11/2019

1. INTRODUCTION

Peet Stratton Pty Ltd (Peet) propose to subdivide Lot 102 Farrall Road, Midvale (referred to herein as 'the site' and shown in **Figure 1**) for residential land uses as part of the broader Movida Estate. The Local Structure Plan (LSP) incorporating the site (and wider area) was approved by the Western Australian Planning Commission (WAPC) in September 2016. The site is located approximately 18 km north east of the Perth Central Business District and lies within the City of Swan (CoS). The site is bound by the existing Farrall Road reserve to the west, the existing rail corridor to the north and east, and vacant lots to the south.

A Section 38 referral pursuant to the *Environmental Protection Act 1986* (EP Act) for the site was submitted to the Office of the Environmental Protection Authority (EPA) (now EPA Services, Department of Water and Environmental Regulation (DWER)) in September 2017. From this, the EPA set a level of assessment as 'Referral Information with Additional Information (2-week public review)' in May 2018. The EPA provided correspondence to the proponent requesting additional information for assessment in October 2018. As part of this, further information was requested regarding the inland waters (surface and groundwater) environmental factor.

The purpose of this technical memorandum are to: provide context, clarify potential environmental impacts, and summarise the proposed management and mitigation measures in relation to inland waters.

2. RECEIVING ENVIRONMENT

A desktop assessment has been undertaken by Emerge Associates to assess the environmental values within the site that are supported by, or depend on, inland waters (being surface water and groundwater). These environmental values are shown in **Figures 2** to **7** over aerial imagery from March 2015, as the environmental investigations (e.g. geotechnical) were conducted prior to subdivision of Movida Estate to the west of the site (as seen in **Figure 1**).

2.1. Rainfall

The site experiences a dry Mediterranean climate of hot dry summers and cool wet winters. The majority of rainfall is received between June and August (BoM 2019). Long term climatic averages observed at Midland (station no. 9025) from 1886 to 2019 indicate that the site is located in an area of moderate rainfall, receiving 794 mm on average annually. However, the average annual rainfall taken from 1961 to 1990 is lower, being 753 mm, and is more reflective of the existing climate.

2.2. Landform and topography

The physiography across the site and broader area is characterised by a colluvial slope in the east (i.e. the Piedmont Zone) that is a foothill of the Darling Plateau located further to the east, and the Pinjarra Plain in the west, an alluvial plain composed of clayey alluvium that has been transported from the Darling Plateau (Gozzard 2011). These are shown in **Figure 2**.

Existing topographic contours (see **Figure 2**) across the site range from 25 m Australian height datum (AHD) in the east to 19 m AHD in the south west and has an average grade of 4 %. To the east of the site the land rises towards the Darling Plateau, with the exception of the existing rail corridor which is up to 3 m below the adjacent land. To the west the site grades more gently towards the Swan River. Topographic contours are consistent with the physiography described above.

2.3. Geology and soil

Surface geology across the site has been mapped by the Geological Survey of Western Australia (Gozzard 1986). The site comprises of medium-grained yellow sands (S12) of the Yoganup Formation in the east and pebbly silty sand overlying clay (Mgs1) consistent with the Guildford Formation in the west. Geology mapping is shown in **Figure 3**.

Geotechnical investigations have been completed across the site and the broader LSP area, though no test pits or boreholes were able to be installed within or adjacent to the wetland given it is located within Bush Forever (BF) Site 309. The location of test pits or boreholes are shown in **Figure 3**. A copy of the geotechnical reports are provided in **Appendix 1** and **2**.

These investigations describe soils beneath the site as topsoil overlying sand with the exception of a small area in the north (Douglas Partners 2014). This was described as topsoil and fill overlying sand, which is underlain by slightly gravelly clayey sand. To the west of the site and Farrall Road the soil is mostly described as topsoil overlying sand and clayey sand, that is underlain by sandy clayey gravelly materials (Douglas Partners 2014, 2016).

The geotechnical investigations suggest that sands extend to and across Farrall Road, which is further west than shown in **Figure 3**, and that the clays and clayey sands are closer to the surface to the west of Farrall Road. This is further supported by a lithological assessment completed on three monitoring bores and one production bore. The monitoring bores located to the east of Farrall Road noted sand to a depth of seven metres overlying colluvium or sheet wash overlying silty sands, clay or sandy clays. The location of these bores is shown in **Figure 3** and a copy of the lithological assessment is provided in **Appendix 3**.

In situ permeability tests were also completed across the LSP area (Douglas Partners 2014). Permeability measured within four boreholes within the site ranged from 17 m/day to 65 m/day. In comparison, permeability measured at six boreholes located to the west of the site ranged from 0.3 m/day to 1.2 m/day. A design permeability rate of 9 m/day was recommended for sands beneath the site based upon the measured results and analysis with Hazen's formula (Douglas Partners 2014). These permeability measurements support the generalised description that soils are clayey to the western side of Farrall Road and sand to the east of Farrall Road.

2.4. Surface water

2.4.1. Surface water features

Blackadder Creek enters and discharges from the site at the northern corner. It enters the site via culverts (two 900 mm diameter pipes) beneath the railway and discharges under Farrall road via culvert (one 750 mm diameter pipe).

DWER "hydrography" mapping suggested that a tributary of Blackadder Creek begins within the BF site (shown in **Figure 4**). A biophysical assessment was undertaken to establish the physical and biological values of Blackadder Creek and the tributary (Emerge Associates 2015a). Based on the results of the desktop and site analysis, it was concluded that there was no evidence of the mapped tributary within the site. Downstream culverts (five 1200 mm diameter) beneath Roe Highway are located in alignment with the mapped tributary however no waterway, channel or floodplain area associated with the mapped Blackadder tributary could be located (Emerge Associates 2015a). This was further supported by more recent investigations carried out by Douglas Partners in 2016 (provided in **Appendix 2**). No evidence of a waterway or channel could be located. It was concluded that the damp area located to the west of Farrall Road results from an expression of groundwater above a clayey mound.

2.4.2. Surface runoff and infiltration

Given the high permeability of the sands beneath the site, little or no stormwater runoff is anticipated to occur except during extreme rainfall events.

No runoff is expected to occur in small rainfall events (e.g. the first 15 mm of rainfall) given the permeability measured across the site (presented in **Section 2.3** above). Major event runoff (i.e. up to the 1% annual exceedance probability (AEP) rainfall event) is influenced by slope, vegetation cover and underlying soils. While the site slopes from east to west, existing vegetation cover and permeability of the underlying soils suggest runoff would be minimal.

Hydraulic and hydrological models of the LSP area and upstream catchments were prepared to establish pre-development peak flows entering and exiting the Estate as described within the *Local Water Management Strategy* (LWMS) (Emerge Associates 2015b). As part of this process, a 2D model was built based on LiDAR data to identify surface flows and pockets of storage. The results shown in **Figure 4** demonstrate that there are no flow paths or ponding across the majority of the site in a major rainfall event. There is flow within Blackadder Creek and some minor ponding on the eastern side of Farrall Road (which is a barrier to flows). Consequently, in an average rainfall year it is anticipated that rainfall on the site will infiltrate and either be taken up by vegetation or recharge the underlying groundwater.

2.4.3. Surface water quality

GHD (2010) conducted surface water quality monitoring on three occasions between October 2007 and September 2008 across the LSP, including two monitoring locations within Blackadder Creek (SW1 is shown on **Figure 4**) and one within the tributary downstream of Roe Highway. Additional surface water quality monitoring was undertaken by Emerge Associates between May 2015 and August 2016 (Emerge Associates 2016). The 2007 to 2008 monitoring program is summarised in

Table 1 and the 2015 to 2016 monitoring program is summarised in **Table 2**. All monitoring results are shown in **Appendix 4**.

Surface water quality measured within Blackadder Creek inflow (SW1) just upstream of the site was slightly acidic to neutral, and had electrical conductivity (EC) measurements within Australian and New Zealand Environmental Conservation Council (ANZECC) (2000) guideline values or greater. With the exception of two monitoring occasions during 2007 and 2008, total nitrogen (TN) concentrations were below the long-term Healthy Rivers Action Plan (HRAP) interim target concentration (SRT 2009), ANZECC (2000) guideline values, and the short-term HRAP target concentration (SRT 2009). Total phosphorous (TP) concentrations were below all relevant guidelines values (ANZECC and ARMCANZ 2000; SRT 2009).

Surface water quality measured within Blackadder Creek just upstream of Roe Highway (SW6) was neutral to alkaline with EC generally exceeding ANZECC (2000) guideline values. TN concentrations exceeded all relevant guideline values on two of the three occasions, while TP concentrations were below all relevant guideline values (ANZECC and ARMCANZ 2000; SRT 2009).

EC and TN concentrations measured in the tributary downstream of Roe Highway (SW2) exceeded all relevant guideline values (ANZECC and ARMCANZ 2000; SRT 2009). With the exception of one monitoring occasions, TP concentrations exceeded at least two relevant guideline values (ANZECC and ARMCANZ 2000; SRT 2009).

Table 1: Pre-development surface water quality from 2007 to 2008 (GHD 2010)

Site ID	Description	pH	EC (µS/cm)	Total dissolved solids (TDS) (mg/L)	TN (mg/L)	TP (mg/L)
SW1	Blackadder Creek - Inflow	6.46-7.44	**343-532**	171-268	**1.4-2.2**	0.01-0.02
SW2	Tributary - Outflow	**8.25**	**823**	412	**4**	**0.82**
SW6	Blackadder Creek - Outflow	**8.65**	282	142	0.4	<0.01
ANZECC guideline values	*6.5-8*	*120-300*	-	*1.2*	*0.065*	*ANZECC guideline values*
Short-term HRAP target concentrations	-	-	-	*2.0*	*0.2*	*Short-term HRAP target concentrations*
Long-term HRAP target concentrations	-	-	-	*1.0*	*0.1*	*Long-term HRAP target concentrations*

Values given as a range or singular if one monitoring occasion.

Table 2: Pre-development surface water quality from 2015 to 2016 (Emerge Associates 2016)

Site ID	Description	pH	EC (µS/cm)	TDS (mg/L)	TN (mg/L)	TP (mg/L)
SW1	Blackadder Creek - Inflow	**5.69-7.03**	**187-542**	<5	0.2-0.7	0.01-0.03
SW2	Tributary - Outflow	6.6-7.19	**352-558**	<5-28	**3.8-9.6**	**0.02-0.82**
SW6	Blackadder Creek - Outflow	7.28-8.5	**370-469**	<5	**4.5-13.1**	**0.02-0.1**
ANZECC guideline values	*6.5-8*	*120-300*	-	*1.2*	*0.065*	*ANZECC guideline values*
Short-term HRAP target concentrations	-	-	-	*2.0*	*0.2*	*Short-term HRAP target concentrations*
Long-term HRAP target concentrations	-	-	-	*1.0*	*0.1*	*Long-term HRAP target concentrations*

Values given as a range or singular if all monitoring events measured consistent result.

2.5. Groundwater

2.5.1. Groundwater levels

Minimum groundwater levels across the site shown in the *Perth Groundwater Map* range from approximately 10.75 m AHD to 11.5 m AHD with groundwater flowing in a westerly direction (DWER 2019) as shown in **Figure 5**. Depth to groundwater ranges from approximately 8.5 m to 13.5 m below the natural surface.

There are no regional groundwater monitoring bores within or upstream (i.e. east) of the site (DWER 2019).

Monthly groundwater monitoring was carried out by GHD (GHD 2010) between October 2007 and September 2008 at 10 locations across the LSP, as shown in **Figure 5**. Groundwater levels at GW10, the bore closest to the site, fluctuated from approximately 14 m AHD in early 2008 to a peak of 16.25 m AHD in spring 2008. These results are provided in **Appendix 5**.

Additional monthly groundwater level monitoring was undertaken by Emerge Associates between July and November 2015. Results indicated a lower maximum groundwater level (MGL) in 2015 than previous years (Emerge Associates 2015b). Notwithstanding the recent lower levels, a conservative approach was undertaken in generating MGL contours for the LSP (shown in **Figure 5**), which were based on the MGL captured by GHD in July 2008 (GHD 2010). Along the western boundary of the site, MGL contours are at least 1.5 m below the surface.

Groundwater has also been encountered within test pits and boreholes installed as part of geotechnical investigations (as discussed in **Section 2.3** and provided in **Appendix 1** and **2**). Groundwater at TP12 and TP13 (upstream of the wetland) was found 2.5 m and 3.0 m respectively below the surface within sand. Groundwater was also encountered at TP02 and TP04, in the north of the site, at 2.2 m and 2.8 m below the surface, respectively. Therefore, for the majority of test pits and boreholes within the site no groundwater was encountered within 3 m of the surface.

Beyond the site and to the west of the wetland (adjacent to Farrall Road), groundwater was encountered at most bores and ranged from approximately 0.8 m within sand (at TP119) to 1.9 m within clayey sand (at BH18).

When comparing MGL contours and groundwater encountered in geotechnical test pits and boreholes, to soils beneath the LSP (as discussed in **Section 2.3**), it is likely that groundwater is generally perched above the clayey sand and gravelly clayey sand layers. Consequently, within the site, rainfall (that infiltrates through sands) is anticipated to perch on the surface of the underlying sandy clay and flow laterally from east to west (Douglas Partners 2014).

2.5.2. Groundwater quality

GHD (2010) conducted groundwater quality monitoring on six occasions between October 2007 and September 2008 including sampling of physio-chemical parameters in situ and laboratory analysis of nutrient and salt concentrations. Water quality monitoring was carried out within 10 bores, including bore GW10 located downstream of the site (shown in **Figure 5**) (GHD 2010). Groundwater quality measured at GW10 is summarised in **Appendix 4** and summarised in **Table 3**.

Table 3: Pre-development groundwater quality from 2007 to 2008 (GHD 2010)

Site ID	pH	EC (µS/cm)	TDS (mg/L)	TN (mg/L)	TP (mg/L)
GW10	6.04-7.13	**2305-2362**	1410-3200	**0.5-2**	**0.07-0.30**
ANZECC guideline values	*6.5-8*	*120-300*	-	*1.2*	*0.065*
Short-term HRAP target concentrations	-	-	-	*2.0*	*0.2*
Long-term HRAP target concentrations	-	-	-	*1.0*	*0.1*

Groundwater pH was slightly acidic but generally within ANZECC (2000) guidelines, while EC readings exceeded the ANZECC (2000) guidelines. TN concentrations for most monitoring events exceed the ANZECC guidelines (2000) and the long-term HRAP target concentration (SRT 2009). TN concentrations on one monitoring occasion at GW10 also exceeded the short-term HRAP target (SRT 2009). TP concentrations exceeded the ANZECC (2000) guidelines and long-term HRAP target (SRT 2009). With the exception of one monitoring occasion at GW10, TP concentrations also exceeded the short-term HRAP target (SRT 2009).

2.6. Wetland

Based on the *Geomorphic Wetland Database – Swan Coastal Plain* mapping (DBCA 2019), a multiple use wetland (MUW) (UFI 15136) is located in the south-western corner of the site (see **Figure 6**) contained within the BF Site 309 (DBCA 2019). As documented within the original referral, the vegetation within the BF site has been found to be representative of a conservation category wetland (CCW).

CCWs support a high level of environmental values, and are the highest priority wetlands. In accordance with *State Planning Policy 2.9 Water Resources* (WAPC 2006), the management objective for CCWs are the preservation, conservation and protection of wetlands environmental attributes

functions and values. This wetland is the only environmental value within the site that is supported by or dependent on inland waters (surface water and groundwater).

A conceptual water balance is presented in **Section 3.2** to describe the hydrology and surface/groundwater interdependence of the wetland and to assess potential impacts on this wetland due to the proposal. In order to provide a quantitative assessment, a proposed wetland area is shown in **Figure 6**. This was determined by considering the existing landform, topography and canopy of the vegetation described above. The wetland area show in **Figure 6** is approximately 17,850 m^2.

It is noted that the proposed wetland area extends beyond the site and the proponent's landholding to the south. Consistent with EPA's request for additional information, this technical memorandum focuses on addressing the Section 38 referral for subdivision of Lot 102.

3. POTENTIAL IMPACTS

The proposed development could result in the following direct and indirect impacts to inland waters:

- Filling of or clearing of wetland vegetation.
- Alteration of the hydrogeological regime that sustains the wetland.
- Abstraction of groundwater that impacts other groundwater users.
- Impacts to water quality.

3.1. Filing of or clearing of wetland vegetation

The proposal will result in clearing of approximately 460 m^2 of wetland dependent vegetation due to the realignment of Farrall Road. This wetland dependent vegetation is in 'degraded' condition and is outside of the area containing intact wetland vegetation. The remainder of the proposed wetland area located will be retained. As such, the impact to the wetland is not considered significant given the size of the proposed wetland area (i.e. 17,850 m^2).

3.2. Alteration of the hydrogeological regime that sustains the wetland

A conceptual water balance has been completed to describe and quantify how the existing environment outlined in **Section 2** relates to the hydrogeological regime of this wetland. This is summarised in **Figure 7** and the cross-section provided in **Appendix 6**. Based upon the water balance, it is inferred that the proposed wetland is an ecosystem dependent on the subsurface presence of groundwater (Eamus and Froend 2006; Serov and Kuginis 2017).

A conceptual water balance for the proposal has also been completed to assess the impact of the proposal on the hydrogeological regime of the wetland. This is summarised in **Figure 8** and the cross-section provided in **Appendix 6**.

The different components of the hydrogeological regime that sustains the wetland are discussed in detail below and include:

- Direct rainfall
- Surface water from upstream catchment area
- Evapotranspiration

- Groundwater through-flow
- Recharge to groundwater.

The conceptual box model provided in **Appendix 7**, summarises the anticipated alteration of the hydrogeological regime that sustains the wetland.

Direct rainfall

Based on the proposed wetland area (see **Figure 7**), the existing average annual volume of direct rainfall onto the wetland is 13,440 m^3 and has been included in the conceptual cross-section provided in **Appendix 6**.

As discussed above, a decrease in the size of the proposed wetland vegetation by 460 m^2 is anticipated to occur. This will reduce the average annual volume of direct rainfall onto the wetland to 13,095 m^3 (approximately a 2.6 % reduction), which has been included in the conceptual cross-section provided in **Appendix 6**. However, the proposal does not impact the volume of direct rainfall experienced by vegetation within the wetland (i.e. the average annual demand has also decreased) and therefore this impact on the direct rainfall component of the hydrogeological regime is not considered significant.

Surface water

The existing upstream contributing catchment for the proposed wetland area has been determined and is shown in **Figure 7**. The balance of the site (i.e. to the north) is not within the upstream catchment for the wetland. This is based upon available topographic contours, the City of Swan intramaps that illustrates the upstream drainage network, and the location of the existing railway line (given it is a barrier to overland flow).

Wetland vegetation can be sustained by direct rainfall, frequent surface flows and/or groundwater interaction. However, as discussed in **Section 2.4.2**, no runoff is anticipated to occur across the site during the frequent/small rainfall events or major rainfall events. Based on topographical contours, it is also noted that the section of the existing Farrall Road adjacent to the wetland is also a barrier to overland flows with the exception of a small culvert. The flow path provided by this culvert was replicated during the widening of Farrall Road (i.e. the existing low point has been maintained and the pipe network built within Farrall Road and within subdivision to the west accepts this runoff). Therefore, in the existing environment, no surface water inflows into the wetland or significant outflows from the wetland are expected to occur in an average rainfall year, which is shown in the conceptual cross-section provided in **Appendix 6**.

Within the upstream catchment of the site (i.e. only Lot 102), the proposal includes landscaped areas, conservation public open space (POS), road reserves and residential lots (as shown in **Figure 8**). Surface water inflows from the upstream contributing area will not occur to the wetland due to the following proposed design approaches:

- Existing topographic contours (and therefore the existing sand profile) will be maintained within both landscaped areas and conservation POS.
- Existing vegetation within both the landscaped areas and conservation POS will be appropriately managed and improved (e.g. through revegetation) (Emerge Associates 2019a) to ensure vegetation cover is maintained and infiltration continues to occur.

- Future conceptual and detailed design of the landscaped area will need to ensure the vegetation cover and infiltration capacity of the underlying soils is maintained. This will be demonstrated within the future UWMP and landscape concepts included therein.
- Residential lots will be composed of roofs, gardens and paved areas. Given the depth of sand beneath the site, these roofs will be connected to soakwells. It is also anticipated that gardens will be capable of infiltrating direct rainfall and runoff from adjacent pavement. Runoff beyond the capacity of soakwells and infiltration within pervious gardens will overland flow towards the adjacent road reserve, however this would occur infrequently and only in response to major rainfall event.
- Water sensitive urban design (WSUD) measures (e.g. bio-retention areas, swales etc.) are proposed to be located within road verges and/or the landscaped areas to treat and infiltrate the small rainfall event at source, as currently occurs.
- Conveyance of runoff (up to the 1% AEP rainfall event) from road reserves and residential lots towards the west within a piped drainage network into the existing Movida Estate drainage network. This is consistent with surface runoff modelling completed to support the LWMS (Emerge Associates 2015b) and subsequent Urban Water Management Plans (UWMPs) (Emerge Associates 2016, 2017b, a), which were documented to support subdivision areas across Movida Estate (to the west for the site). This approach will ensure stormwater runoff does not enter the wetland.

Based on the proposal and design approaches noted above the risk of modifying the surface flow component of the hydrogeological regime is considered low.

Evapotranspiration

Evapotranspiration from vegetation varies due to vegetation type and density and has an impact on recharge to underlying groundwater. Evapotranspiration within landscape areas and the proposed wetland itself is anticipated to remain consistent, given that the existing vegetation will be maintained. Conservation areas (see **Figure 8**) are proposed to be revegetated with appropriate native species (Emerge Associates 2019b), which is anticipated to increase the vegetation density from approximately low to medium. Consequently, evapotranspiration from the conservation area is anticipated to increase. Finally, evapotranspiration within residential areas will decrease due to clearing of the existing vegetation. The recharge estimates provided further below account for the anticipated change in evapotranspiration.

Groundwater through-flow

As described in **Section 2.5**, it is understood that groundwater beneath the site currently flows from east to west. Consequently, it is inferred that groundwater enters the site along the eastern boundary of Lot 102. Given the lack of regional groundwater monitoring upstream of the site (i.e. to the east of the railway), the extent of the upstream groundwater catchment (shown in **Figure 7**) was estimated by assuming groundwater flow is congruent with the surface topographic contours (shown in **Figure 2**) and that recharge occurs within the similar sand (S12) geological unit (see **Figure 3**).

The majority of test pits and boreholes installed across the site did not encounter groundwater within 3 m of the natural surface. Nevertheless, near the northern portion of the proposed wetland area, groundwater at TP120 and TP13 (see **Figure 7**) was encountered at 1.5 m and 3.0 m below the

surface, respectively. Groundwater at TP120 was observed to be perched above sandy clay layers with relatively low permeability, whereas groundwater at TP13 is located within the sand profile. It is inferred from this that the proposed wetland is an ecosystem depending on the subsurface presence of groundwater (Eamus and Froend 2006; Serov and Kuginis 2017).

The conceptual cross-section provided in **Appendix 6** illustrates the extrapolated groundwater levels beneath and upstream (i.e. east) of the wetland, based on the data obtained from site investigations. Across this indicative section, depth to groundwater within the wetland ranges from approximately 1.6 to 2.25 m below the existing surface, and depth to groundwater within the existing vegetation area ranges from approximately 2.25 m to 5.5 m below existing surface.

A number of design elements have been proposed to minimise impacts to the flow of groundwater toward the wetland. These measures focus on avoiding the intersection, diversion and abstraction of groundwater upstream of the wetland, and include:

- No clay grading will occur within Lot 102. This is due to the depth of sand beneath the site (as discussed in **Section 2.3**), which will be sufficient to meet "A" class lots from a geotechnical perspective.
- Groundwater production bores for the purposes of establishment or ongoing landscape irrigation will not be installed within the superficial aquifer, as the groundwater licenses secured for Movida Estate (GWL 201397 and GWL 182854) are for the confined Perth-Leederville aquifer.
- Existing topographic contours will be maintained within both landscaped areas and conservation POS. The preliminary bulk earthworks provided to support the LWMS (Emerge Associates 2015b) proposed that the residential area have an indicative finished lot level of 23.1 m AHD, which maintains a clearance to groundwater of approximately 5 m.

Abstraction from the superficial aquifer has the potential to impact groundwater levels beneath the proposed wetland area. The severity of any potential impact is mostly dependent on the location and operation of any production bore. The development is currently taking water from the Superficial Aquifer (specifically the Yoganup Formation) for temporary dust suppression purposes. The use of this resource has been granted by DWER under groundwater licence GWL181629. The use of groundwater from this resource will only be required during periods of construction and dust suppression, which are generally limited during winter. Nevertheless, measures will be implemented to appropriately locate and operate any future temporary production bore so that any impacts to groundwater levels beneath the proposed wetland are minimised. Finally, it is predicted that development will be concluded in 2024 (K Majewski [Peet] 2019, pers comm., 6 March) and therefore no impacts will occur once development has concluded.

The existing production bore has been used for for temporary construction and dust suppression purposes since 2016 and accesses the superficial aquifer under GWL181629. As demonstrated through monitoring and the analysis below, abstraction from this bore has been successfully managed in such a way that minimises any significant impacts to the wetland. These management options are also discussed in more detail below.

This production bore (see **Figure 3**) is located approximately 290 m north-west of the proposed wetland area and pumping has been restricted to construction operating hours on weekdays. Two groundwater level monitoring bores, MB01 and MB03 bore (see **Figure 3**), have been used to

monitor the magnitude of drawdown in the local area during the periods of abstraction from the production bore. Monitoring bores MB01 and MB03 are located at distances of 8.6 m and 203 m away from the production bore, respectively. MB03 is approximately 50 m north of the proposed wetland.

Groundwater level data collected at MB01 and MB03 during periods of groundwater abstraction at the production bore are illustrated in **Plate 1** (2016 construction period) and **Plate 2** (2017 construction period).

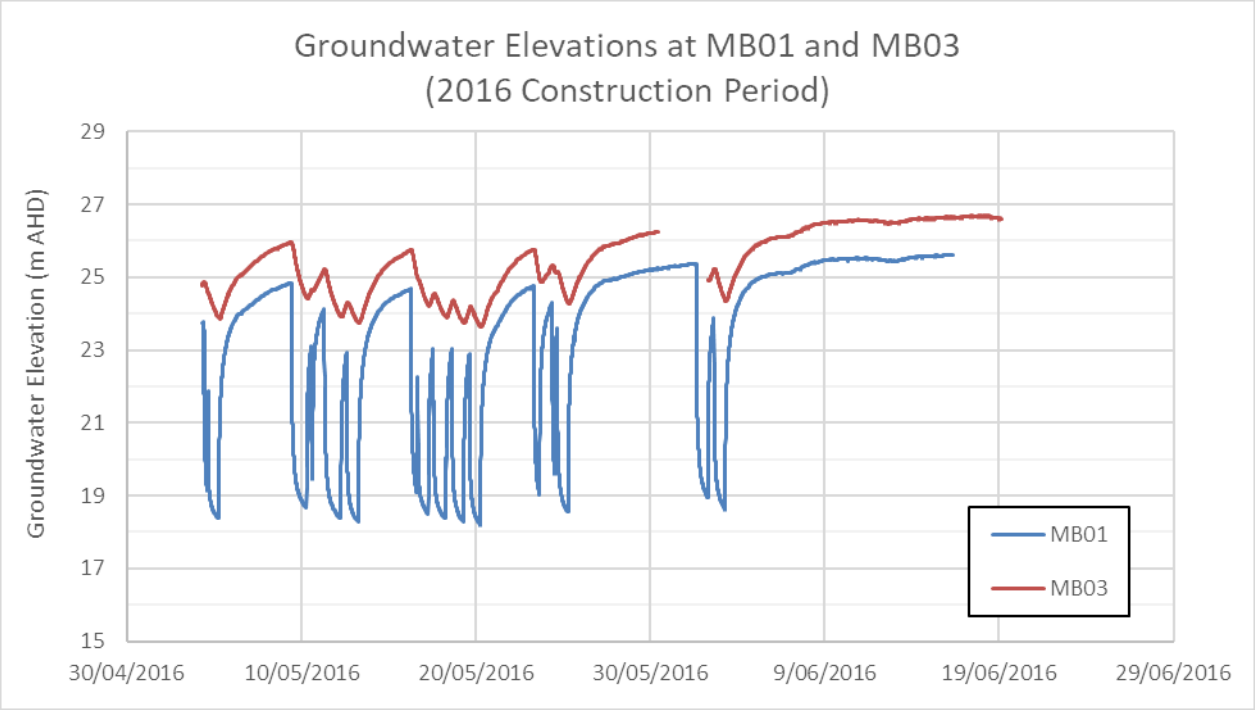

Plate 1: Groundwater elevations, MB01 and MB03, 2016 construction period

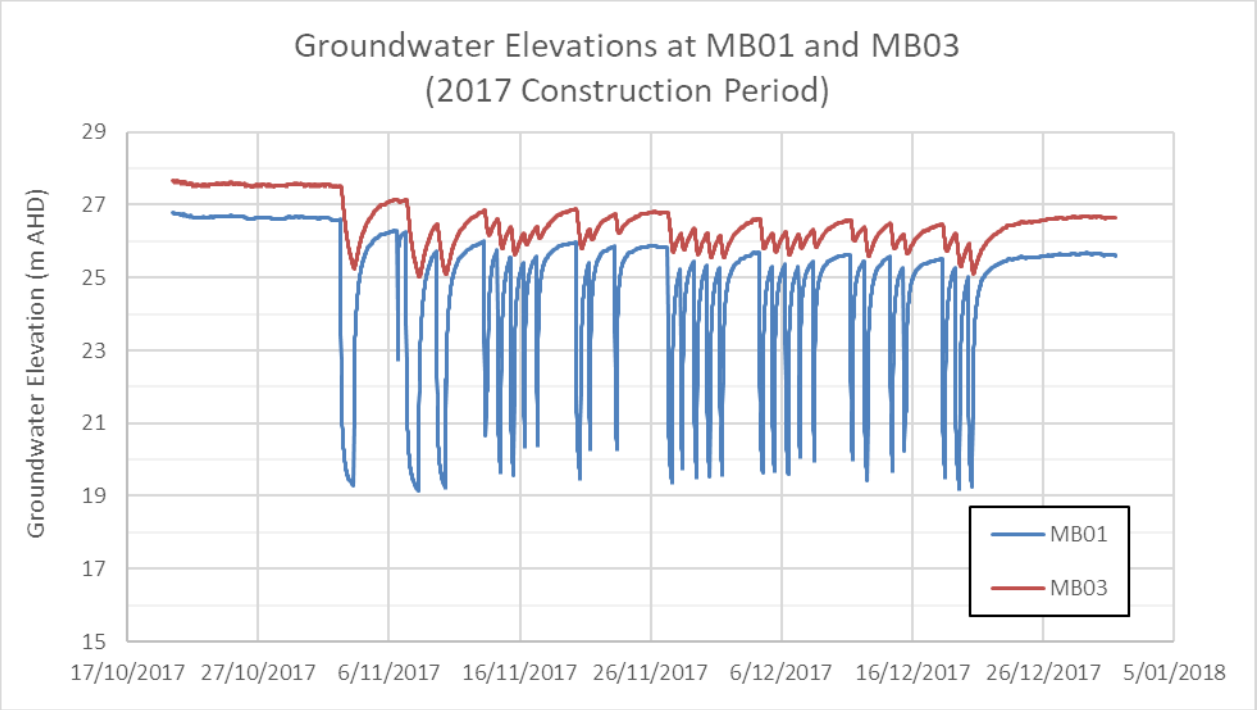

Plate 2: Groundwater elevations, MB01 and MB03, 2017 construction period

This data shows the drawdown that occurs in direct response to pumping. It demonstrates that groundwater levels within both monitoring bores, including MB03 (adjacent to the proposed wetland), consistently recover very promptly once abstraction ceased. Impacts to groundwater levels beneath the proposed wetland resulting from the abstraction of groundwater have therefore been minimised by the seasonal and daily scheduling of abstraction.

The maximum drawdown observed at MB03 was 2.63 m, which occurred on 20/05/2016. The corresponding drawdown at MB01 at this time was 7.03 m. This and other measured drawdown data have been plotted on a distance-drawdown curve to enable the magnitude of drawdown at the proposed wetland to be estimated. The resulting distance-drawdown curves are illustrated in **Plate 3**.

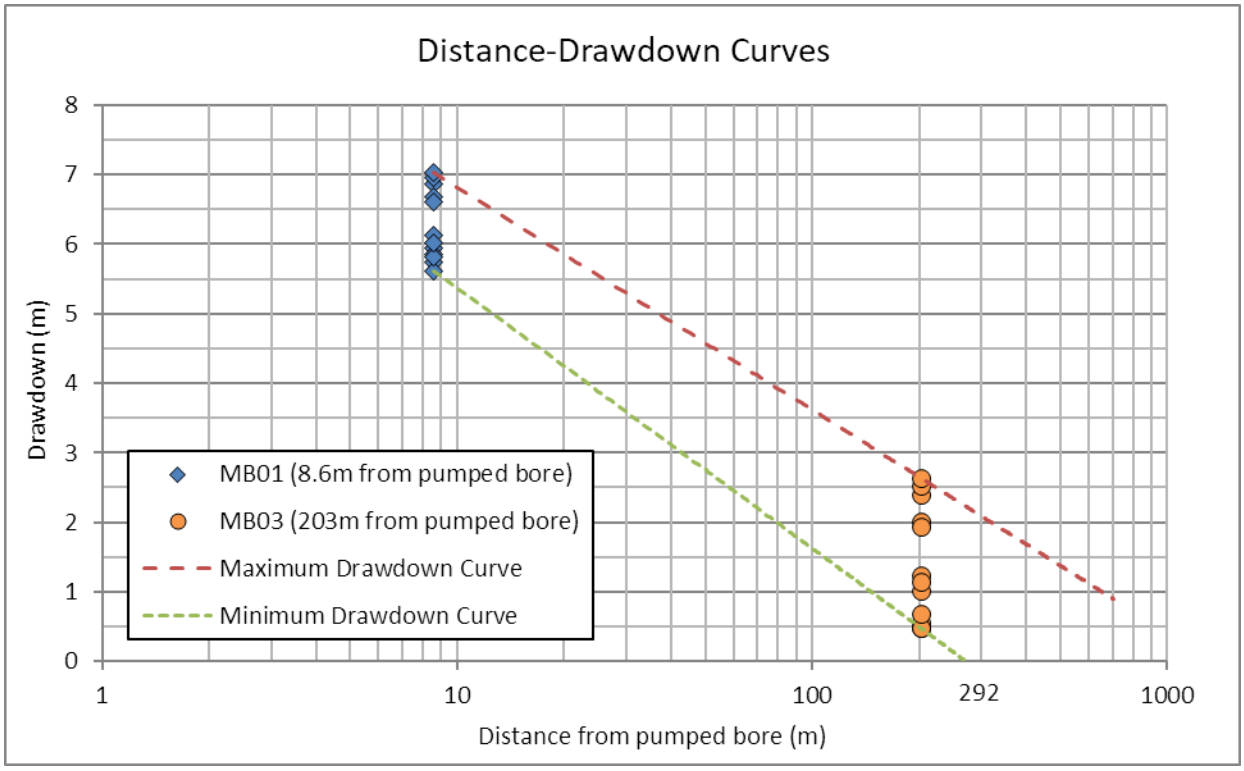

Plate 3: Distance-drawdown curves based on measured data

Based on the distance-drawdown curves shown in **Plate 3**, the estimated maximum magnitude of drawdown experienced at the northern extent of the proposed wetland (292 m away from the production bore) was 2.12 m in 2016. This magnitude of drawdown is likely to have lowered the groundwater table to below the root zones of some plant species within the proposed wetland and would therefore not be acceptable on a long term basis. However, the measured data (see **Plate 1** and **Plate 2**) demonstrates that the groundwater levels at MB01 and MB03 were able to recover to within 80% of the standing water level within 5 and 12 hours, respectively, following the cessation of pumping. This rapid recovery suggests that plants within the proposed wetland did not experience adverse impacts as a result of taking water from the production bore for temporary construction and dust suppression purposes.

Consequently, it is recommended that any future production bore be installed, operated and monitored in a manner consistent with the current production bore. When installed, the bore should be tested to assess its performance (e.g. recovery) under different flow rates and understand properties of the aquifer (e.g. distance-drawdown curve) in accordance with *Test pumping of water wells: AS 2368 - 1990*. Pumping should be restricted to construction operating hours on weekdays to enable recovery of water levels overnight. Finally, an appropriate ongoing monitoring program should be implemented to measure groundwater levels adjacent to any future production bore and the wetland (i.e. at MB03 or through installation of another monitoring bore). Results of the monitoring program should be continually assessed to determine whether a contingency action needs to be implemented due to drawdown at the wetland. Contingency actions may include:

- Modify the operation of the bore (e.g. decrease the flow rate, reduce the length of time pumping occurs, utilise a turkey nest dam etc)
- Supplementing groundwater with alternative water sources (where available)
- Decommissioning the bore and installing another bore further away from the wetland.

Based on the proposal and design approaches noted above the risk of modifying the groundwater through-flow flow component of the hydrogeological regime is considered low.

Recharge to groundwater

As detailed above, no surface water inflows into the wetland or significant outflows from the wetland are expected to occur in an average rainfall year and therefore, this will either be evaporated, be taken up by the existing vegetation (i.e. evapotranspiration) or be recharged into the underlying groundwater. No changes to evaporation, evapotranspiration or recharge are anticipated to occur across the proposed wetland area given the vegetation is being retained. Assuming 18% of annual rainfall is recharged (DoW 2009), the reduction in size of the proposed wetland will reduce the average annual volume recharged from 2,420 m^3 to 2,355 m^3 (a 2.6% reduction).

The proposal has the potential to alter recharge within the upstream groundwater recharge catchment area (see **Figures 7** and **8**) (i.e. the approximately 2.15 ha portion within Lot 102). The proposal will not change any of the broader 24.9 ha catchment. Existing vegetation within the upstream groundwater recharge catchment area (within Lot 102) are proposed to be modified into the following land uses:

- Conservation POS area
- Landscaped area
- Residential lot(s)
- Road reserve.

Existing vegetation within the conservation area (see **Figure 8**) will be appropriately managed and improved (e.g. through revegetation) (Emerge Associates 2019a) to ensure vegetation cover is maintained and infiltration continues to occur. Through this revegetation it is anticipated that vegetation density will increase from approximately low to medium and consequently that average annual recharge will decrease from 38% to 18% of annual rainfall (DoW 2009). The conservation area is 9,730 m^2 in area and therefore the annual recharge volume from this area will decrease from approximately 2,785 m^3 to 1,320 m^3 once the revegetation program has been completed and these plants are established in size.

Existing topographic contours and vegetation cover within the landscaped area (see **Figure 8**) will be maintained and therefore the infiltration capacity of the underlying soils will be maintained. The conceptual design proposes to include areas of retained vegetation, some garden bed planting and limestone paths. No turf is proposed to be utilised to avoid the leaching of fertilisers into groundwater. No significant change to recharge within the landscaped area is anticipated to occur given the measures being proposed.

Approximately 4,770 m^2 within the groundwater recharge catchment area is proposed to be developed into residential lot(s) from the low density vegetation that exists (see **Figure 8**). It is estimated that (on average) 75% of the lot will be roof with the remainder being gardens and paved areas. Given the depth of sand beneath the site, these roofs will be connected to soakwells. Approximately 85% and 35% of annual rainfall on the roof and on gardens and paved areas, respectively, will therefore be recharged (DoW 2009). Therefore, the annual recharge volume from this residential area will increase from 1,365 m^3 to 2,605 m^3 once the lots have been built and landscaped.

Approximately 1,475 m^2 within the (Lot 102) groundwater recharge catchment area is proposed to be developed into road reserve from the low density vegetation that exists (see **Figure 8**). As discussed previously, runoff from this road reserve will be conveyed towards a WSUD measure for treatment. As such, approximately 65% of annual rainfall from this portion will be recharged (DoW 2009) and on this basis the annual recharge volume from this road reserve area will increase from 420 m^3 to 720 m^3 once the road reserves and downstream WSUD measures have been built and landscaped.

In summary, recharge to groundwater from the upstream groundwater recharge area due to the proposal (i.e. development within Lot 102) is anticipated to increase from 4,570 m^3 to 4,645 m^3 (a 1.6% increase) once the proposal has been implemented. Spread across the upstream groundwater recharge catchment area within the site boundary (2.15 ha) is represents a rise of approximately 3.5 mm. This is not considered a significant impact especially as the majority of the 24.9 ha upstream groundwater recharge catchment (see **Figure 7**) could recharge in the order of 85,000 m^3 assuming an average annual recharge rate of 50% (DoW 2009)). When considering the entire groundwater recharge catchment, the potential change to recharge to groundwater would be an increase of 0.08%, and on this basis it can be concluded that groundwater recharge will not be modified by the proposal.

3.3. Abstraction of groundwater that impacts other groundwater users

The proposal will abstract groundwater for the purposes of dust suppression and civil construction, and irrigation of POS. Groundwater licencing is regulated by DWER in accordance with the *Rights in Water and Irrigation Act 1914*. DWER's assessment process ensures the proposed take and use of water is unlikely to have a detrimental effect on another person.

A temporary groundwater licence (GWL 181629) from the superficial aquifer has been secured for dust suppression and civil construction, which will not be required once civil construction has been completed across the site. Temporary (GWL 201397) and longer-term (GWL 182854) licences from the Leederville aquifer have been secured for the establishment and ongoing irrigation of POS, respectively. The proposal will comply with the statutory requirements and conditions of these licences.

Given the licensing process that has been completed in accordance with the *Rights in Water and Irrigation Act 1914* and ongoing reporting requirements, it is expected that no significant impact to other groundwater users will occur.

3.4. Impacts to water quality

Pollutants generated in urban developments include nutrients, sediments/suspended solids, metals and hydrocarbons from atmospheric deposition, wear of roads, vehicles, erosion, fertilisers, pesticides, paint, metals, plant debris etc (Engineers Australia 2006). There are two key pollutant transport pathways (Engineers Australia 2006) relevant to the proposal, being: infiltration through the sandy soil profile and conveyance within stormwater along road reserves and through the piped drainage network.

Infiltration through sandy soils will naturally filter particles such that only fine colloidal material and dissolved nutrients would reach the underlying groundwater (Engineers Australia 2006). However, a

piped drainage network can convey all pollutants towards the downstream discharge location (Engineers Australia 2006).

The wetland, described in **Sections 2.6** and **3.2**, is sustained by direct rainfall, recharge from the site, and upstream groundwater flows. The conceptual water balance summarised in the cross-section of **Appendix 6**, demonstrates that without interception, runoff generated within the site and upstream of the proposed wetland would be transported towards groundwater beneath the wetland through recharge (upstream groundwater recharge catchment shown in **Figures 7** and **8**). As discussed in **Section 2.4.1**, there is one surface water feature (i.e. Blackadder Creek) within the very north of the site. Without interception, runoff generated within the site would be transported towards the Creek by conveyance within stormwater along road reserves and through the piped drainage network. Consequently, management and mitigation measures should address the source of pollutants that could enter runoff as well as propose the use of appropriate treatment structures to intercept/manage these pollutants.

The generation of pollutants within the site will be minimised by the following design and ongoing management measures:

- Maximising the area of retained vegetation within conservation POS areas.
- Minimising road reserves within the upstream surface water catchment.
- Minimising the area of residential development within the upstream groundwater recharge catchment to the wetland.
- Information regarding fertiliser application will be provided to residents at point of sale.
- Retaining the small rainfall event within the lot at source (i.e. within soakwells and infiltration within pervious area), to minimise the conveyance on pollutants from lots.
- Treating the small rainfall event that falls on road reserves (i.e. within appropriately designed and maintained WSUD measures), to minimise the conveyance of pollutants from road resrves.
- Implementation of construction management strategies that address dust, erosion and sediment, and stormwater runoff etc.
- Where conservation POS areas may be improved by revegetation, a slow nitrogen release, low phosphorus fertiliser will be applied at time of planting and no fertiliser will be applied thereafter.
- No turf is proposed to be utilised in this area to avoid the application and subsequent leaching of fertiliser.
- Within the landscaped areas, a slow nitrogen release, low phosphorus fertiliser will applied at time of planting and no fertiliser will be applied to shrubs/trees thereafter.
- Front landscaping packages installed by the developer (as part of an opt-in landscaping bonus) require that turf areas are minimised and waterwise species utilised within garden beds in order to minimise fertiliser application within lots.

4. PROPOSED MANAGEMENT AND MITIGATION MEASURES

The mitigation hierarchy for the inland waters factor is outlined in **Table 4**.

Table 4: Mitigation hierarchy for inland waters factor

Hierarchy	Summary of management and mitigation measures
Avoid	The proposal avoids clearing of the wetland with the exception of a small area associated with the realignment of Farrall Road.
	A UWMP will be prepared in accordance with relevant environmental approvals and reviewed/approved by the CoS. It will be implemented during subdivision, construction and maintenance period. Specific measures relevant to the factor to be included in the UWMP are: • No clay grading will occur within the site to maintain the hydrogeological regime that sustains the wetland. • Bulk earthworks contours will ensure the depth of cut does not intersect/divert regional groundwater and therefore maintains the hydrogeological regime that sustains the wetland. • Existing topographic contours will be maintained within both landscaped and conservation POS areas to ensure the existing highly permeable sand profile is maintained. • The small rainfall event will be treated within lots and road reserves to maintain the hydrogeological regime that sustains the wetland and ensure pollutants generated within the site are appropriately treated. • Conveyance of minor and major event runoff (up to the 1% AEP rainfall event) from road reserves and residential lots towards the west into the existing Movida Estate drainage network to avoid runoff being directed into the proposed wetland. • Landscape designs will ensure the vegetation cover and infiltration capacity of the underlying soils is retained to maintain the hydrogeological regime that sustains the wetland.
	Groundwater production bores for the purposes of establishment or ongoing landscape irrigation will not be installed within the superficial aquifer, in accordance with the secured license approved by DWER.
Minimise	The proposal minimises the generation of pollutants towards the proposed wetland from within the site by: • Maximising the area of retained vegetation within conservation POS areas. • Minimising the area of residential development or road reserves within the upstream groundwater recharge catchment to the wetland. • Not utilising turf within the landscaped area. • Front landscaping packages require that turf areas are minimised and waterwise species utilised in order to minimise fertiliser application within lots
	Abstraction of groundwater from the superficial aquifer is temporary; it will not be required once civil construction has been completed across the site.
	A UWMP will be prepared in accordance with relevant environmental approvals and reviewed/approved by the CoS. It will be implemented during subdivision, construction and maintenance period. Specific measures relevant to the factor to be included in the UWMP are: • Retaining the small rainfall event within the lot to minimise the conveyance of pollutants from lots onto the road reserve or piped drainage network. • Stormwater runoff from the small rainfall event conveyed along the road reserve is proposed to be treated within a WSUD meausure. • Information regarding fertiliser application will be provided to residents at point of sale to minimise the generation of nutrients from residential lots towards the wetland. • The use of appropriate slow nitrogen release, low phosphorous fertilisers in minimal locations to minimise the leaching of nutrients towards the wetland. • An appropriate management and maintenance schedule to ensure the functions of WSUD measures are maintained. • Any future production bore proposed will need to be located at least 290 m from the wetland boundary to minimise any impact to the proposed wetland due to drawdown of groundwater from the superficial aquifer. • A monitoring program should measure groundwater levels adjacent to the wetland and any future production bore so that any impacts can be noted and modifications to operations made.

Table 4: Mitigation hierarchy for inland waters factor (continued)

Hierarchy	Summary of management and mitigation measures
Minimise	A Construction Environmental Management Plan (CEMP) will be prepared in accordance with relevant guidelines and reviewed/approved by the CoS. It will be implemented during construction. Specific measures to be included in the CEMP are: • Strategies that address dust, erosion and sediment, and stormwater runoff etc to minimise the generation of pollution from the residential area. • Pumping of any future production bore proposed will need to be restricted to construction operating hours on weekdays to enable recovery of water levels overnight. • Pump testing of the production bore and monitoring of levels at associated monitoring bores will be completed to provide site specific advice regarding the pumping regime. • A monitoring program consistent with that documented in the UWMP to measure groundwater levels adjacent to the wetland and any future production bore so that any impacts can be noted and modifications to operations made.
	The statutory requirements and conditions of the secured temporary dust suppression license (as approved by DWER) will be complied with.
Rehabilitate	Existing vegetation will be appropriately managed and improved (e.g. through revegetation) to ensure vegetation cover is maintained and infiltration continues to occur, which sustains the hydrogeological regime associated with the wetland. This revegetation will be completed in accordance with a Rehabilitation and Vegetation Management Plan (RVMP) (Emerge Associates 2019a).
Offset	As no residual impacts are expected, no offset is proposed for this factor.

5. RESIDUAL IMPACTS

This technical memorandum has outlined the receiving environment associated with the proposal and specifically in relation to inlands waters environmental factor and clarified and assessed potential environmental impacts against the management and mitigation measures to be implemented. The proponent predicts that implementation of the management and mitigation measures outlined above (managed through the RVMP, future UWMP(s) and future CEMP(s) will result in no significant impact to the environment, and therefore believe the EPA's objective will be met.

FIGURES

Figure 1: Site Location
Figure 2: Landform and Topographic Contours
Figure 3: Geology
Figure 4: Surface Water
Figure 5: Groundwater
Figure 6: Geomorphic Wetlands, Bush Forever and Proposed Wetland Extent
Figure 7: Conceptual Water Balance - Existing Environment
Figure 8: Conceptual Water Balance - Proposal

APPENDICES

Appendix 1: Report on Geotechnical and Preliminary Acid Sulphate Soil Investigation, Proposed Residential Development Lots 50, 102 and 427 Farrall Road, Midvale, WA (Douglas Partners 2014).
Appendix 2: Letter on Geotechnical Investigation, Movida 'Wet Area' Investigation, Farrall Road, Midvale, WA (Douglas Partners 2016).

Appendix 3: Lithological Assessment of Drilling Samples at Farrall Road, Midvale (Western Irrigation Pty Ltd 2016).
Appendix 4: Surface and Groundwater Quality Monitoring Results (GHD 2010; Emerge Associates 2016).
Appendix 5: Groundwater Level Hydrographs (GHD 2010).
Appendix 6: Indicative Cross-Section – Existing Environment and Proposal.
Appendix 7: Conceptual Water Balance Box Model.

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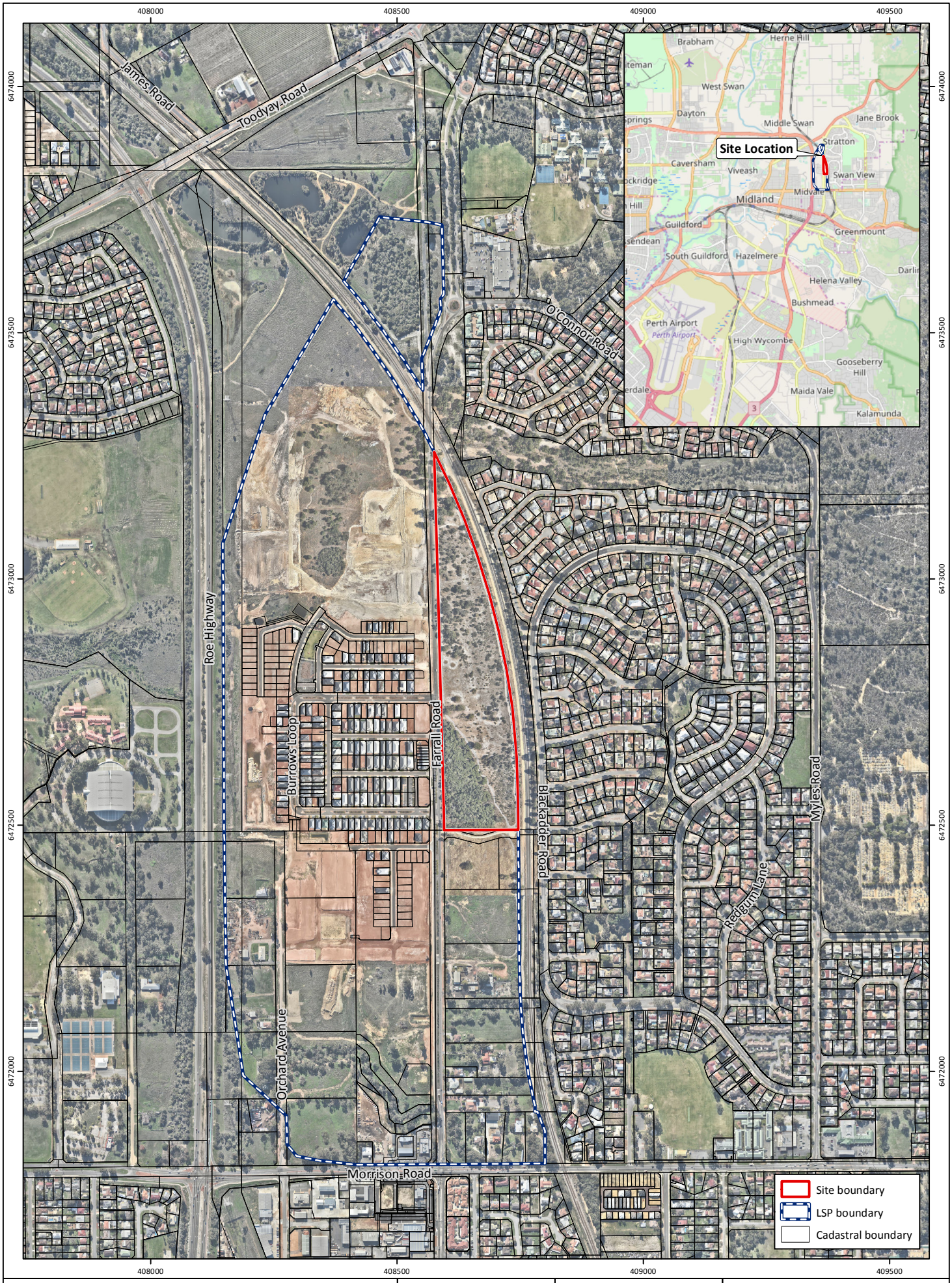

Figure 1: Site Location

Project: Environmental Factor: Inland Waters
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F101

Drawn:	KNM
Date:	22/02/2019
Checked:	ASC
Approved:	DPC
Date:	03/05/2019

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Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

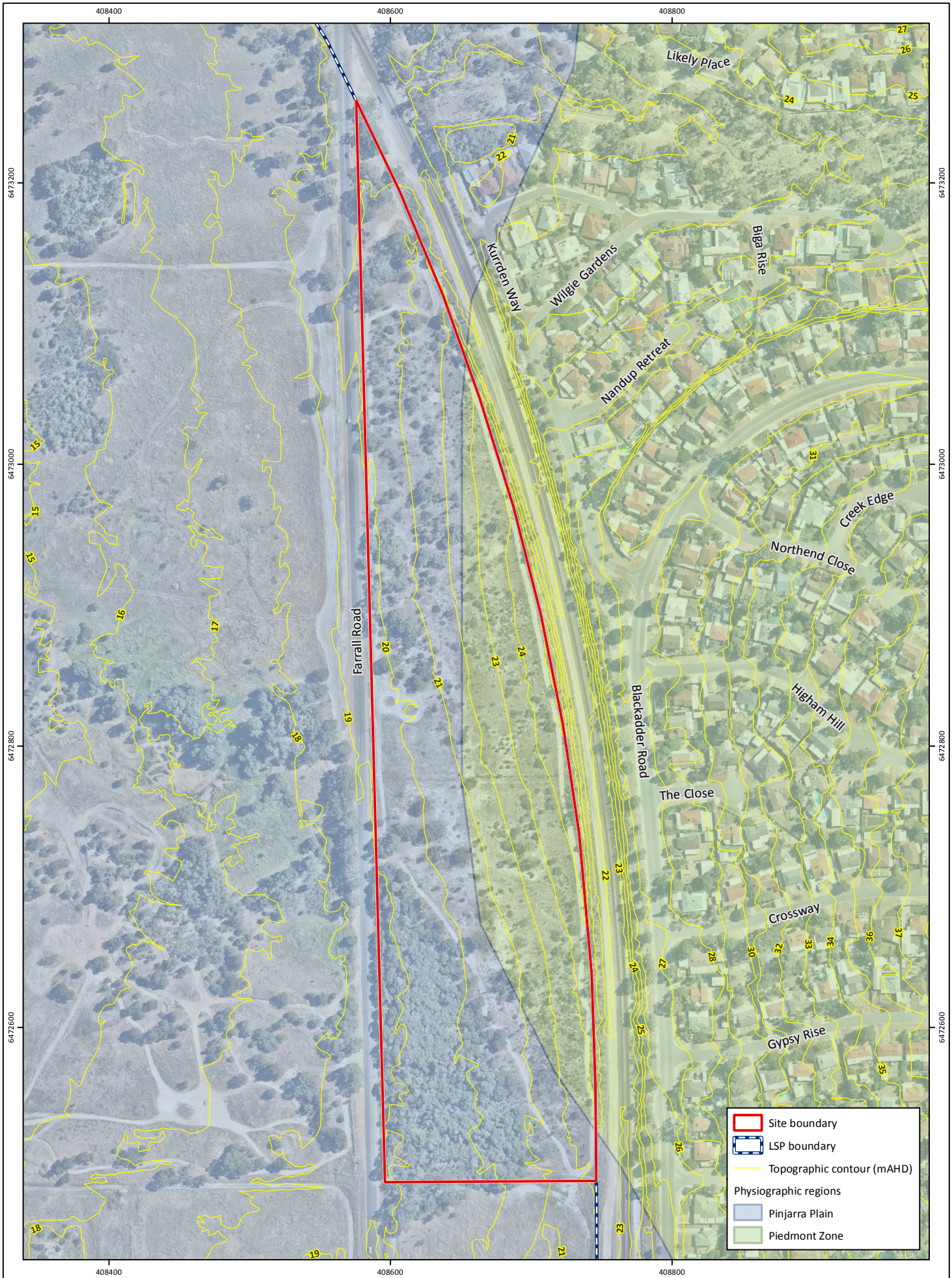

Figure 2: **Landform and Topographic Contours**

Project:	Environmental Factor: Inland Waters Lot 102 Farrall Road, Midvale
Client:	Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F102

Drawn:	KNM
Date:	22/02/2019
Checked:	ASC
Approved:	DPC
Date:	03/05/2019

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Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

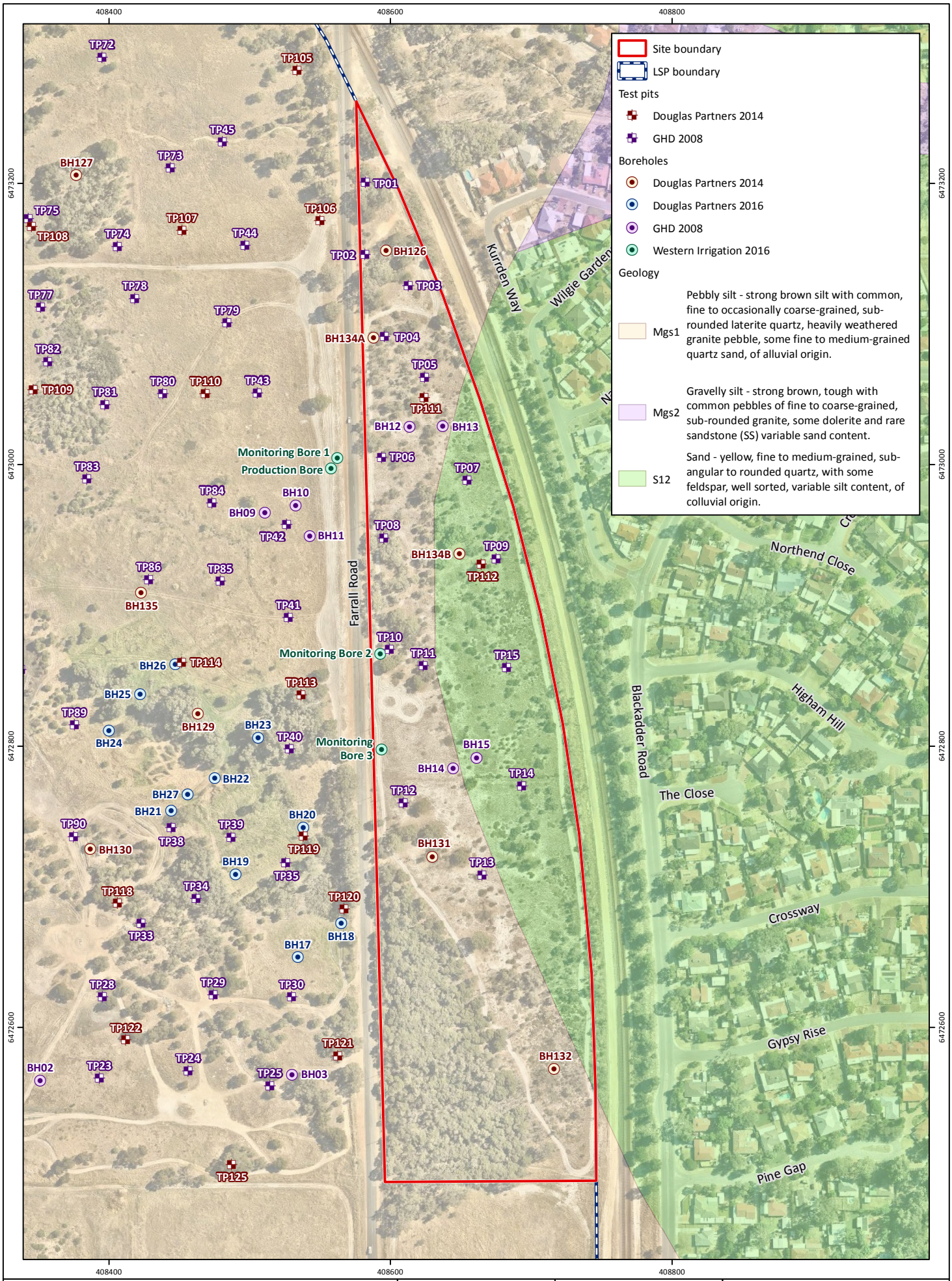

Figure 3: **Geology**

Project: Environmental Factor: Inland Waters
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F103

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Date:	22/02/2019
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Approved:	DPC
Date:	03/05/2019

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

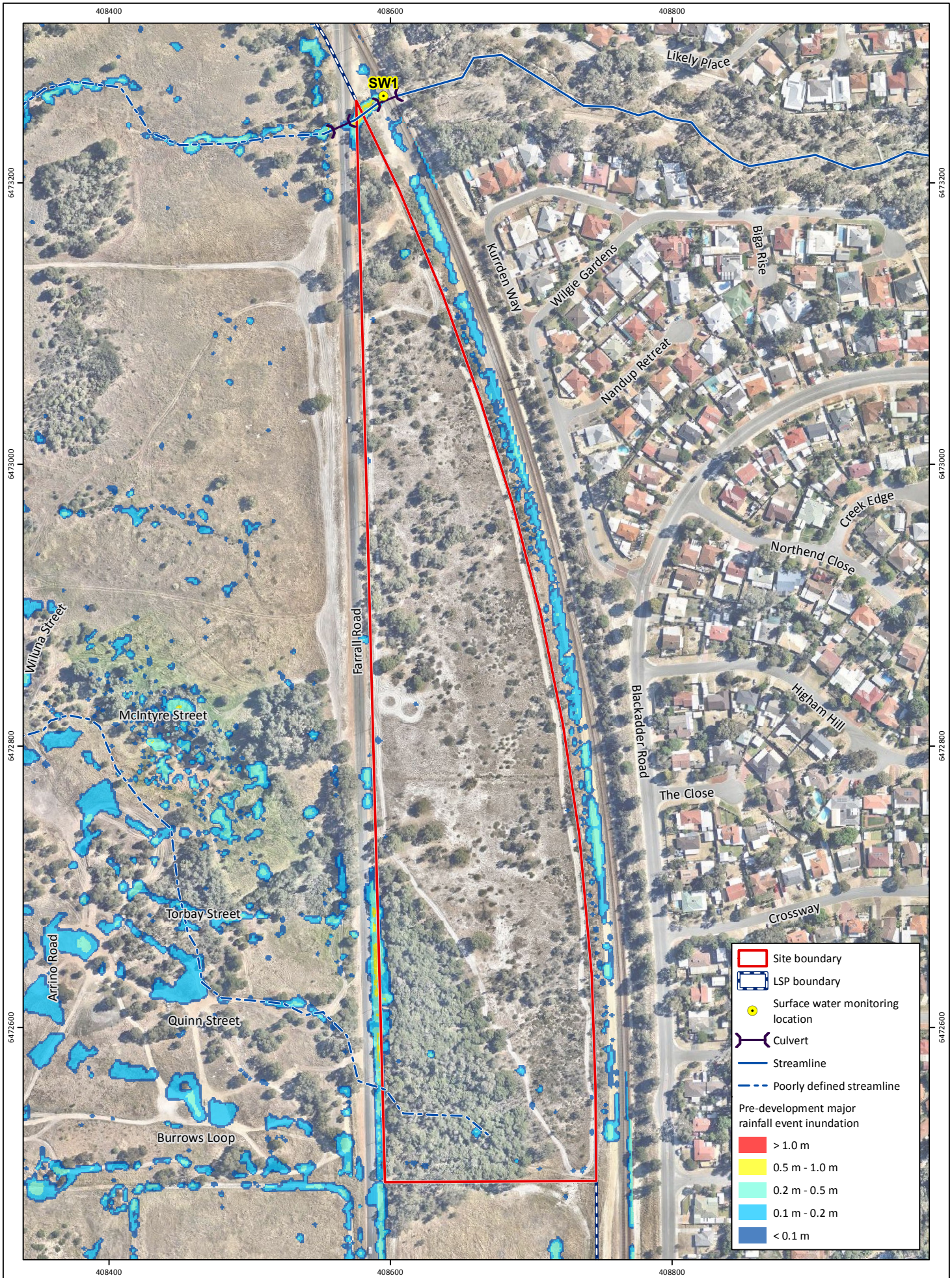

Figure 4: Surface Water

Project:	Environmental Factor: Inland Waters Lot 102 Farrall Road, Midvale
Client:	Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F104

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Date:	22/02/2019
Checked:	ASC
Approved:	DPC
Date:	03/05/2019

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

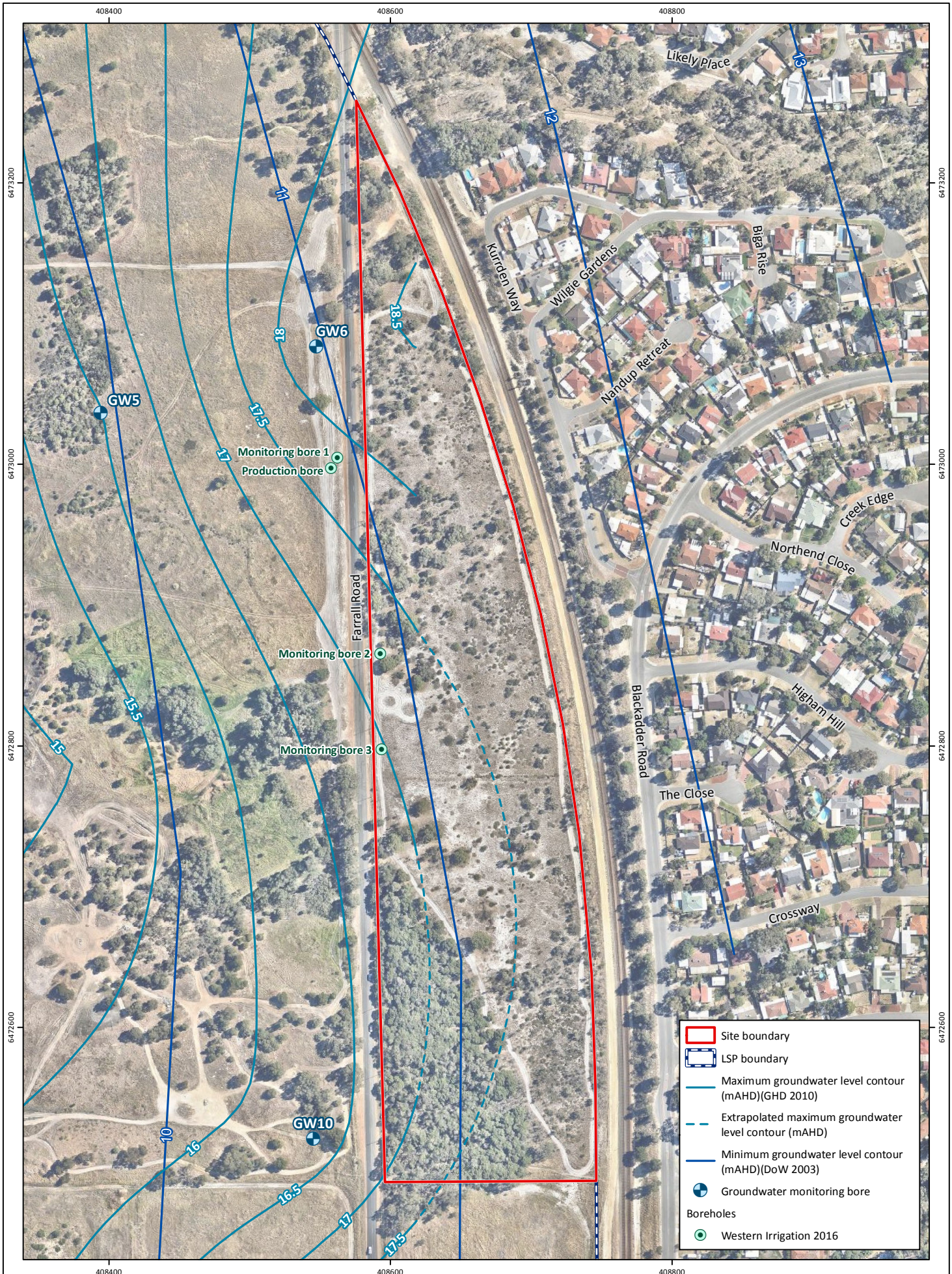

Figure 5: Groundwater

Project: Environmental Factor: Inland Waters
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F105

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Checked:	ASC
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GDA 1994 MGA Zone 50

emerge ASSOCIATES

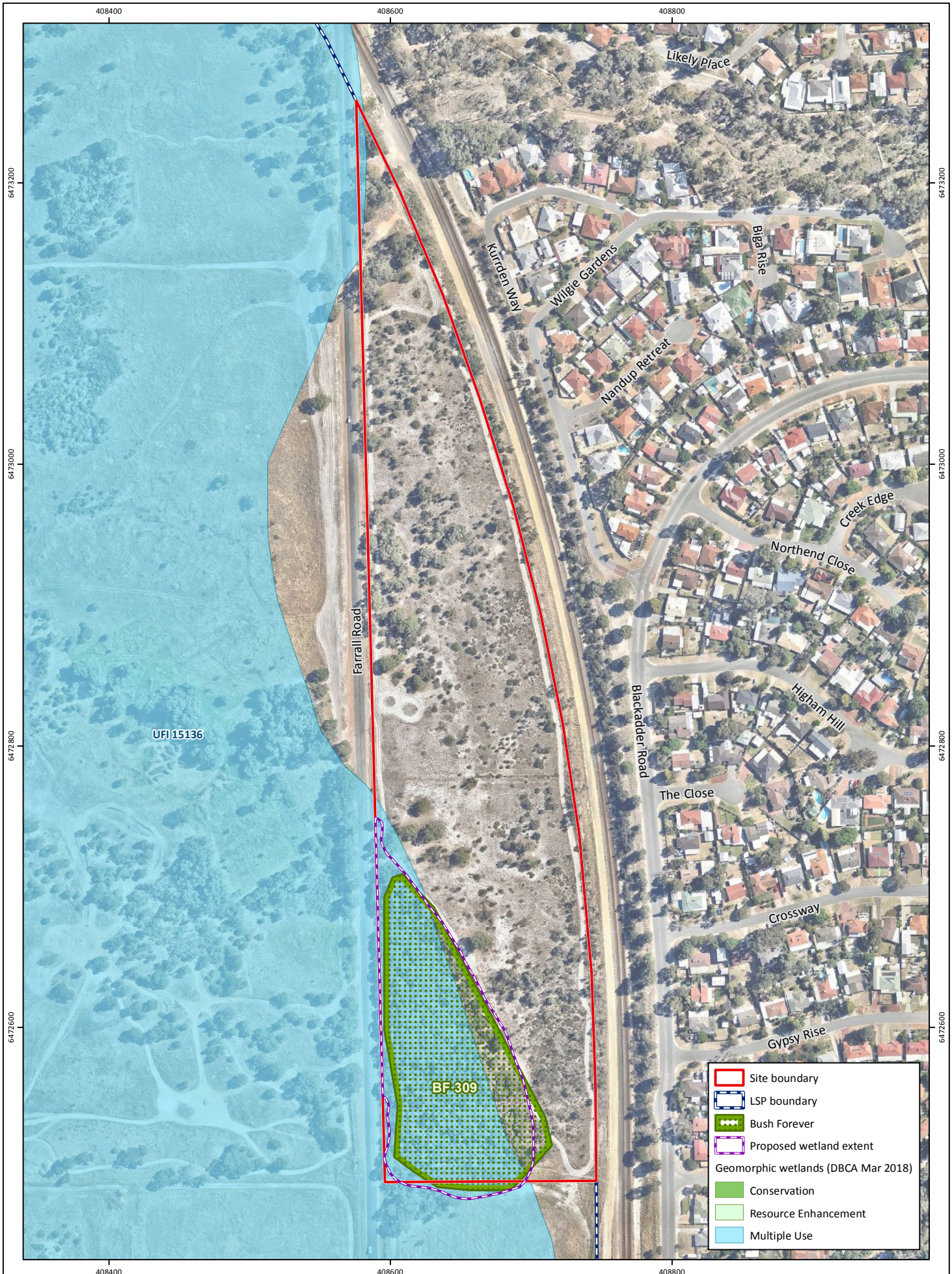

Figure 6: **Geomorphic Wetlands, Bush Forever and Proposed Wetland Extent**

Project: Environmental Factor: Inland Waters
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F106

Drawn:	KNM
Date:	22/02/2019
Checked:	ASC
Approved:	DPC
Date:	03/05/2019

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

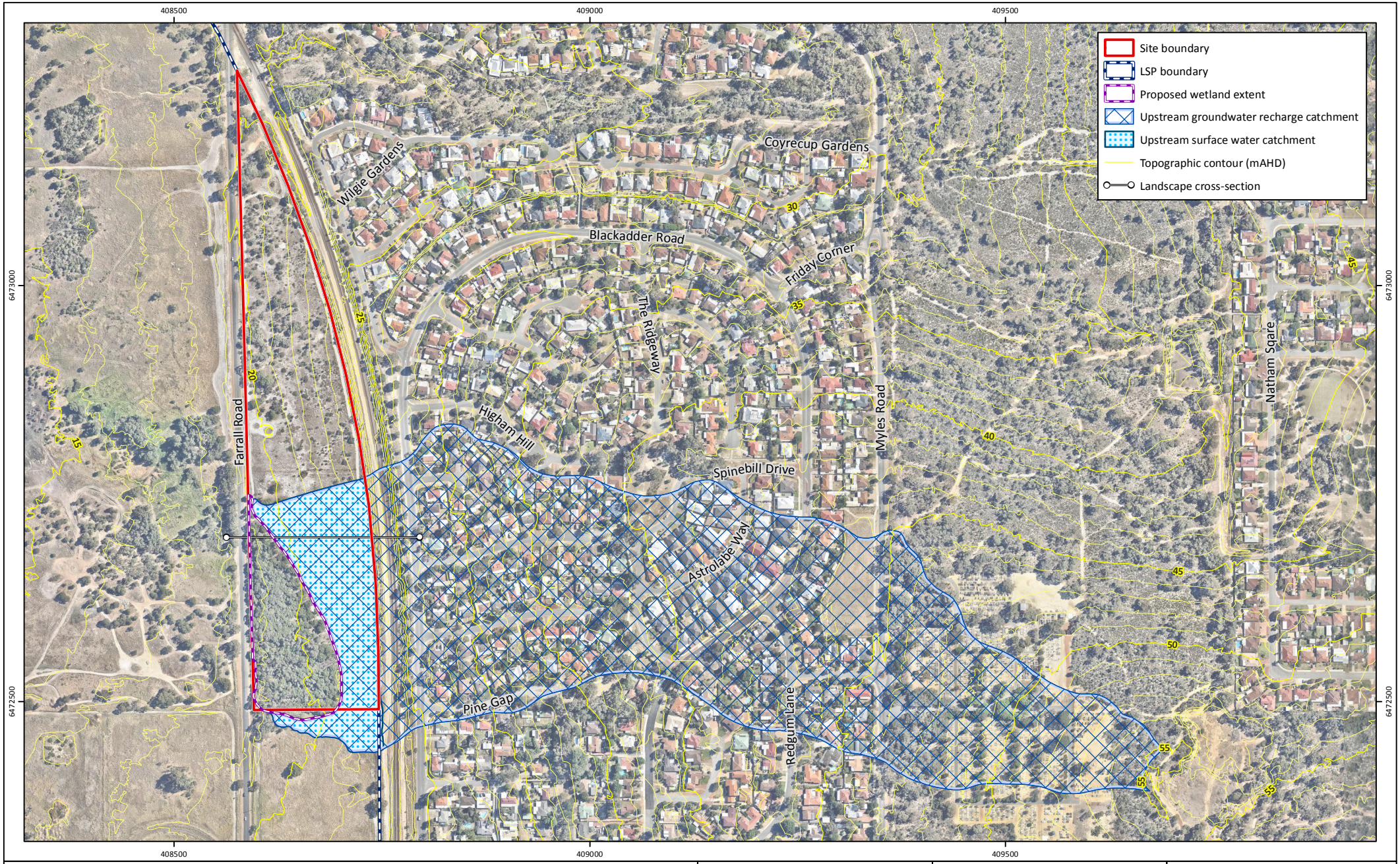

Figure 7: **Conceptual Water Balance - Existing Environment**

Project: Environmental Factor: Inland Waters
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F121

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Date:	04/04/2019
Checked:	ASC
Approved:	DPC
Date:	03/05/2019

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Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

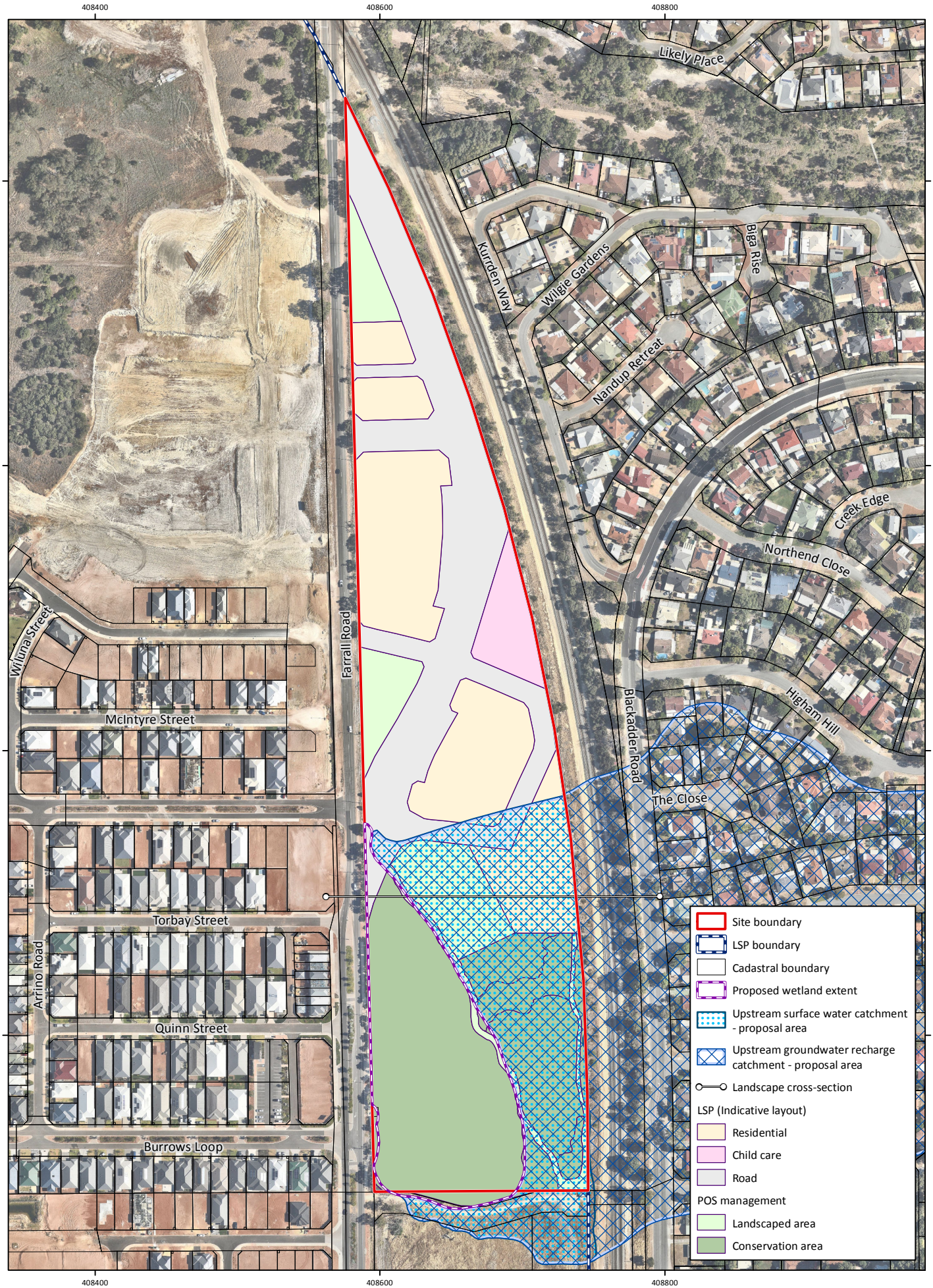

Figure 8: Conceptual Water Balance - Proposal

Project: Environmental Factor: Inland Waters
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F124

Drawn:	KNM
Date:	15/04/2019
Checked:	ASC
Approved:	DPC
Date:	03/05/2019

N

0 40 80
Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix 1

Geotechnical Report (Douglas Partners 2014)

Douglas Partners
Geotechnics | Environment | Groundwater

Integrated Practical Solutions

Report on Geotechnical and Preliminary Acid Sulphate Soil Investigation

Proposed Residential Development
Lots 50, 102 and 427 Farrall Road
Midvale, WA

Prepared for
Peet Stratton Pty Ltd

Project 82334
September 2014

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	82334	Document No.	1
Document title	Report on Geotechnical and Preliminary Acid Sulphate Soil Investigation		
Site address	Lots 50, 102 and Part Lot 427 Farrall Road, Midvale, WA		
Report prepared for	Peet Stratton Pty Ltd		
File name	P:\82334 Midvale, Farrall Road\Docs\82334 - DP Geotechnical Report - Farrall Rd, Midvale.docm		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
1	J.Khandwalla / D.Jagoe-Banks	F.Verheyde	01 October 2014

Distribution of copies

Revision	Electronic	Paper	Issued to
1	1	1	Mr. Paul Abel, Peet Stratton Pty Ltd
1	1		Mr Peter Bowyer, The Civil Group

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	pp. F. Verheyde	1 October 2014
Reviewer	F. Verheyde	1 October 2014

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Report on Geotechnical and Preliminary Acid Sulphate Soil Investigation
Proposed Residential Development
Lots 50, 102 and 427 Farrall Road, Midvale, WA

1. Introduction

This report presents the results of a geotechnical and preliminary acid sulphate soil (ASS) investigation undertaken by Douglas Partners Pty Ltd (DP) across the proposed residential subdivision development within Lots 50, 102 and Part Lot 427 Farrall Road, Midvale, WA. This work was commissioned in a purchase order dated 13 August 2014, from Mr. Paul Abel of Peet Stratton Pty Ltd, and was undertaken in accordance with Douglas Partners' proposal dated 10 July 2014.

The site has been subject to a previous geotechnical investigation reported in GHD (2008). The GHD report covers Lots 50, 102 and Part Lot 427 Farrall Road, however it was undertaken prior to AS 2870/2011 and as such, does not comply with the requirements of the most recent version of the standard. Due to the existing information from GHD (2008), the frequency of testing by Douglas Partners was minimized to a level that was considered suitable to provide a suitable amount of laboratory testing results to assess the site in accordance with AS 2870/2011 and verify the findings of the previous investigation.

In accordance with the brief included in Peet Stratton's letter request, the purpose of Phase 1 was to assess the sub/surface conditions beneath the site and thus provide comments on:

- The suitability of the site for the proposed development.
- A description of the sub/soil conditions.
- Site classification in accordance with the requirements of AS 2870/2011 and earthworks requirements to achieve Class S and Class A, where required.
- Site preparation and earthworks requirements, likely excavation conditions, recommended batter slopes and suitable materials for structural filling.
- Suitable foundation system(s) including assessment of allowable bearing pressures and likely in/ service settlements.
- Recommended pavement design parameters including California bearing ratios.
- Earth pressure coefficients for retaining wall design assuming the use of on/site soils and granular backfill.
- The suitability of the proposed drainage system and identification of areas where infiltration systems may be feasible.
- Possible quarry sites or sources in the district for suitable fill material for the proposed development.
- Assess the risk of acid sulphate soils at the site based upon review of readily available desktop information and limited sampling and analysis.

The investigation included the excavation of 25 test pits, 10 in/situ permeability tests, dynamic penetrometer testing adjacent to test pits and boreholes and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the issues listed above.

2. Review of Previous Investigations

As mentioned in Section 1, a previous third party report by GHD titled "Reports for Various Lots in West Stratton, Geotechnical investigation, January 2008" was available to DP during the investigation. Logs of the ground conditions and laboratory results from this report are included in Appendix E.

Additionally, a report by MPA Williams titled "Geotechnical Investigation, Midvale Property Development, Midvale, Western Australia, report 105403.01R01, December 2005" presents the results of a geotechnical investigation for an area immediately south of the site and was available for review. This report included some information on ground conditions to the south of the site.

The ground conditions described in GHD (2008) include "*topsoil followed by fine to medium grained quartz sand of the Yoganup formation to between 2.2 and 3.0 m depth*" for the area east of Farrall Road. The ground conditions to the west of Farrall Road are described as "*variable sands and clays, with some laterite*". A review of the test pit logs indicates that the majority of the cohesive materials encountered in the western portion of the site is defined as "sandy clay".

The MPA Williams report covers an area of land bounded by Farrall Road to the east and Roe Highway to the west from the southern boundary of the subject site to a southern boundary approximately 500 m to the south. MPA Williams reported that the ground conditions generally included "*silty sand overlying clayey sand*" in the majority of the site with alluvial materials along a water course and sand likely to be associated with the Yoganup Formation in the north/eastern corner of their investigation area.

Results included in the abovementioned reports which cover an area greater than the subject site corroborate the geology shown on the published mapping.

3. Site Description

The site comprises Lot 50, Lot 102 and part Lot 427 in Midvale, WA.

Lot 50 and Lot 427, which are west of Farrall Road have a combined area of approximately 38 ha. Lot 50 is bound by Farrall Road to the east and by Lot 427 on all other sides, which in turn is bound by Farrall Road to the east, railway tracks to the north, Roe Highway to the west and rural properties to the south. Lot 102 is bound by a railway to the north and east, Farrall Road to the west, and rural properties to the south. For clarity, Lots 50 and 427 would henceforth be referred to as the 'west section of the site', and Lot 102 as the 'east section of the site'. Refer to Drawing 1 in Appendix A.

At the time of the investigation, the site was vacant. The west section of the site generally consisted of tall grass scattered with bushes and groups of trees of up to approximately 20 m (estimated) tall. Fly tipped refuse including metal sheets, wooden crates and household furniture were observed towards the southern area of this section. An open drainage channel, approximately 1 m wide, was also observed to run from near the intersection of Farrall Road and the railway to the drainage culvert under Roe Highway. Vehicle tracks were observed across the western section of the site, particularly towards the southern end.

At the time of the investigation, surface water was observed ponding over relatively large areas, generally towards the southern part of the site. The areas where DP personnel observed surface water are indicated on Drawing 1 in Appendix A. It should be noted that the areas noted on Drawing 1 were observed near DP's areas of work and poor traficability conditions precluded a systematic survey of surface water across the entire site.

The east section of the site generally consisted of short to medium length grass, interspersed with some group of bushes. Groups of trees were observed, generally towards Farrall Road, and were estimated to be up to approximately 15 m in height. Some fly tipped refuse, including wooden crates and plastic pipes, was observed towards the northern area of this section.

Survey information provided by The Civil Group indicates that the surface levels generally fall from RL 24 m relative to Australian Height Datum (AHD) on the eastern boundary of Lot 102 (near the railway) to RL 14 m AHD on the western boundary of Lot 427 (near Roe Highway). Ground surface contours are shown in Drawing 1 in Appendix A.

The published Perth 1:50 000 Environmental Geology sheet and DP's experience indicate that the site is predominantly underlain by pebbly silt from the Guildford Formation with an area in the eastern part of the site identified as sand from the Yoganup Formation.

The Perth Groundwater Atlas (2004) indicates that the groundwater level ranged from approximately RL 11 m AHD in the east to RL 9 m AHD in the west in May 2003, i.e. approximately 5 m below the lowest level of the site. Review of the 2007 GHD Local Water Management Strategy (LWMS) however, indicates the average annual maximum groundwater levels (AAMGL) at the site range from 21 m AHD in the south east to 14 m AHD in the central western area where ponding occurs.

Published acid sulphate soil (ASS) risk mapping indicates that most of the site is mapped as "no known risk of acid sulphate soils occurring within 3 m of natural soil surface". The Yoganup formation deposit in the eastern part of the site is mapped as "low to moderate risk of acid sulphate soils occurring within 3 m of natural soil surface".

4. Field Work Methods

Field work was carried out between 25 and 27 August 2014 and comprised:

- The excavation of 25 test pits (TP101 to TP125).
- The drilling of 11 boreholes (BH126 to BH135, BH134A and BH134B).
- The performance of ten in/situ permeability tests within each of the boreholes BH126 to BH135, with the exception of BH134A.

The test pits were excavated to a maximum depth of 3.0 m using a 5 tonne excavator equipped with a 600 mm toothed bucket. The test pits were logged in general accordance with AS 1726–1993 by a suitably experienced geotechnical engineer from DP. Soil samples were recovered from selected locations for subsequent laboratory testing.

Soil samples were also collected at 0.5 m depth intervals from ten test pits for laboratory analysis of acid sulphate soils. The locations of these test pits were selected by an environmental scientist from DP. These soil samples were quickly placed in air tight sample bags and chilled in insulated coolers. The following sample handling and transport procedures were employed:

- Snap lock bags were labelled with individual and unique identification, including project number and sample number.
- Samples were placed in insulated coolers during field work and subsequently frozen until transported to the analytical laboratory.
- Chain/of/custody documentation was maintained at all times and countersigned by the receiving laboratory on transfer of samples.
- A National Association of Testing Authorities (NATA) accredited laboratory was engaged to conduct the analysis.

Perth sand penetrometer (PSP) and dynamic cone penetrometer tests were carried out adjacent to the test pits in accordance with AS 1289.6.3.3 and AS 1289.6.3.2 respectively, to assess the in situ density/consistency of the shallow soils.

Permeability tests were carried using the falling head method generally within the shallow sandy soils at 0.45 m depth, with the exception of BH129 which was carried out at 0.85 m depth and BH134B at 1.96 m depth.

Test locations were recorded using a hand held DGPS, and are shown on Drawing 1 (Appendix A). Surface elevations at each test location were interpolated from a survey plan provided by The Civil Group and are quoted in metres above Australian Height Datum (m AHD) on the test pit logs (Appendix B).

5. Field Work Results

5.1 Ground Conditions

Detailed logs of the ground conditions and results of the field testing are given in Appendix B, together with notes defining descriptive terms and classification methods.

The shallow ground conditions were generally consistent within the western section of the site, and included sandy soils overlying clayey sands with variable gravel content. The eastern section of the site generally consisted of sand to test pit and borehole termination depths.

Three primary zones have been designated following the assessment of the ground conditions from DP's results in conjunction with DP's interpretation of the factual data included in GHD's report. The ground conditions encountered in each zone are summarised below;

Zone A:	Sand from the surface to the test termination depths
Zone A1:	Sand from the surface to approximately 2 m depth underlain by reactive materials.
Zone B:	Sand of various thicknesses overlying cohesive material with variable gravel content.
Zone C:	Thin layers of sand and cohesive material overlying cemented materials at depths typically less than 1 m.

The following sections provide further detail of the ground conditions encountered at DP's test locations and include comment on the consistency of these results with the data available from GHD (2008).

5.1.1 Eastern Section – Lot 102 Farrall Road (Zones A and A1)

This section of the site comprises Zone A and Zone A1 (refer to Drawing 2, Appendix A). The shallow ground conditions which characterise the zones are as follows:

Zone A

- **Topsoil –** brown mottled grey sandy topsoil with some silt and rootlets, generally to a depth up to 0.1 m.
- **Sand –** medium dense, light brown to orange/brown, sand with traces of silt, underlying the topsoil and extending to test pit and borehole termination depths of up to 2.2 m (DP investigation) and 3.2 m (GHD investigation).

Zone A1

- **Topsoil –** light grey/brown to dark brown, sandy topsoil with some silt and rootlets, generally to a depth of up to 0.1 m, with the exception of BH126 where no topsoil was encountered.
- **Filling -** The following uncontrolled filling was encountered within Zone A1:
    - brown mottled red/brown, sand filling, with some clay and trace of gravel and rootlets at BH126 from surface to a depth of 0.1 m. This filling is considered to be localised and not a characteristic of Zone A1.

- Sand filling with some building rubbles underlying the topsoil to a depth of 1.2 m, is indicated in GHD (2008).

- **Sand –** medium dense, light brown to orange/brown sand with traces of silt, underlying the topsoil and filling and extending to test pit and borehole termination depths of between 0.6 m to 2.2 m.
- **Slightly Gravelly Clayey Sand –** light yellow/brown, medium plasticity slightly gravelly clayey sand, at BH134A underlying the sand to a borehole termination depth of 2.5 m. Laterite is described in GHD (2008) at a depth of 2.2 m at TP03.

The ground conditions encountered in Zone A1 indicate that the sandy Yoganup Formation to the east overlaps the Guildford formation to the west. It is possible that similar conditions exist along the western edge of Zone A as a boundary between Zones A and B.

5.1.2 Western Section - Lots 50 and 427 Farrall Road (Zones A, B and C)

This section of the site comprises Zone A, B and C (refer to Drawing 2, Appendix A). The shallow ground conditions across the western section of the site generally comprised the following:

Zone A

As per the description in Section 5.1.1 above.

Zone B

- **Topsoil –** dark brown and dark grey sand and silty sandy topsoil with some rootlets and traces of clay, generally to a depth of between 0.09 m and 0.25 m, with the exception of BH129 where the topsoil extended to 0.4 m depth.
- **Sand –** loose to dense, light grey/brown to yellow/brown sand with traces of silt, and some gravel and clay at greater depths underlying the topsoil and extending to depths of between 0.2 m to 1.9 m at Test Locations 101 to 135, with the exception of TP117 where no sand was encountered. GHD (2008) indicate that the sand layer was encountered to depths of between 0.3 m and 1.7 m at TP1 to TP95 during the 2008 investigation. Loose material was encountered at several locations, up to a depth of 1 m, during DP's and GHD's investigations.
- **Clayey Sand –** firm to hard, brown, yellow/brown, orange/brown mottled red/brown, grey and grey/green, low to medium plasticity clayey sand, with some gravel at some test pits from 0.1 m to test pit termination depths of 3.0 m. Slow digging rates and refusal was observed within this material at some test locations.

  The material is described as "Sandy Clay" and "Clayey Sand" in GHD (2008).
- **Sandy Clayey Gravelly Materials, locally cemented:**
  - Gravelly Sand – yellow/brown, gravelly sand underlying and overlying clayey sand at TP102 between depths of 1.4 m and 1.9 m depths.
  - Gravelly Clayey Sand and Clayey Sandy Gravel – yellow/brown to red/brown, mottled light grey, gravelly clayey sand and clayey sandy gravel, low to medium plasticity underlying sand and clayey sand at test locations TP104 to TP109 from depths of 1.4 m to 2.4 m to depths of between 2.3 m and test pit termination depths.

This material appears to be described as “Laterite”, “Laterite Gravel with Sand” and “Laterite Gravel with Sand and Silt” in GHD (2008).

- Iron Cemented Sand – strongly cemented, medium to high strength, red/brown mottled purple cemented sand was observed at test location TP104 from a depth of 2.3 m to a termination depth of 2.7 m (excavator refusal).

  This material is described as “Laterite” in GHD (2008).

Zone C

- **Topsoil –** dark brown and dark grey sand and silty sandy topsoil with some rootlets and traces of clay, generally to a depth of between 0.09 m and 0.25 m, with the exception of BH129 where the topsoil extended to 0.4 m depth.
- **Sand and Clayey Sand –** loose and stiff, brown and grey/brown, sand and clayey sand underlying the topsoil at all test locations.
- **Cemented Sand –** strongly cemented, medium to high strength, light yellow/brown sand with some silt underlying the sand and clayey sand from depths of 0.2 m to 0.6 m to test pit termination depths. Slow digging rates and refusal was experienced within this material.

5.2 Groundwater

Groundwater was observed at several test locations between 25 and 27 August 2014. The depth of groundwater is shown on the test pit and borehole logs in Appendix B. All test pits and boreholes were immediately backfilled following sampling, which precluded longer/term monitoring of groundwater levels. A summary of groundwater levels observed during the field investigation is presented in Table 1.

Table 1: Summary of Groundwater Levels on 25 to 27 August 2014

Test Location	Interpolated Surface Level [1] (m AHD)	Groundwater Depth (m)	Groundwater Level [2] (m AHD)	Date
TP101	16.25	0.80	15.45	25/08/2014
TP102	15.75	0.40	15.35	25/08/2014
TP103	17.05	0.35	16.70	25/08/2014
TP104	18.05	1.30	16.75	25/08/2014
TP105	19.00	2.00	17.00	25/08/2014
TP106	19.45	1.80	17.65	25/08/2014
TP107	17.50	0.60	16.90	25/08/2014
TP108	16.00	0.70	15.30	25/08/2014
TP109	15.25	0.35	14.90	25/08/2014
TP110	17.05	0.90	16.15	25/08/2014

Test Location	Interpolated Surface Level [1] (m AHD)	Groundwater Depth (m)	Groundwater Level [2] (m AHD)	Date
TP111	21.55	>2.10	<19.45	25/08/2014
TP112	22.80	>2.20	<20.60	25/08/2014
TP113	18.20	1.50	16.70	26/08/2014
TP114	16.75	1.20	15.55	26/08/2014
TP115	14.50	0.20	14.30	26/08/2014
TP116	13.90	>0.90	<13.00	26/08/2014
TP117	14.50	>0.70	<13.80	26/08/2014
TP118	15.75	0.80	14.95	26/08/2014
TP119	17.90	0.80	17.10	26/08/2014
TP120	17.95	1.50	16.45	26/08/2014
TP121	18.15	1.10	17.05	26/08/2014
TP122	16.25	>1.80	<14.45	26/08/2014
TP123	14.00	0.50	13.50	26/08/2014
TP124	15.80	0.60	15.20	26/08/2014
TP125	17.50	0.90	16.60	26/08/2014
BH126	20.60	>0.60	<20.00	27/08/2014
BH127	16.60	0.40	16.20	27/08/2014
BH128	15.25	0.30	14.95	27/08/2014
BH129	16.85	0.50	16.35	27/08/2014
BH130	15.40	0.45	14.95	27/08/2014
BH131	20.05	>0.60	<19.45	27/08/2014
BH132	21.65	>0.70	<20.95	27/08/2014
BH133	14.50	0.30	14.20	27/08/2014
BH134A	20.40	>2.50	<17.90	27/08/2014
BH134B	22.35	>2.10	<20.25	27/08/2014
BH135	16.25	0.35	15.90	27/08/2014

Notes: [1]: Surface level interpolated from contour plan provided by The Civil Group.
[2]: Groundwater Level = Interpolated Surface Level – Groundwater Depth.

The field work was undertaken in September, which is the time of year when groundwater levels are expected to be near their maximum seasonal levels.

It should be noted that groundwater levels are affected by climatic conditions and soil permeability, and will therefore vary with time.

5.3 In Situ Permeability Testing

In/situ permeability tests were carried out within ten boreholes using the falling head method. A field permeability value was estimated using the Hvorslev method (1951). An indicative permeability value was also derived using grading results below and Hazen's formula which applies for sand in a loose state. Results of the permeability analysis are summarised in Table 2.

Table 2: Summary of In-situ Permeability Testing

Test Location	Depth (m)	Measured Permeability[1]		Derived Permeability[2]		In Situ Condition of the Tested Material
		(m/s)	(m/day)	(m/s)	(m/day)	
BH126	0.6	1.9×10^{-4}	17	1.7×10^{-4}	14	Sand – very dense, light grey/brown
BH127	0.7	8.9×10^{-6}	0.7	2.3×10^{-4}	19	Sand – medium dense, light brown mottled grey
BH128	0.6	1.1×10^{-5}	1.0	1.7×10^{-4}	14	Sand – medium dense, light brown
BH129	1.0	1.4×10^{-5}	1.2	2.3×10^{-4}	19	Sand – dense, light grey/ brown
BH130	0.6	4.4×10^{-6}	0.3	8.1×10^{-5}	7	Sand – medium dense, grey/ brown
BH131	0.6	7.0×10^{-4}	61	3.2×10^{-4}	28	Sand – medium dense, light grey/brown
BH132	0.7	4.2×10^{-4}	37	2.3×10^{-4}	19	Sand – medium dense, light brown mottled grey
BH133	0.6	9.9×10^{-6}	0.8	1.0×10^{-4}	9	Sand – medium dense, light grey/brown
BH134B	2.1	7.5×10^{-4}	65	1.4×10^{-4}	12	Sand – medium dense, orange/brown
BH135	0.6	5.5×10^{-6}	0.4	1.4×10^{-4}	12	Sand – medium dense, grey/ brown

Notes: [1]: Horslev's method.
[2]: Hazen's formula.

6. Laboratory Testing

6.1 Geotechnical

A geotechnical laboratory testing programme was carried out by a NATA registered laboratory on selected samples and comprised the determination of:

- The particle size distribution on 28 samples.
- The Atterberg limits and linear shrinkage on ten samples.
- The shrink/swell index on seven samples.
- The California Bearing Ratio (CBR) and Modified Maximum Dry Density (MMDD) on six samples.

The detailed test report sheets are given in Appendix C with the results summarised in Tables 3 and 4.

Table 3: Results of Laboratory Testing for Soil Identification

Pit	Depth (m)	Fines (%)	d_{10} (mm)	d_{60} (mm)	LL (%)	PL (%)	PI (%)	LS (%)	I_{ss} (%)	Material
TP101	1.5	15	<0.013	0.44	20	13	7	2.5	/	Slightly gravelly, slightly clayey sand
TP102	0.9	29	<0.0135	0.27	25	11	14	5.5	/	Clayey sand
TP103	1.1	38	<0.0135	0.33	/	/	/	/	1.0	Clayey sand
TP104	1.6	21	<0.0135	0.70	/	/	/	/	1.0	Gravelly, clayey sand
TP105	0.9	38	<0.0135	0.33	/	/	/	/	1.7	Clayey sand
TP107	0.9	38	<0.0135	0.38	/	/	/	/	0.9	Clayey sand with a trace of gravel
TP108	1.0	44	<0.0135	0.28	/	/	/	/	1.7	Clayey sand
TP109	0.9	37	<0.0135	0.31	/	/	/	/	1.8	Clayey sand
TP110	0.9	23	<0.0135	0.37	28	15	13	5.0	/	Clayey sand
TP111	1.5	3	0.15	0.37	/	/	/	/	/	Sand with a trace of silt
TP112	2.0	4	0.12	0.36	/	/	/	/	/	Sand with a trace of silt
TP115	0.6	9	0.08	0.59	NP	NP	NP	/	/	Sand with some gravel and some clay

Pit	Depth (m)	Fines (%)	d_{10} (mm)	d_{60} (mm)	LL (%)	PL (%)	PI (%)	LS (%)	I_{ss} (%)	Material
TP116	0.2	/	/	/	27	12	15	6.0	/	Slightly clayey sand
TP117	0.5	16	0.014	0.67	NP	NP	NP	/	/	Slightly silty sand with a trace of gravel
TP120	1.65	30	<0.0135	0.33	39	13	26	9.0	/	Clayey sand with a trace of gravel
TP121	1.0	43	<0.0135	0.32	/	/	/	/	1.4	Gravelly sand and clay
TP122	1.0	30	<0.0135	1.20	38	15	23	10.5	/	Gravelly, clayey sand
TP124	0.7	28	<0.0135	0.95	40	17	23	10.5	/	Gravelly, clayey sand
TP125	1.1	32	<0.0135	0.42	39	13	26	9.5	/	Slightly gravelly, clayey sand
BH126	0.45	3	0.13	0.39	/	/	/	/	/	Sand with a trace of silt
BH127	0.45	3	0.15	0.33	/	/	/	/	/	Sand with a trace of silt
BH128	0.45	4	0.13	0.33	/	/	/	/	/	Sand with a trace of silt
BH129	0.85	4	0.15	0.42	/	/	/	/	/	Sand with a trace of silt
BH130	0.45	7	0.09	0.42	/	/	/	/	/	Sand with some silt and a trace of gravel
BH131	0.45	2	0.18	0.44	/	/	/	/	/	Sand with a trace of silt
BH132	0.45	3	0.15	0.40	/	/	/	/	/	Sand with a trace of silt
BH133	0.45	4	0.10	0.33	/	/	/	/	/	Sand with a trace of silt
BH134B	1.9	4	0.12	0.34	/	/	/	/	/	Sand with a trace of silt
BH135	0.45	4	0.12	0.34	/	/	/	/	/	Sand with a trace of silt

Notes:

/ The % fines is the amount of particles smaller than 75 Rm.

/ A d_{10} of 0.17 mm means that 10% of the sample particles are finer than 0.17 mm.

/ A d_{60} of 0.23 mm means that 60% of the sample particles are finer than 0.23 mm.

/ I_{ss}: Shrink/Swell Index
/ PL: plastic limit.
/ LS: linear shrinkage.
/ NP: non/plastic sample
/ LL: liquid limit.
/ PI: plasticity Index.
/ '/' means 'Not Tested'

The CBR tests were undertaken at a target compaction level of 95% of modified maximum dry density. The sample was tested after soaking for four days with a confining surcharge of 4.5 kg.

Table 4: Results of Laboratory Testing for Pavement Parameters

Pit	Depth (m)	MMDD (t/m^3)	CBR (%)	OMC (%)	Material
TP104	0.5	1.91	40	10.8	Sand
TP106	0.5	1.70	18	10.2	Sand
TP109	0.5	1.91	20	8.5	Sand
TP114	0.3	1.74	20	11.8	Sand
TP121	0.4	1.76	25	10.0	Sand
TP122	0.4	2.09	20	6.5	Sand

Notes:
/ MMDD: modified maximum dry density. / CBR: California bearing ratio. / OMC: optimum moisture content.

6.2 Acid Sulphate Soil

Acid sulphate soil screening tests were undertaken on all soil samples retrieved from ten test pits (TP101, TP105, TP108, TP111, TP112, TP114, TP116, TP118, TP123, and TP125).

Samples were tested by MPL Laboratories in accordance with the method as described in Ahern CR, McElnea AE, Sullivan LA (2004), Acid Sulphate Soils Laboratory Methods Guidelines. The screening tests comprised measurement of pH of the soil in water (pH_F) and the pH of the soil after oxidation with a 30% solution of hydrogen peroxide (pH_{FOX}).

Following the screening tests, as required by the Department of Environment Regulation (DER), testing was commissioned on selected soil samples for the Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) suite. Soil samples were submitted for laboratory analysis with due consideration of the following:

- Lowest reported pH_{FOX} within a soil strata at each test location.
- Reported reaction strength.
- Visual identification of the soils encountered.

The screening results and laboratory testing for the SPOCAS suite are presented in Table D/1 in Appendix D together with the detailed laboratory reports and associated chain of custody reports. The results are evaluated and discussed in Section 9.

7. Proposed Development

The proposed development is understood to comprise the subdivision of the site into approximately 600 residential lots, associated roadways and areas of public open space. Details for the proposed finished ground levels were not available at the time of writing this report, however it is understood that an estimated 400,000 m^3 of filling will be placed to achieve the proposed design levels, i.e. an assumed preliminary filling thickness of approximately 1 m across most of the site.

It is understood that the eastern part of the site is proposed to be cut in order to reuse the sand from this location as filling material in other parts of the site.

The proposed drainage for the site is understood to include the use of drainage basins with overflow set to be diverted to a drainage reserve adjacent to Roe Highway. It is also proposed to reduce stormwater flows through the use 'on/lot' infiltration systems where the ground conditions are suitable.

8. Engineering Comments

8.1 Site Suitability

Results of the investigation indicate that the ground conditions are primarily sandy to the east of Farrall Road, and comprise sand overlying mostly clayey sand and clayey gravel, locally cemented, to the west of Farrall Road.

No significant areas of uncontrolled filling or problematic materials were encountered within the test pits undertaken by GHD in 2008 and DP in 2014, other than some localised filling at TP01, BH126 and possibly TP51.

Therefore, from a geotechnical standpoint, the land is physically capable of residential development, provided that the provisions outlined in the subsequent subsections of the report are taken into consideration, and the recommendations implemented.

8.2 Impact of the Ground Reactivity

8.2.1 Site Classification

The site classification was derived using the results of the 2014 investigation undertaken by Douglas Partners and current best industry practice (i.e. using shrink swell testing) at Test Locations 101 to 135 (either TP or BH). These results were extrapolated to allocate a site classification at other locations (Test Locations TP1 to TP90) from the interpretation of available results from others. A minor level of uncertainty should be attached to the site classification at TP1 to TP90 owing to some assumptions used during the interpretation and extrapolation at these locations. The results of the assessment, i.e. the site classification at each test location, are shown on Drawing 2 Appendix A, and discussed in the paragraphs below.

8.2.1.1 Eastern Section

Ground conditions in the eastern part of the site are predominantly sandy and thus a site classification 'Class A' applies in this area.

Uncontrolled filling was identified at TP101 and BH126. A site classification 'P' should be allocated at these locations based on current ground conditions. However, a site classification 'A' should be suitable at these locations following suitable site preparation (refer to Section 8.3).

8.2.1.2 Western Section

Results of the laboratory testing presented in Section 6.1 indicates that the shallow clayey materials from the Guildford Formation identified in the western part of the site and underlying a thin layer of sand and topsoil, is slightly to moderately reactive, with a possible decrease of reactivity with increasing depth. These results are consistent with laboratory data available from GHD (2008).

Results of a soil reactivity analysis using the available laboratory results regarding soil shrink/swell index presented in Section 6.1, indicate that a thickness of non/reactive material of 0.15 m or greater is suitable over the reactive clayey material to achieve a site classification 'Class S' in accordance with AS2870. Owing to the occurrence of such non/reactive cover, a site classification 'S' is considered suitable for most of the western part of the site in its current conditions.

The depth of design suction change defined in AS2870 is the depth to which any reactive materials would participate to some ground surface movement. No reactive material was identified to a depth of 1.8 m, i.e. to the depth of design suction change for Perth, at several test locations in the western part of the site. Therefore, a site classification 'Class A' is suitable at these locations. In particular, such conditions were encountered at the adjacent tests TP85, TP86, TP113 and TP114 (refer Drawing 2, Appendix A), and thus a site classification 'A' was allocated for an area that includes these tests. Testing on a smaller testing grid than currently available will be required if accurately delineating this area is required at a later stage of the project. The use of test pitting, hand auger drilling or cone penetration testing is suggested if such additional testing is required.

Loose granular material was encountered at TP103, TP105 and TP119 (Zone B), resulting in 'Class P' conditions in strict accordance with AS 2870/2011. However, a 'Class A' and 'Class S', as shown on Drawing 2 (Appendix A) should be readily achievable following suitable site preparation.

8.2.1.3 Site Classification based on Current Levels

The site classification based on current site levels and the filling thickness required to amend the site class to a possible 'Class A', are provided in Table 5 below for each test location assessed by DP.

Table 5: Filling Thickness Required to Achieve a Class 'A' at Test Locations

Test Location	Interpolated existing ground surface level [1] (m AHD)	Site classification for current site level (AS2870)	Filling thickness above current levels to achieve a 'Class A' [2] (m)	Comments
TP101	16.25	S	0.8 [3]	
TP102	15.75	S	0.8 [3]	
TP103	17.05	P (A)	0.8	Currently P owing to loose sand. 'A' should be readily achievable following site preparation.
TP104	18.05	S	0.8 [3]	
TP105	19.00	P (A)	1.0	Currently P owing to loose sand. 'A' should be readily achievable following site preparation.
TP106	19.45	S	0.8 [3]	
TP107	17.50	S	1.0	
TP108	16.00	S	1.1	
TP109	15.25	S	1.1	
TP110	17.05	S	1.2	
TP111	18.20	A	/	
TP112	16.75	A	/	
TP113	14.50	A	/	
TP114	15.75	A	/	
TP115	17.90	S	1.7	
TP116	17.95	S	1.7	
TP117	18.15	S	1.7	
TP118	14.00	S	0.9	
TP119	15.80	P (A)	0.8 [3]	Currently P owing to loose sand. 'A' should be readily achievable following site preparation.
TP120	17.50	S	0.8 [3]	
TP121	16.25	S	1.2	
TP122	15.75	S	1.3	
TP123	17.05	S	1.3	
TP124	18.05	S	1.2	
TP125	19.00	S	1.2	

(see notes next page)

Notes to Table 5:

[1]: Surface level interpolated from contour plan provided by the client.

[2]: Does not account for material removed during topsoil stripping.

[3]: These thickness values are controlled by a clause in the Australian Standard AS2870/2011 requesting that the site classification of a reactive site can be amended only if a thickness of 0.8 m or greater of controlled sand filling is placed.

Review of the test pits logs included in GHD (2008) indicates that sand was encountered to the base (2.5 m to 3 m depth) of the tests located near Farrall Road within Zone A (i.e. TP04, TP06, TP08 and TP12; see Drawing 3, Appendix A). Ground surface levels are not available from these logs, however, these results suggest that the site classification is unlikely to change following cutting to a level similar to Farrall Road, for the part of the site within Zone A. However, owing to the occurrence of reactive material at shallow depths within Zone A1, cutting might impact the current site classification 'A' in this area. It is recommended that the available geotechnical information be reviewed once final finish level are known, in order to assess the impact on site classification, of any proposed cutting within Zone A, and the requirement, if any, for any additional testing to address any uncertainty.

The site classification recommendations in this section do not take into account the possible effect of trees increasing the seasonal surface movement. In accordance with AS2870/2011, a group of trees would impact the classification of a building envelope if the trees are located within a distance of approximately twice their mature height. The presence of trees (either existing or proposed) may therefore impact the site classification (mostly from 'S' to 'M', or 'A' to 'S') in particular areas of the development. It is recommended that DP review the site classification of particular areas following further information on tree locations, species and distances to future structures, if required.

8.2.2 Characteristic Ground Surface Movement (y_s)

The Characteristic Ground Movement (y_s), rather than the site classification, is used by some structural engineers to design footing designs that are different to those suggested in the Australian Standard AS2870/2011. Therefore such information could be valuable to the project civil engineers to assess a cost effective balance between proposed filling thicknesses and suitable sizes of footings to resist ground surface movement that are partially controlled by the proposed filling thickness.

Characteristic ground surface movement values (y_s) were analytically derived for several thicknesses of sand and compiled in Table 6 below.

Table 6: Impact of the thickness of non-reactive material cover on ground surface moment

Thickness of non-reactive material (e.g. sand) overlying reactive subgrade (m)	Derived Characteristic Ground Surface Movement (y_s, mm)	Associated Site Classification (AS2870)
<0.15	>20	M
0.3	17	S
0.5	14	S
0.7	11	S
0.9	9	S

Thickness of non-reactive material (e.g. sand) overlying reactive subgrade (m)	Derived Characteristic Ground Surface Movement (y_s, mm)	Associated Site Classification (AS2870)
1.2	4	S
1.5	1	S
≥1.8	0	A

Note: AS2870/2011 requires a minimum thickness of controlled sand filling of 0.8 m to alter the original site classification shown on Drawing 4, Appendix A.

The derived values of Characteristic Ground Surface Movement (y_s) were calculated using the methods suggested in the current Australian Standards and best industry practices. However, they should be considered as estimates owing to assumptions and engineering judgement required for their assessment, and inherent variations in ground conditions over short distances. An indicative accuracy of the order of ±5 mm is suggested when considering the Characteristic Ground Surface Movement values given in Table 6 above.

Possible impact of trees on characteristic ground surface movement is discussed in Section 8.2.1. Such impact was not considered to derive the values in Table 6. Therefore, results should be reviewed if significant treed areas are proposed near the proposed buildings, once this information is available.

8.3 Site Preparation

8.3.1 Timing of the Earthworks

As noted in Section 3 and Section 5.2, several parts of the site were waterlogged and groundwater was encountered at shallow depths at several locations during the investigation near the end of August 2014. It is therefore recommended that the bulk earthworks be preferably undertaken during dry periods of the year in order to:

- Ease the trafficking of the construction plants;
- Ease or remove the requirement for surface drainage during construction;
- Ease handling, moisture conditioning and compaction of the clayey subgrade;
- Ease compaction of loose sand identified near groundwater level during the investigation in August 2014.

Some notable difficulties are anticipated during the bulk earthworks if the subgrade preparation in the western part of the site is undertaken during the wet months of the year. Once the subgrade is prepared and suitable drainage implemented, it is anticipated that placing and compacting the overlying sand filling will be less adverse to weather.

The eastern part of the site is mostly sandy and thus it is anticipated that site preparation will be less impacted by weather conditions at this location.

8.3.2 Stripping

All topsoil, vegetation and deleterious material should be stripped from building envelopes and pavement areas. Tree roots remaining from any clearing operations should be completely removed.

A visual assessment indicates that the topsoil is generally sandy with some organic silt. Topsoil could be re/used as non/structural filling and for landscaping purposes, or blended with clean sand to form a structural filling material of low organic content. It should be noted that blended topsoil is anticipated to have a lower permeability than clean sand, and therefore possible implication on drainage design will need to be considered.

If re/using the topsoil following screening and blending is considered, it is recommended that some laboratory testing be undertaken prior to or during the earthworks, in order to assess:

- a suitable blending topsoil/sand ratio to achieve a structural filling with a low organic content, and
- the permeability of the blended material, for drainage design consideration.

A preliminary assessment could be undertaken prior to the earthworks on samples of in/situ topsoil. However, more representative results are achieved from sampling the topsoil following the stripping operations, possible screening of vegetation and stockpiling. Douglas Partners will be pleased to assist with this task if required.

Uncontrolled filling (sand with some clay) was encountered at BH126 and sand filling with some building rubbles was noted at TP01 in GHD (2008). It is recommended that this material be excavated under geotechnical supervision in order to assess their suitability for re/use.

8.3.3 Compaction of Loose Material and Proof Rolling

As discussed in Section 5.1.1, loose sand was encountered up to a depth of 1.0 m. The loose material encountered at the test locations may exist elsewhere and is not suitable for foundation support in its current state.

Therefore, following the site stripping operations and prior to any filling, it is recommended that that the exposed subgrade within proposed building envelopes and pavement areas be compacted using a heavy roller (14 tonnes minimum deadweight) to achieve not less than 8 blows per 300 mm penetration when using a Perth sand penetrometer (PSP) in accordance with AS 1289.6.3.3. Any areas that show signs of excessive deformation during compaction should be compacted until deformation ceases or, alternatively, the poor quality material should be excavated and replaced with suitable structural filling.

It is anticipated that both sandy and clayey subgrades will be exposed following the topsoil stripping operations in the western part of the site.

The type of roller (smooth drum or sheepfoot) and the use of vibratory modes should be at the discretion of the earthworks contractor based on the encountered subgrade, the depth to groundwater, and the size and type of compaction plant. A smooth drum roller is preferred to compact sandy subgrade and a sheepfoot roller to compact clayey subgrade. The use of vibration is not recommended to compact clayey subgrade or where shallow groundwater is within the depth of influence of the roller.

8.3.4 Re-use of In-Situ Material

The naturally occurring sand encountered east of Farrall Road and overlying the cohesive materials to the west of Farrall Road is considered suitable for re/use as structural fill, provided it is free from organic material and particles greater than 150 mm in size.

Shallow sandy soils with increasing clay content with depth were encountered at several locations in the western part of the site. If re/use of such material is proposed to achieve Class A conditions, it is recommended that geotechnical supervision is undertaken to ensure suitable filling material is selected for re/use.

The clayey sand underlying the sandy soils to the west of Farrall Road is not recommended for re/use as structural filling due to the shrinking and swelling experienced with changes in moisture content and the difficulty in placement and compaction at the correct moisture content. It can however, be used if it is to be placed deeper than 1.8 m below finished surface level, without impacting the site classification. It is recommended that any clayey sand or similar material demonstrating plastic behaviour required for structural filling is first inspected by a geotechnical engineer for assessment and if suitable for use, is placed under geotechnical supervision.

It should be noted that this study has not assessed whether unacceptable levels of contaminants exist within the in/situ material as this was outside the scope of the investigation. Such levels, if they occur, may limit or prevent the use of this material.

8.3.5 Imported Filling

If required, imported filling should comprise free draining, cohesionless, well graded sand that:

- Contains less than 5% by weight of particles less than 75 microns in size.
- Contains no particles greater than 150 mm in size.
- Is free of organic and other deleterious materials.

It is recommended that test certificates are reviewed and approved by the geotechnical engineer prior to importing material to site.

Other materials could be suitable following review by a geotechnical engineer.

8.3.6 Fill Placement and Compaction Testing

It is recommended that sand filling be placed in layers not exceeding 300 mm loose thickness, placed near optimum moisture content and compacted with a heavy roller to achieve a density of not less than 8 blows per 300 mm of rod penetration when tested using a PSP. The filling can be placed in thicker lifts if suitable compaction can be demonstrated. The use of a medium to heavy vibrating smooth drum roller is suggested. Care should be taken not to run heavy plant immediately adjacent to existing structures and services. It is recommended that earthworks be carried out with regular inspections by a geotechnical engineer.

Compaction control of the sand filling could be carried out using a Perth sand penetrometer (PSP) test in accordance with test method AS 1289.6.3.3. All areas within the proposed building envelopes should be compacted to achieve a minimum blow count of 8 blows per 300 mm penetration to a depth of not less than 1.0 m below foundation level.

During construction, some loosening of the surface materials in foundation excavations is expected. Therefore the top 300 mm in the base of any excavation should be re/compacted using a vibratory plate compactor prior to construction of any footings. Confirmation of adequate compaction should be carried out as outlined above.

8.3.7 Excavation Conditions

Based on the available results, the use of conventional earthmoving equipment, such as loaders and excavators, is anticipated to be suitable to excavate the sand of the Yoganup Formation located in the eastern part of the site. However, it should be noted that ferricrete deposits can locally exist within the Yoganup Formation and cannot be precluded beneath the site. If encountered, such material will possibly require powerful excavation equipment such as dozers.

Strongly cemented, medium to high strength materials were encountered at several locations within Zone A1, B and C (see Drawing 2, Appendix A), resulting in test pitting refusal using a 9 t excavator.

The use of powerful excavators equipped with hydraulic rock breakers or heavy ripping using dozers (say D10 or heavier) is anticipated if excavation of this material is required.

Control of groundwater for excavations within the Guildford Formation is anticipated to be challenging, owing to the possible presence of perched and confined aquifers. The use of spears around the proposed excavation to depressurised confined aquifers, and sumps at the base of the excavation is suggested if groundwater control is required. Pre/drilling will possibly be required to drive the dewatering spears, owing to hard and cemented zones within the Guildford Formation.

8.4 Foundation Design

Shallow foundation systems comprising slab, pad and strip footings should be suitable to support typical one and two storey residential dwellings. Footings of buildings covered by AS 2870/2011 should be designed to satisfy the requirements of this standard for the site classification discussed in Section 8.2, provided that site preparation is carried out in accordance with Section 8.3.

If a proposed building is not covered by AS 2870/2011 then the foundation should be designed using engineering principles. A maximum allowable bearing pressure of 200 kPa is suggested for preliminary foundation design of strip footings less than 1 m wide founded at a minimum depth of 0.5 m in at least medium dense or denser sand. This value should ensure that total and differential settlements will be less than 10 mm. It should be reviewed and amended once further details on structures not covered by AS2870, if any, are available.

8.5 Design Parameters for Earth Retaining Systems

During construction, it is recommended that batter slopes in sand are flatter than or equal to 1.5:1 (H:V) if not retained. Recommended permanent batter slopes should be flatter than or equal to 2:1 (H:V). These batter angles are valid provided no load applies at the top of the slope.

Design parameters for the design of temporary and permanent retaining structures are suggested in Table 7.

In addition to the soil pressure, wall design should also allow for external loads such as buildings, live loads and hydrostatic pressure (the latter if adequate drainage is not provided).

Table 7: Soil Parameters for Retaining Wall Design

Soil Type	Soil Unit Weight Above Water Table γ (kN/m^3)	Drained Angle of Friction Φ' (Degrees)	Undrained Shear Strength C_U (kPa)	Coefficient of Earth Pressure – Active K_a	Coefficient of Earth Pressure – at Rest K_0	Coefficient of Earth Pressure – Passive K_p
Sand, medium dense and denser	20	32	0	0.3	0.5	3.3
Clayey Sand, stiff to hard	20	25	75	0.3	0.5	2.0

8.6 Pavement Design Parameters

Subgrade for the proposed pavement across the site is likely to comprise sand and sand filling once the proposed site surface is raised.

Based on the results of the field work, a design CBR value of 12% is suggested for pavement constructed on natural sand subgrade, provided the subgrade is compacted to achieve a dry density ratio of not less than 95% relative to modified compaction, and the clearance from the base of the pavement material to any reactive clayey materials is equal to or greater than 0.5 m. A reduced design CBR value of 6% is recommended in the case of the clearance being 0.3 m to 0.5 m. Further targeted testing would be required for pavement areas with clearance to cohesive materials less than 0.3 m however a presumptive design CBR value of 2% is considered to be suitable for preliminary design.

In the event that the subgrade comprises imported sand filling, the pavement should be designed using an appropriate CBR of that material. A presumptive design CBR value of 12% is suggested for clean sand filling, however, this value should be confirmed prior to pavement construction once the type of filling material is known and its CBR has been assessed.

It is recommended that subgrade be inspected by a suitably experienced geotechnical engineer prior to placement of pavement materials to allow identification of possible unsuitable materials and to provide specific drainage measurements if deemed required. Particular care should be exercised in implementing a suitable drainage strategy for the proposed roads to prevent water ingress into pavement layers.

8.7 Surface Water and Groundwater

No surface water was observed in the part of the site east of Farrall Road. However, it should be noted that groundwater is indicated at a depth of 2.7 m at TP11 and 2.2 m at TP12 (GHD, 2008) within Zone A east of Farrall Road, and its possible impact should be considered if cutting the site is proposed. Levels associated to groundwater depths are not available from GHD (2008).

As discussed in Section 3 and shown on Drawing 1, several areas in the western part of the site were waterlogged during the investigation undertaken, following a period of significant rains near the end of June 2014. Waterlogging was also present during the investigation undertaken by GHD during the second half of October 2008 and is described as follow in GHD (2008): *"A low lying wet area is located near the eastern boundary, approximately halfway along the Farrall Road site boundary* [of Lots 50 and Lot 427 Farrall Road]*, linking to another low lying area opposite, near the west boundary*."

Groundwater was generally observed at shallow depths in the western part of the site as detailed in Section 5.2.

8.8 Soil Permeability and Stormwater Disposal

8.8.1 Eastern Section

The ground conditions east of Farrall Road and other than at TP01 to TP03 comprise sand with a low fines content, to the base of the tests.

As detailed in Section 4.3, the results of the testing indicate permeability values of between 1.9 x $10^{/4}$ m/s and 7.5 x $10^{/4}$ m/s at the test locations within sand in the eastern section site. Results of the Hazen's formula indicate permeability values between 1.0 x $10^{/4}$ m/s and 3.2 x $10^{/4}$ m/s. Based on the above results, a design permeability value of 1 x $10^{/4}$ m/s (9 m/day) is suggested for the shallow natural sand of the Yoganup Formation occurring east of Farrall Road.

It should be noted that silty sand, clayey sand and laterite are described in GHD (2008) within the soil profile encountered in the test pits at TP01 to TP03. Impact of the relatively low permeability of these materials on drainage design should be considered, in particular if cutting is proposed at these locations.

In situ infiltration of stormwater will be suitable in the Yoganup sand.

8.8.2 Western Section

Permeability testing was undertaken within the shallow sand encountered above the cohesive material of the Guildford Formation across the western section of the site.

The results of the testing (refer to Section 4.3) indicate permeability values of between 0.4 x 10^{-4} m/s and 1.2 x 10^{-4} m/s for the shallow sand. A design permeability value of 0.4 x 10^{-4} m/s (0.4 m/day) is suggested for this material.

A presumptive value between the orders of 1 x 10^{-7} m/s (0.009 m/day) and 1 x 10^{-6} m/s (0.086 m/day) is suggested for the clayey subgrade (generally clayey sand) underlying the shallow sand.

The cemented material identified within Zone C should be considered as impervious for stormwater disposal purposes. Owing to the variability of the Guildford Formation, the occurrence of cemented materials at other locations than those encountered should not be precluded.

8.8.3 General Comments

Bio build/up and siltation of the surface infiltration decrease the performance of infiltration systems. Therefore, regular maintenance of the infiltrating systems is recommended.

A separation of not less than 0.5 m is generally suggested between the base of the soakwells and the top of any impervious layers or the maximum groundwater level.

In the western part of the site, the clayey and cemented materials from the Guildford Formation form a relatively impervious barrier to vertical infiltration, owing to its contrast in permeability compared to the overlying existing thin layer of sandy soils and any proposed sand filling. Therefore, any concentrated infiltration of stormwater water within an overlying granular layer (proposed filling and existing sand) would be anticipated to perch on the surface of the Guildford Formation, and mostly migrate laterally. Owing to the general apparent dipping of the clayey surface of the Guildford Formation down from East to West, the lateral flow of perched groundwater is anticipated to be mostly into a general westerly direction.

Concentrated infiltration in granular layers overlying (e.g. proposed filling) and upstream (i.e. in the Yoganup Formation) of the Guildford Formation is anticipated to result in mounding of perched groundwater above the surface of the clayey materials of the Guildford Formation. Therefore, consideration should be given to control maximum groundwater level beneath site finished level using a network of subsoil drains directing groundwater into a suitable outflow.

8.9 Local Sources of Construction Materials

Two large quarries likely capable of supplying the required quantities of sand for structural filling and road construction materials are located within 20 km of the site. Hanson's Red Hill Quarry is located about 9 km by road to the northeast and Rocla's Lexia Quarry is located about 18 km by road to the northwest.

9. Acid Sulphate Soil Evaluation

9.1 Adopted Assessment Criteria

The screening test results were assessed for the possible presence of actual acid sulphate soil (AASS) or potential acid sulphate soil (PASS) on the basis of the following guidance indicators specified in the Department of Environment Regulation (DER) (2013), namely:

- $pH_F \leq 4$ strongly indicates oxidation has occurred in the past and that AASS are likely to be present; and
- $pH_{FOX} < 3$, plus a pH_{FOX} reading at least one pH unit below the corresponding pH_F, plus a strong reaction with peroxide, strongly indicates the presence of PASS.

DER (2013) specifies texture/based action criteria to initiate management of acid sulphate soils. These are summarised in Table 8 below.

If the net acidity, calculated from the results of the titratable actual acidity (TAA) and the peroxide oxidisable sulphur (S_{POS}) is greater than the appropriate action criterion for the amount of disturbance, it is considered that acid sulphate soils are present and excavations/dewatering within this material would require specific management.

Table 8: Texture-Based Action Criteria

Type of Material		Net Acidity Action Criteria	
		< 1,000 tonnes of material is disturbed	> 1,000 tonnes of material is disturbed
Texture range McDonald et al (1990)	Approx. Clay content (%)	Equivalent sulphur (%S)	Equivalent sulphur (%S)
Coarse texture sands to loamy sands	< 5	0.03	0.03
Medium texture sandy loams to light clays	5 – 40	0.06	0.03
Fine texture medium to heavy clays and silty clays	> 40	0.1	0.03

Notes 1. Adopted from Table 10 of DER (2013)

Net acidity using the SPOCAS suite of analysis is calculated as follows:

Net Acidity ($\%_{sulphur}$) = S_{POS} + TAA + S_{RT} – ANCe/FF
whereby:

- TAA / titratable actual acidity;
- S_{POS} – peroxide oxidisable sulphur;
- S_{RT} / retained acidity (reported for pH_{kCl} <4.5);
- ANC_E – excess acid neutralising capacity (reported for pH_{kCl} >6.5); and

- FF – fineness factor (assumed by the laboratory to be 1.5).

As per DER requirements, in the absence of particle size information, ANC_e has been excluded from the net acidity equation. It is assumed that greater than 1,000 tonnes of soils will be disturbed as part of site works, an action criterion of 0.03% has been adopted for the assessment.

9.2 Assessment of Analytical Results

Screening Test Results
The screening test results presented in Table D/1, Appendix D indicate the following:

- The results for pH_F are not indicative of actual acid sulphate soils conditions; and
- The results for pH_{FOX} are not indicative of potential acid sulphate soil conditions.

Laboratory Results and Discussion
The results of laboratory testing summarised in Table D/1, Appendix D indicate that the calculated net acidity values using $S_{POS,}$ excluding ANC, were all below the adopted action criterion of 0.03% S.

9.3 Conclusion on Acid Sulphate Soils

Based upon the results of the investigation, DP concludes that the risk of acid sulphate soils to depths of 2.0 m is low, which is generally consistent with the published mapping.

Following completion of detailed design, i.e. when excavation depths and alignments are known, the requirement to undertake further detailed investigations for acid sulphate soils should be assessed. It is considered that further detailed investigations would be required for the following:

- to address a WAPC condition in relation to acid sulphate soils; and/or
- dewatering is required to be undertaken.

If dewatering activities are proposed to be undertaken, assessment of acid sulphate soils and groundwater including the preparation of a dewatering management plan is also required as part of an application for the following dewatering licences to be submitted to Department of Water (DoW):

- 5C Licence to Take Groundwater; and
- 26D Licence to Construct and Alter a Well.

The abovementioned licences are required under the provisions of the *Rights in Waters Irrigations Act 1914* for proposed dewatering activities. It is noted that dewatering is exempt from licensing if:

- (a) the only water that can be taken from the well is from the water table aquifer; and
- (b) water is taken from the well solely for the purpose of removing underground water to facilitate construction or other activity; and
- (c) the water is taken at a pump rate not exceeding 10 litres per second over a period of less than 30 consecutive days; and

- (d) the volume of water taken over the period referred to in paragraph (c) does not exceed 25 000 kL.

10. References

1. Australian Standard AS 1289/2000, Methods of Testing Soils for Engineering Purposes.
2. Australian Standard AS 1289.6.3.2/1999, Soil Strength and Consolidation Tests/Determination of the Penetration Resistance of a Soil – Dynamic Cone Penetrometer Test.
3. Australian Standard AS 1289.6.3.3/1999, Soil Strength and Consolidation Tests/Determination of the Penetration Resistance of a Soil – Perth Sand Penetrometer Test.
4. Australian Standard AS 1726/1996, Geotechnical Site Investigation.
5. Australian Standards AS 2870/2011, Residential Slabs and Footings.
6. Australian Standard AS 3798/2007, Guidelines on Earthworks for Commercial and Residential Developments.
7. Department of Environment, Perth Groundwater Atlas, Second Edition, December 2004.
8. Department of Environment (March 2013) Identification and Investigation of Acid Sulphate Soils, Perth, Western Australia.
9. Geological Survey of Western Australia (1986) Perth 1:50,000 Sheet.
10. GHD (2008), 'Department of Housing and Works, Report for Various Lots in West Stratton, Geotechnical Investigation, January 2008'

11. Limitations

Douglas Partners (DP) has prepared this report for the proposed residential subdivision project at Lots 50, 102 and 427 Farrall Road in Midvale, WA in accordance with DP's proposal dated 10 July 2014 and purchase order received from Mr. Paul Abel of Peet Stratton Pty Ltd on 13 August 2014. The report is provided for the exclusive use of Peet Stratton Pty Ltd and their agents for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub/surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub/surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions

between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report
Drawings

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

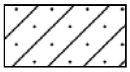
Soils


Topsoil

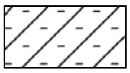

Peat


Clay

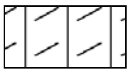

Silty clay

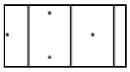

Sandy clay

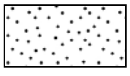

Gravelly clay

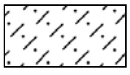

Shaly clay

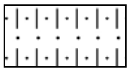

Silt


Clayey silt


Sandy silt

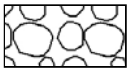

Sand

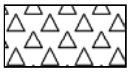

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

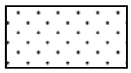

Talus

Sedimentary Rocks

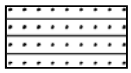

Boulder conglomerate

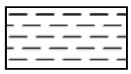

Conglomerate


Conglomeratic sandstone

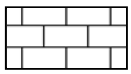

Sandstone


Siltstone


Laminite

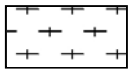

Mudstone, claystone, shale

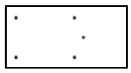

Coal


Limestone

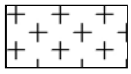
Metamorphic Rocks

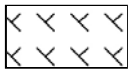

Slate, phyllite, schist

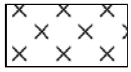

Gneiss

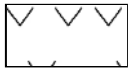

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

CONTOURS SOURCE: The Civil Group.
CADASTRAL SOURCE: Landgate, September 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2014.

82334-d01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

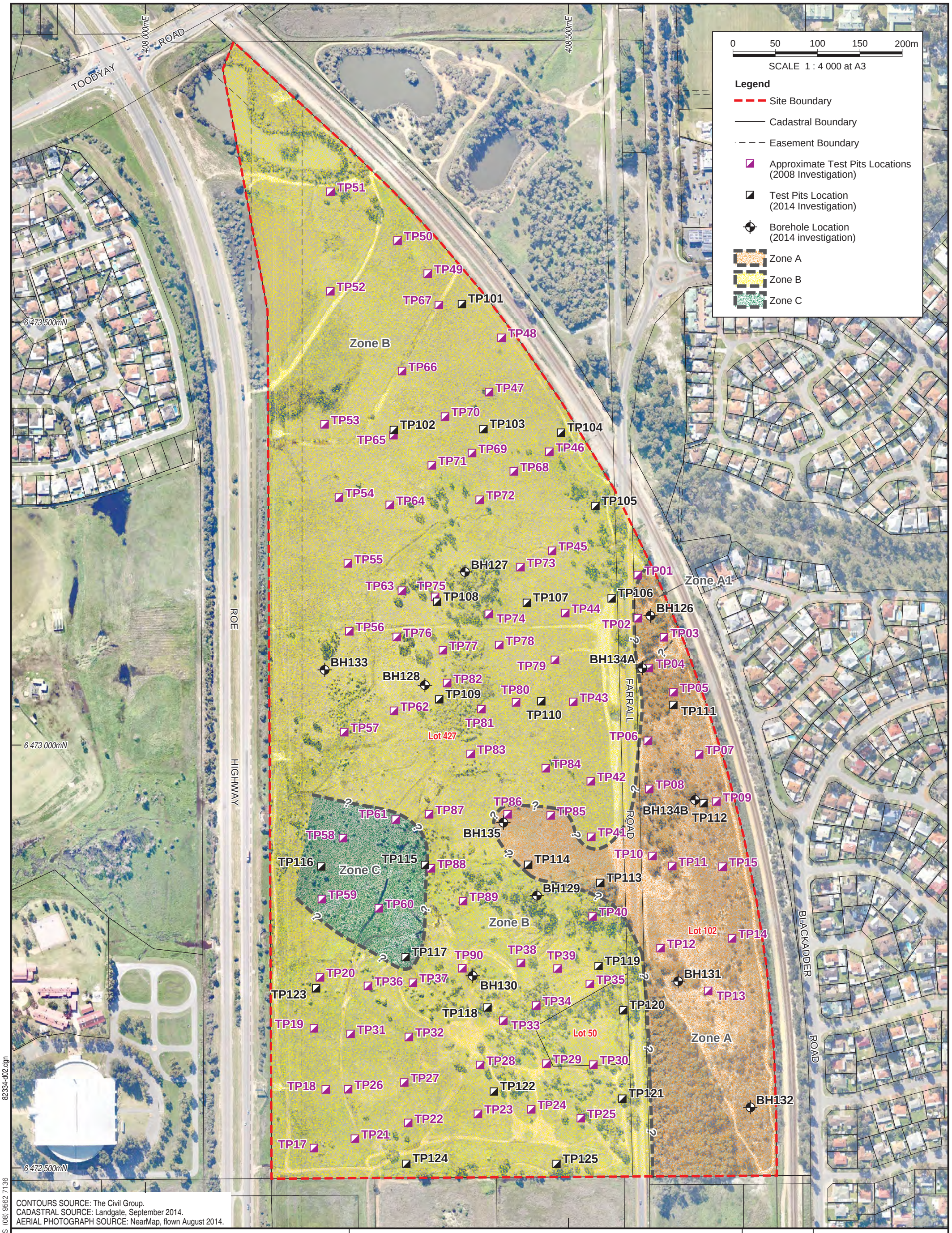
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Locations**
Lots 50, 102 and 427 Farrall Road
Midvale

MGA

OFFICE:	Perth
DRAWN BY:	D.Jagoe-Banks
DATE:	1 Oct 2014

CLIENT: Peet Stratton Pty Ltd	PROJECT No.: 82334	DRAWING No.: 1	REVISION: A	SCALE: As shown



CONTOURS SOURCE: The Civil Group.
CADASTRAL SOURCE: Landgate, September 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2014.

82334-d02.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

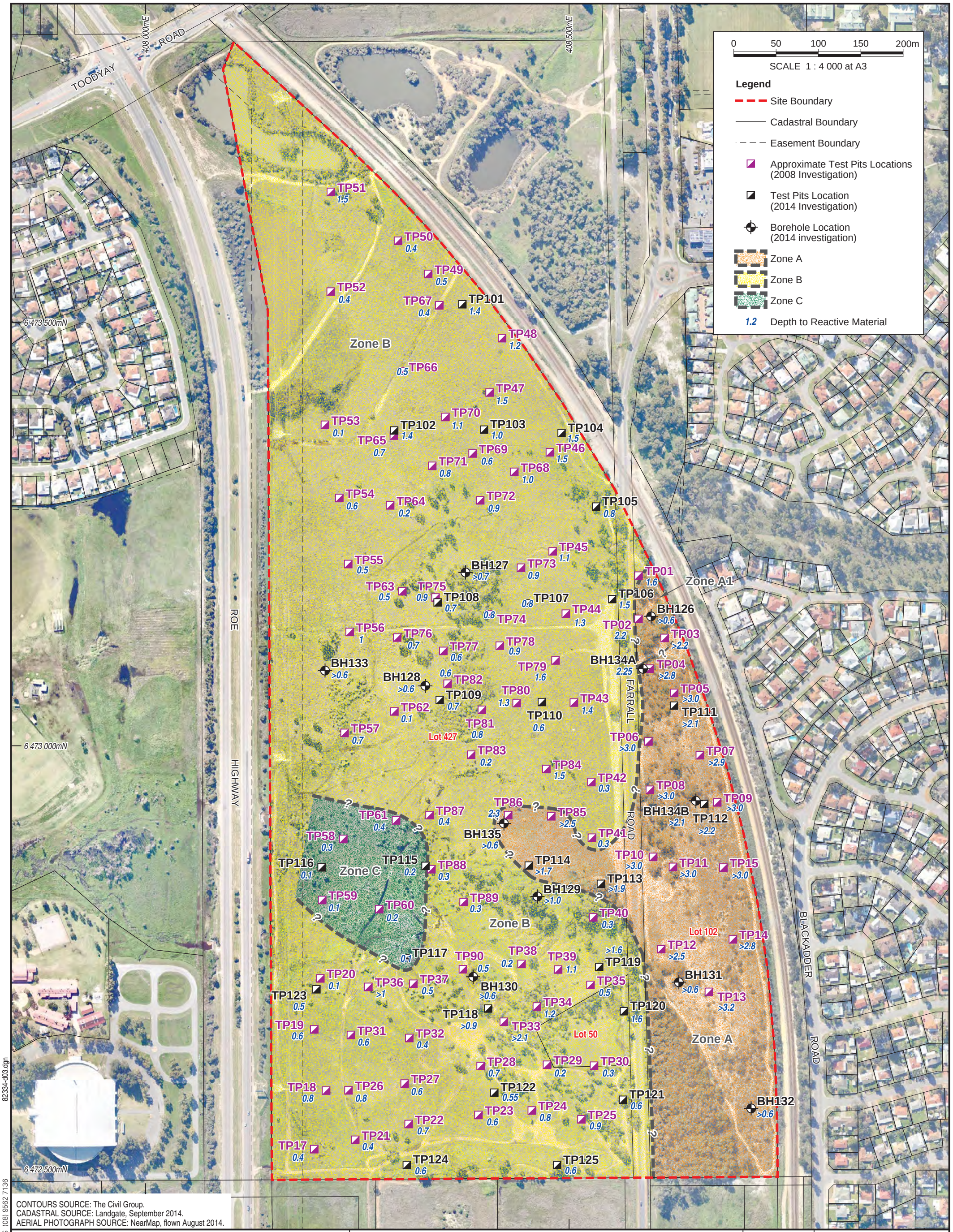
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Zoning of Similar Ground Conditions**
Lots 50, 102 and 427 Farrall Road
Midvale

MGA

OFFICE:	Perth
DRAWN BY:	D.Jagoe-Banks
DATE:	1 Oct 2014
SCALE:	As shown

CLIENT: Peet Stratton Pty Ltd	PROJECT No.: 82334	DRAWING No.: 2	REVISION: A



CONTOURS SOURCE: The Civil Group.
CADASTRAL SOURCE: Landgate, September 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2014.

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Depth to Reactive Material**
Lots 50, 102 and 427 Farrall Road
Midvale

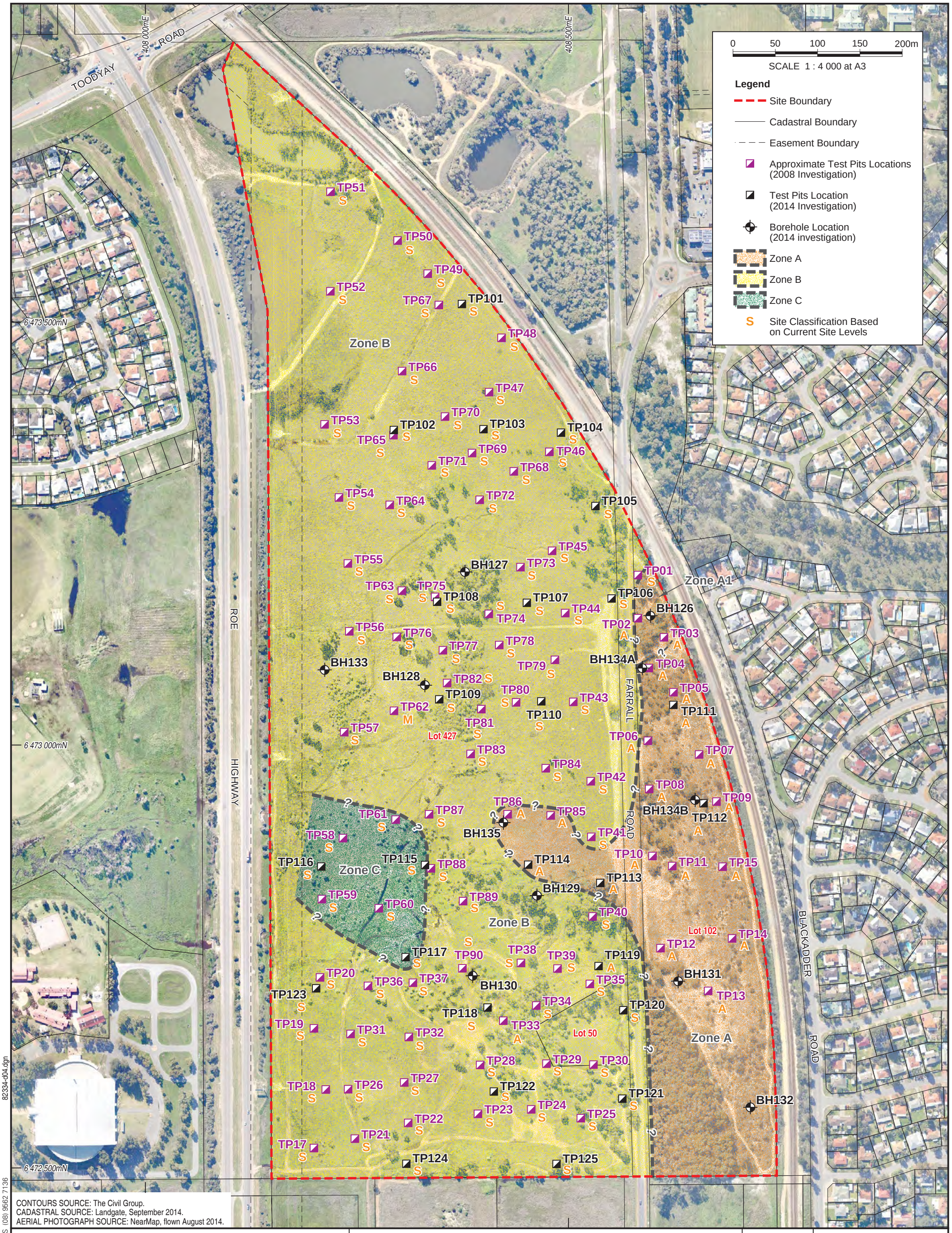
MGA

OFFICE:	Perth
DRAWN BY:	D.Jagoe-Banks
DATE:	1 Oct 2014
SCALE:	As shown

CLIENT: Peet Stratton Pty Ltd | PROJECT No.: 82334 | DRAWING No.: 3 | REVISION: A

82334-d03.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136



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CADASTRAL SOURCE: Landgate, September 2014.
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82334-d04.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Classification**
Lots 50, 102 and 427 Farrall Road
Midvale

MGA

CLIENT: Peet Stratton Pty Ltd	PROJECT No.: 82334	DRAWING No.: 4	REVISION: A

OFFICE: Perth
DRAWN BY: D.Jagoe-Banks
DATE: 1 Oct 2014
SCALE: As shown

Appendix B

Results of Field Work

TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.25 m AHD
EASTING:
NORTHING:

PIT No: TP101
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.1	TOPSOIL (SILTY SAND) - dark brown, fine to medium grained, silty sand topsoil, with some roots, wet.							
		SAND - loose, light brown, fine to medium grained sand, with a trace of silt, wet.							
		- becoming medium dense from 0.3 m.		E D	0.5 0.6				
		- becoming dense, yellow-brown, fine to medium grained, sand with some gravel, wet. Gravel consists of brown, fine sized cemented sand.						25-08-14	
15	1			E D	1.0 1.1				1
		- becoming slightly gravelly, slightly clayey sand from 1.4 m depth. Gravel is fine to coarse sized, red-brown, gravel.		E D	1.5 1.6				
	1.8	Pit discontinued at 1.8m (Collapse)							
14	2								2
13	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.8 m depth.

REMARKS: Strong odour from test pit

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 15.75 m AHD
EASTING:
NORTHING:

PIT No: TP102
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.14	TOPSOIL (SAND) - light grey, fine to medium grained sand topsoil, with some silt and rootlets, wet.							
		SAND - medium dense, brown, fine to medium grained sand, with trace of silt and a trace of clay, wet.		D	0.3 0.4			▼ 25-08-14	
	0.8	CLAYEY SAND - firm, yellow-brown, mottled orange-brown, fine to medium grained clayey sand, moist to wet, low plasticity		D	0.9 1.0		pp = 60 kPa		
14	1.4	GRAVELLY SAND - yellow-brown, fine to medium grained gravelly sand, wet. Gravel is red-brown, fine sized laterite.		D	1.7 1.8				
	1.9	CLAYEY SAND - very stiff, grey-green mottled orange-brown, fine to medium grained clayey sand, wet.		D	1.95 2.05		pp = 370 kPa		
13	2.8	Pit discontinued at 2.8m (Collapse)							

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.4 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 17.05 m AHD
EASTING:
NORTHING:

PIT No: TP103
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0.09	TOPSOIL (SILTY SAND) - dark grey , fine to medium grained silty sand topsoil, with some rootlets, and a trace of clay, wet.							
		SAND - loose,light grey, fine to medium grained sand, wet.							
		- becoming yellow brown with a higher fines content from 0.3 m depth.		D	0.3 0.4			25-08-14	
		- becoming medium dense from 0.6 m.							
16	1.0	CLAYEY SAND - stiff, orange-brown mottled red-brown and light grey, fine to medium grained clayey sand, wet, medium plasticity		D U	1.1 1.2		pp = 100 kPa		
		- with some red-brown, fine to coarse sized gravel pieces of laterite from 1.4 m depth.			1.49				
15	2.8	Pit discontinued at 2.8m (Collapse)							
14									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.35 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 18.05 m AHD
EASTING:
NORTHING:

PIT No: TP104
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
18	0.09	TOPSOIL (SILTY SAND) - dark grey , fine to medium grained silty sand topsoil, with some rootlets, and a trace of clay, moist.							
		SAND - medium dense, light yellow-brown, fine to medium grained sand, with a trace of silt, moist.		B	0.5 0.6				
17	1								1
	1.5	GRAVELLY CLAYEY SAND - light yellow-brown mottled light grey, fine to medium grained, gravelley clayey sand, wet, low plasticity. Gravel is red-brown, fine to coarse sized laterite.		D U	1.6 1.7 1.99			25-08-14	
16	2								2
	2.3	IRON CEMENTED SAND - stongly cemented, medium to hgih strength, red-brown mottled purple, cemented sand with some silt. Hard digging.							
	2.7	Pit discontinued at 2.7m (Refusal)							
15	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 1.3 m depth.

REMARKS: Slow digging on cemented material.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 19.00 m AHD
EASTING:
NORTHING:

PIT No: TP105
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
19	0.1	TOPSOIL (SAND) - dark brown mottled grey, fine to medium grained sand, with some silt and rootlets, moist.							
		SAND - loose, light brown, fine to medium grained sand with a trace of silt, moist.							
		- becoming medium dense from 0.45 m.		E	0.5				
		- with a trace of roots at 0.7 m depth.							
	0.8	CLAYEY SAND - stiff, orange-brown mottled grey, fine to medium grained clayey sand, wet, medium plasticity.			0.9		pp = 160 kPa		
18	1	- becoming mottled red-brown with a trace of gravel from 0.9 m depth.		D E U	1.0 1.18				1
	1.4	GRAVELLY CLAYEY SAND -orange-brown mottled light grey, fine to medium grained, gravelley clayey sand, wet. Gravel is red-brown, fine to coarse grained laterite.		E	1.5				
17	2			E	2.0			25-08-14	2
				E D	2.5 2.6				
	2.9	Pit discontinued at 2.9m (Collapse)							
16	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 2.0 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 19.45 m AHD
EASTING:
NORTHING:

PIT No: TP106
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
19	0.1	TOPSOIL (SAND) - brown, fine to medium grained sand with a trace of silt and rootlets, moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, moist.							
		- becoming brown, with a trace of gravel and clay from 0.5 m depth.		B	0.5 0.6				
18	1.5	GRAVELLY CLAYEY SAND - orange-brown mottled light grey, fine to medium grained, gravelley clayey sand, saturated. Gravel is red-brown, fine to coarse grained laterite.							
		- becoming red-brown mottled orange brown and light grey, wet from 1.9 m depth.		D	2.0 2.1			25-08-14	
17	2.7	Pit discontinued at 2.7m (Refusal)							
16									

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 1.8 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 17.50 m AHD
EASTING:
NORTHING:

PIT No: TP107
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0.2	TOPSOIL (SILTY SAND) - dark grey-brown, fine to medium grained, silty sand, with some rootlets and a trace of clay, wet.							
		SAND - medium dense, light yellow-brown, fine to medium grained sand with a trace of silt, moist.						▼ 25-08-14	
	0.8	CLAYEY SAND - stiff to very stiff, orange-brown mottled red-brown and grey clayey sand with a trace of fine to coarse gravel, wet, low plasticity		D	0.9		pp = 130 kPa		
	1			U	1.0				1
					1.16				
		- with some fine to coarse gravel from 1.2 m depth.			1.3		pp = 260 kPa		
16									
				D	1.5				
					1.6				
	2								2
	2.4	CLAYEY SANDY GRAVEL - light yellow-brown mottled light grey and red-brown, clayey sandy gravel, wet. Gravel consists of red-brown laterite.							
15				D	2.5				
					2.6				
	2.7	Pit discontinued at 2.7m (Refusal)							
	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.6 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.00 m AHD
EASTING:
NORTHING:

PIT No: TP108
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.15	TOPSOIL (SILTY SAND) - dark brown, fine to medium grained silty sand with a trace of clay, moist.							
		SAND - loose, light yellow-brown mottled orange-brown, with a trace of silt, wet.							
		- becoming medium dense from 0.3 m.		E	0.5				
	0.7	CLAYEY SAND - stiff, light yellow-brown, mottled orange brown and light grey, fine to medium grained clayey sand, wet, medium plasticity.						▼ 25-08-14	
15	1			E	1.0		pp = 110 kPa		1
				D	1.1				
				U					
					1.39				
		- becoming very stiff from 1.5 m depth.		E	1.5		pp = 190 kPa		
14	2			E	2.0		pp = 300 kPa		2
	2.3	GRAVELLY CLAYEY SAND - orange-brown mottled light grey, fine to medium grained, gravelley clayey sand, saturated. Gravel is red-brown, fine to coarse grained laterite.		E	2.5				
13	3 3.0	Pit discontinued at 3.0m (Target)		E	3.0				3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.7 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 15.25 m AHD **PIT No:** TP109
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.15	TOPSOIL (SILTY SAND) - dark grey-brown, fine to medium grained silty sand, with a trace of clay, wet.							
		SAND - medium dense, light yellow-brown, fine to medium grained, with a trace of silt, wet.		B	0.5 0.6			25-08-14	
	0.7	CLAYEY SAND - stiff, orange-brown mottled red-brown and light grey, fine to medium grained clayey sand, wet, medium plasticity. - with a trace of gravel from 0.8 m depth.		D U	0.9 1.0 1.3		pp - 160 kPa		
13	2.3	GRAVELLY CLAYEY SAND - orange-brown, mottled red-brown and light grey, fine to medium grained gravelly clayey sand, wet. Gravel consists of red-brown, fine to coarse sized laterite.			2.5		slow digging using 5 tonne excavator		
12	2.6	Pit discontinued at 2.6m (Refusal)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1, 2, 3

RIG: 5 Tonne Excavator with toothed bucket **LOGGED:** JK **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: Groundwater observed from 0.35 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 17.05 m AHD
EASTING:
NORTHING:

PIT No: TP110
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0.15	TOPSOIL (SILTY SAND) - dark brown, fine to medium grained, silty sand, wet.							
		SAND - medium dense, light yellow-brown, fine to medium grained sand, with a trace of silt, wet.							
		- with some clay from 0.6 m depth.							
	0.8	CLAYEY SAND - orange-brown, mottled light yellow-brown, fine to medium grained clayey sand, wet, low plasticity.		D	0.9 1.0			25-08-14	
16	1	- becoming mottled light grey with some gravel.							
	2.0	Pit discontinued at 2.0m (Collapse)							
15	2								
14	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.9 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 21.55 m AHD
EASTING:
NORTHING:

PIT No: TP111
PROJECT No: 82334
DATE: 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
21	0.1	TOPSOIL - light grey-brown, fine to medium grained sand, with some silt and rootlets, moist.							
		SAND - medium dense, light grey, fine to medium grained sand, with a trace of silt, moist.		E	0.5				
	1			E	1.0				1
20				E	1.5				
				D	1.6				
	2			E	2.0				2
	2.1	Pit discontinued at 2.1m (Collapse)							
19	3								3

Dynamic Penetrometer Test (blows per 150mm) scale: 5, 10, 15, 20

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 22.80 m AHD **PIT No:** TP112
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 25/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
22	0.1	TOPSOIL - light grey-brown, fine to medium grained sand, with some silt and rootlets, moist.							
		SAND - loose to medium dense, light yellow mottled light grey, fine to medium grained sand, with a trace of silt, moist.		E	0.5				
		- becoming medium dense from 0.6 m.							
	1	- becoming light yellow-brown from 1.0 m depth.		E	1.0				1
21				E	1.5				
				D	1.6 1.7				
	2			D	2.0 2.1				2
	2.2	Pit discontinued at 2.2m (Collapse)							
20	3								3

RIG: 5 Tonne Excavator with toothed bucket **LOGGED:** JK **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 18.20 m AHD **PIT No:** TP113
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
18	0.25	TOPSOIL (SAND) - dark brown, fine to medium grained sand with some silt, roots and rootlets, moist							
		SAND - loose, grey-brown, fine to medium grained sand, with a trace of silt and rootlets, moist.							
		- becoming medium dense from 0.45 m.							
				D	0.7				
					0.8				
		- becoming wet from 0.8 m depth.							
17	1								1
		- becoming saturated from 1.5 m depth.						▼ 26-08-14	
	1.9	Pit discontinued at 1.9m (Collapse)							
16	2								2
15	3								3

RIG: 5 Tonne Excavator with toothed bucket **LOGGED:** JK **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: Groundwater observed from 1.5 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.75 m AHD
EASTING:
NORTHING:

PIT No: TP114
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.17	TOPSOIL (SILTY SAND) - dark grey, mottled light grey, fine to medium grained silty sand, with some rootlets and a trace of clay, moist.			0.05				
		SAND - medium dense, dark grey, fine to medium grained sand, with a trace of silt and roots, moist.		B	0.3				
					0.4				
		- becoming grey-brown, fine to medium grained sand with a trace of silt, wet.		E B	0.5				
					0.6				
		- becoming light grey-brown from 0.7 m depth.							
	1	- becoming saturated from 1.0 m depth.		E	1.0			26-08-14	
				E	1.5				
15	1.7	Pit discontinued at 1.7m (Collapse)							
	2								
14	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 1.2 m depth.

REMARKS: Perched water observed on surface adjacent to test pit. Strong odour from test pit

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 14.50 m AHD
EASTING:
NORTHING:

PIT No: TP115
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
14	0.12	TOPSOIL (SILTY SAND) - dark grey, mottled light grey, fine to medium grained silty sand, with some rootlets and a trace of clay, moist.			0.05				
		SAND - loose to medium dense, brown, fine to medium grained sand, with a trace of silt, wet.						26-08-14 ▼	
		- becoming wet, sand with some clay from 0.2 m depth.			0.35		pp = 120 kPa		
	0.5	- becoming strongly cemented, light yellow-brown, sand with some silt and some gravel, dry to moist from 0.5 m depth.			0.6				
				D	0.65		pp > 600 kPa		
					0.7				
	1								1
	1.15	Pit discontinued at 1.15m (Refusal)							
13									
	2								2
12									
	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.2 m depth.

REMARKS: Perched water observed on surface adjacent to test pit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 13.90 m AHD
EASTING:
NORTHING:

PIT No: TP116
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL (SILTY SAND) - dark grey, mottled light grey, fine to medium grained silty sand, with some rootlets and a trace of clay, saturated.							
		SAND - loose, grey-brown, fine to medium grained slightly clayey sand, wet.		E	0.2				
				D	0.3				
		- with a trace of roots from 0.3 m depth.							
		- becoming medium dense and brown from 0.45 m depth.		E	0.5				
	0.6	- becoming strongly cemented, light yellow-brown, slightly silty sand, dry to moist from 0.6 m depth.			0.7		pp > 600 kPa		>>
					0.8				
13	0.9	Pit discontinued at 0.9m (Refusal)							
	1								1
12	2								2
11	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Slow digging with 5 tonne excavator. Approximately 10 min to dig 0.3 m.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 14.50 m AHD
EASTING:
NORTHING:

PIT No: TP117
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - dark grey-brown, fine to medium grained, silty sand topsoil, dry to moist.			0.05				
	0.2	CLAYEY SAND - stiff, brown, fine to medium grained clayey sand, moist.			0.15		pp = 120 kPa		
		CEMENTED SAND - strongly cemented, light brown, slightly silty sand with a trace of gravel, dry to moist.			0.3		pp > 600 kPa		
14					0.5				
				D	0.6				
	0.7	- becoming light yellow-brown mottled orange-brown, dry to moist from 0.6 m depth.			0.65		pp > 600 kPa		
		Pit discontinued at 0.7m (Refusal)			0.7				
	1								1
13									
	2								2
12									
	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Perched water and thin layer of possibly organic material observed on surface adjacent to test pit. Slow digging with a 5 tonne excavator. Approximately 10 min to dig 0.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 15.75 m AHD
EASTING:
NORTHING:

PIT No: TP118
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.2	TOPSOIL (SILTY SAND) - dark grey-brown, fine to medium grained silty sand, with some roots and a trace of clay, wet.							
		SAND - medium dense, light brown, fine to medium grained sand, with a trace of silt, wet.		E	0.5				
		- becoming orange-brown mottled red-brown mottled dark grey coarse grained sand from 0.8 m depth.		E D	0.8 0.85			▼ 26-08-14	
	0.9	Pit discontinued at 0.9m (Collapse)							
14	1								1
	2								2
13	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.8 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 17.90 m AHD
EASTING:
NORTHING:

PIT No: TP119
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0	TOPSOIL (SILTY SAND) - dark grey mottled light grey, fine to medium grained silty sand, with a trace of rootlets, moist.							
	0.15	SAND - medium dense, light brown, fine to medium grained sand, with a trace of silt, wet.							
		- becoming loose between 0.75 m and 1.0 m depth.			0.8			26-08-14	
	1	- becoming saturated from 1.0 m depth.							1
16	1.6	Pit discontinued at 1.6m (Collapse)							2
15	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.8 m depth.

REMARKS: Mild odour from test pit

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 17.95 m AHD
EASTING:
NORTHING:

PIT No: TP120
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0.25	TOPSOIL (SILTY SAND) - dark grey mottled light grey and light brown, fine to medium grained, silty sand, moist.							
		SAND - dense to medium dense, light brown, fine to medium grained sand, with a trace of silt, wet.		D	0.3				
		- with a trace of roots at 0.4 m depth.			0.4				
		- becoming light grey mottled brown from 0.5 m depth.							
	1.6	CLAYEY SAND - yellow-brown mottled grey-green, clayey sand with a trace of gravel, wet.		D	1.65			26-08-14	
	1.8	Pit discontinued at 1.8m (Collapse)			1.75				

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 1.5 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 18.15 m AHD
EASTING:
NORTHING:

PIT No: TP121
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
18	0.2	TOPSOIL (SILTY SAND) - dark grey mottled light grey silty sand with some roots and rootlets, moist.							
		SAND - medium dense, light brown, mottled orange-brown and light grey, fine to medium grained sand, with a trace of silt		B	0.4 0.5				
	0.6	SAND and GRAVELLY CLAY AND SAND - medium dense, brown, fine to medium grained sand with a trace of silt, wet observed on one half of the pit. Very stiff, orange-brown mottled grey-green, fine to medium grained gravelly clay and sand, wet, observed on the other half of test pit.		D U	1.0 1.1 1.25		pp = 270 kPa	25-08-14	
17	1.3	GRAVELLY CLAY AND SAND - very stiff, orange-brown mottled grey-green, fine to medium grained gravelly clay and sand, wet, low to medium plasiticty.							
		- becoming orange-brown mottled light grey and red-brown with some gravel from 1.7 m depth.							
		- becoming hard from 1.9 m depth.			2.0		pp > 600 kPa		
16	3.0	Pit discontinued at 3.0m (Target)							
15									

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 1.1 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.25 m AHD **PIT No:** TP122
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.15	TOPSOIL (SILTY SAND) - dark brown, fine to medium grained silty sand, with a trace of clay, moist.							
		SAND - medium dense, light brown, fine to medium grained sand, with a trace of silt, moist.		B	0.4 0.5				
	0.55	GRAVELLY CLAYEY SAND - very stiff to hard, orange-brown mottled red-brown and light grey, fine to medium grained gravelly clayey sand, moist, medium plasticity.		D U	1.0 1.1 1.2				
15	1			D	1.55 1.65				1
		- becoming hard from 1.7 m depth.		D	1.75				
	1.8	Pit discontinued at 1.8m (Refusal)			1.8				
14	2								2
13	3								3

RIG: 5 Tonne Excavator with toothed bucket **LOGGED:** JK **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 14.00 m AHD
EASTING:
NORTHING:

PIT No: TP123
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
14	0	TOPSOIL (SILTY SAND) - dark brown, fine to medium grained silty sand, with a trace of clay and rootlets, moist.							
	0.15	SAND - medium dense, light brown, fine to medium grained sand, with a trace of silt, wet.							
		- becoming brown, coarse grained sand from 0.4 m depth.							
	0.5	GRAVELLY CLAYEY SAND - firm, orange-brown mottled red-brown and light grey, fine to medium grained gravelly clayey sand, moist, medium plasticity.		E	0.5 0.55		pp = 80 kPa	▼ 26-08-13	
		- becoming hard from 0.6 m depth.			0.7		pp = 600 kPa		
		- pocket of firm, grey-green, clayey sand between 0.6 m and 0.8 m depth.							
13	1			E	1.0				1
	1.1	Pit discontinued at 1.1m (Refusal)							
12	2								2
11	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.5 m depth.

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 15.80 m AHD
EASTING:
NORTHING:

PIT No: TP124
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.2	TOPSOIL (SILTY SAND) - dark grey-brown, fine to medium grained, silty sand, with a trace of clay, wet.							
	0.6	SAND - dense, light brown, fine to medium grained sand, with a trace of silt and roots, moist.							
		GRAVELLY CLAYEY SAND - very stiff, orange-brown mottled red-brown and light grey, fine to medium grained gravelly clayey sand, moist, medium plasticity.		D	0.7			▼ 26-08-14	
14	1.9			U	0.8				
					0.95				
		Pit discontinued at 1.9m (Refusal)							
13									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1, 2, 3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.6 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 17.50 m AHD
EASTING:
NORTHING:

PIT No: TP125
PROJECT No: 82334
DATE: 26/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0.2	TOPSOIL (SILTY SAND) - dark grey, fine to medium grained, silty sand, with a trace of clay and roots, moist.							
		SAND - medium dense, light brown, fine to medium grained sand, with a trace of silt and roots, moist.		D	0.3				
					0.4				
		- becoming loose between 0.45 m and 0.75 m depth.		E	0.5				
		- with some clay from 0.6 m depth.							
		- with some gravel from 0.7 m depth.							
	1 1.0							26-08-14	1
		CLAYEY SAND - orange-brown mottled red-brown and light grey slightly gravelly clayey sand, moist, medium plasticity.		E	1.0				
				D	1.1				
					1.2				
16				E	1.5				
	2			E	2.0				2
15				E	2.5				
	2.55	Pit discontinued at 2.55m (Refusal)							
	3								3

RIG: 5 Tonne Excavator with toothed bucket

LOGGED: JK

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater observed from 0.9 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 20.60 m AHD **BORE No:** BH126
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0.1	FILLING (SAND) - brown, mottled red-brown, fine to medium grained sand filling, with some clay and a trace of rootlets and fine sized lateritic gravel, moist.							
		SAND - very dense, light grey-brown, fine to medium grained sand, with a trace of silt, moist.		D	0.45				
	0.6	Bore discontinued at 0.6m (Target)			0.6				>>
19	1								1
	2								2
18	3								3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.60 m AHD **BORE No:** BH127
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.15	TOPSOIL (SILTY SAND) - dark grey, silty sand topsoil, with a trace of clay and some roots, moist.							
		SAND - medium dense, light brown mottled grey, fine to medium grained sand, with a trace of silt, wet.							
		- becoming saturated from 0.4 m depth.		D	0.45			27-08-14	
	0.7	Bore discontinued at 0.7m (Target)			0.7				
15	1								1
	2								2
14	3								3

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: Groundwater observed at 0.4 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 15.25 m AHD **BORE No:** BH128
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.12	TOPSOIL (SLIGHTLY SILTY SAND) - dark brown, slightly silty sand, with a trace of clay and rootlets, wet.							
		SAND - medium dense, light brown, dine to medium grained sand, with some silt, wet.							
		- becoming saturated from 0.3 m depth.		D	0.45			27-08-14	
	0.6	Bore discontinued at 0.6m (Target)			0.6				
14	1								1
13	2								2
12	3								3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: Groundwater observed at 0.3 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.85 m AHD **BORE No:** BH129
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.4	TOPSOIL (SLIGHTLY SILTY SAND) - loose, dark grey mottled light grey, slightly silty sand topsoil, with a trace of clay and some roots and rootlets, moist.							
		SAND - medium dense to dense, light grey-brown, fine to medium grained sand, with a trace of silt, wet.						▼ 27-08-14	
		- becoming saturated from 0.5 m depth.							
		- becoming dense from 0.75 m depth.		D	0.85				
1	1.0	Bore discontinued at 1.0m (Target)			1.0				
15	2								
14	3								

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: Groundwater observed at 0.5 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 15.40 m AHD **BORE No:** BH130
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.06	TOPSOIL (SAND) - brown, fine to medium grained sand topsoil, with some silt and rootlets, moist.							
		SAND - dense to medium dense, grey-brown sand with some silt and a trace of gravel, moist.							
		- becoming brown from 0.3 m depth.		D	0.45			▼ 27-08-14	
	0.6	Bore discontinued at 0.6m (Target)			0.6				
14	1								1
13	2								2
12	3								3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: Groundwater observed at 0.45 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 20.05 m AHD **BORE No:** BH131
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0.1	TOPSOIL (SAND) - brown, mottled light grey, fine to medium grained sand topsoil, with a trace of silt and rootlets, dry to moist.							
		SAND - loose, light grey-brown, fine to medium grained sand, with a trace of silt, moist.							
		- becoming medium dense from 0.3 m.		D	0.45				
	0.6	Bore discontinued at 0.6m (Target)			0.6				
19	1								1
18	2								2
17	3								3

Dynamic Penetrometer Test (blows per 150mm) scale: 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 21.65 m AHD **BORE No:** BH132
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
21	0.08	TOPSOIL (SAND) - dark brown, mottled grey, fine to medium grained sand topsoil, with some silt, and a trace of rootlets, moist.							
		SAND - loose, light brown mottled grey, fine to medium grained sand, with a trace of silt, moist.							
		- becoming medium dense from 0.45 m.		D	0.45				
	0.7	Bore discontinued at 0.7m (Target)			0.7				
20	1								1
	2								2
19	3								3

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 14.50 m AHD **BORE No:** BH133
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
14	0.1	TOPSOIL (SLIGHTLY SILTY SAND) - dark grey-brown, fine to medium grained, slightly silty sand topsoil, with a trace of rootlets, wet.							
		SAND - medium dense, light grey-brown, fine to medium grained sand, with a trace of silt, wet.						28-08-14 ▼	
		- becoming saturated from 0.4 m depth. - loose between 0.45 m and 0.75 m depth.		D	0.45				
13	0.6	Bore discontinued at 0.6m (Target)			0.6				
12	1								1
	2								2
	3								3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: Groundwater observed at 0.3 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 20.40 m AHD **BORE No:** BH134A
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0.1	TOPSOIL (SAND) - brown, mottled light grey, fine to medium grained sand, with a trace of silt and rootlets, moist.							
		SAND - medium dense, light grey mottled brown, fine to medium grained sand, with a trace of silt, moist.							
	1								1
19		- with a trace of weakly cemented sand (coffee rock) at 1.6 m depth.							
		- becoming brown with some cemented sand (coffee rock) from 1.7 m depth.							
		- becoming orange-brown, fine to medium grained sand, with a trace to some silt, moist.							
	2	- becoming yellow-brown with a trace of clay from 2.0 m depth.							2
	2.25	SLIGHTLY GRAVELLY CLAYEY SAND - light yellow-brown, fine to medium grained, slightly gravelly clayey sand, moist.		D	2.3 2.4				
18	2.5	Bore discontinued at 2.5m (Target)							
	3								3
17									

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 22.35 m AHD **BORE No:** BH134B
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
22	0.1	TOPSOIL - light grey-brown, fine to medium grained sand, with some silt and rootlets, moist.							
		SAND - medium dense, light yellow-brown mottled light grey, fine to medium grained sand, with a trace of silt, moist.							
	1	- becoming light yellow-brown from 0.9 m depth.							1
21		- becoming orange-brown from 1.5 m depth.							
				D	1.9				
	2								2
	2.1	Bore discontinued at 2.1m (Target)			2.1				
20									
	3								3
19									

Dynamic Penetrometer Test (blows per 150mm) scale: 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Peet Stratton Pty Ltd
PROJECT: Lots 50, 102, and 427 Farrall Road
LOCATION: Midvale, WA

SURFACE LEVEL: 16.25 m AHD **BORE No:** BH135
EASTING: **PROJECT No:** 82334
NORTHING: **DATE:** 27/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.15	TOPSOIL (SILTY SAND) - dark grey-brown, fine to medium grained, silty sand, with a trace of clay and rootlets, moist.							
		SAND - medium dense, dark grey mottled light grey, fine to medium grained, with some silt, wet.							
		- becoming grey-brown with some silt from 0.35 m depth.							
		- becoming saturated from 0.4 m depth.		D	0.45			28-08-14 ▼	
	0.6	Bore discontinued at 0.6m (Target)			0.6				
15	1								1
14	2								2
13	3								3

Dynamic Penetrometer Test (blows per 150mm): 5 10 15 20

RIG: 110 mm Hand Auger **DRILLER:** JK **LOGGED:** JK **CASING:** No casing

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: Groundwater observed at 0.35 m depth.

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C

Geotechnical Laboratory Testing

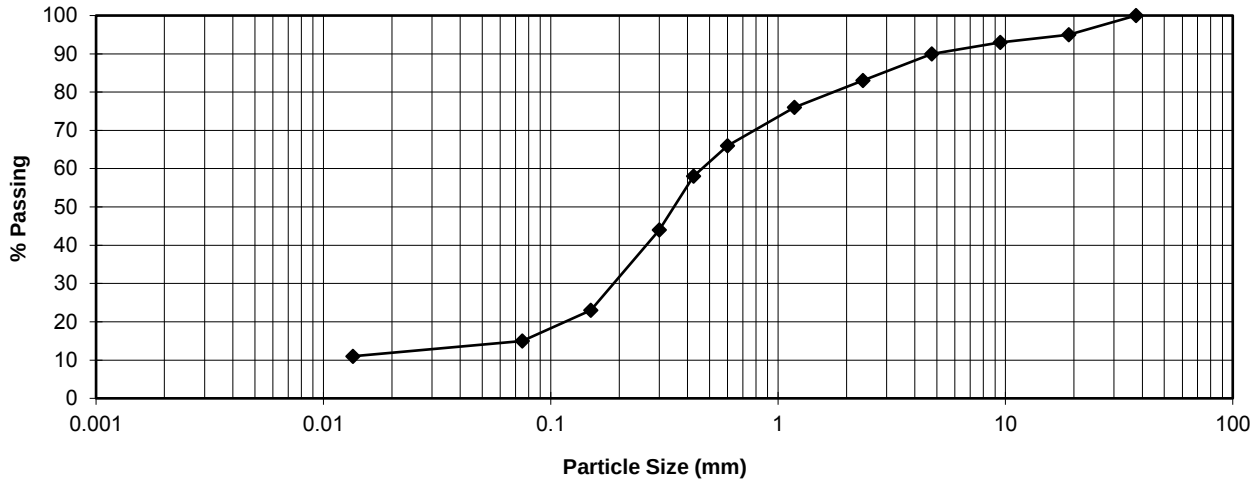
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3277
Sample No:	P14/3277
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP101
Sample Depth(m): 1.5 - 1.6



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	100
19.0	95
9.5	93
4.75	90
2.36	83
1.18	76
0.600	66
0.425	58
0.300	44
0.150	23
0.075	15
0.0135	11

Plasticity index tests
AS 1289

Liquid limit 3.9.1	20	%
Plastic limit 3.2.1	13	%
Plasticity index 3.3.1	7	%
Linear shrinkage 3.4.1	2.5	%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

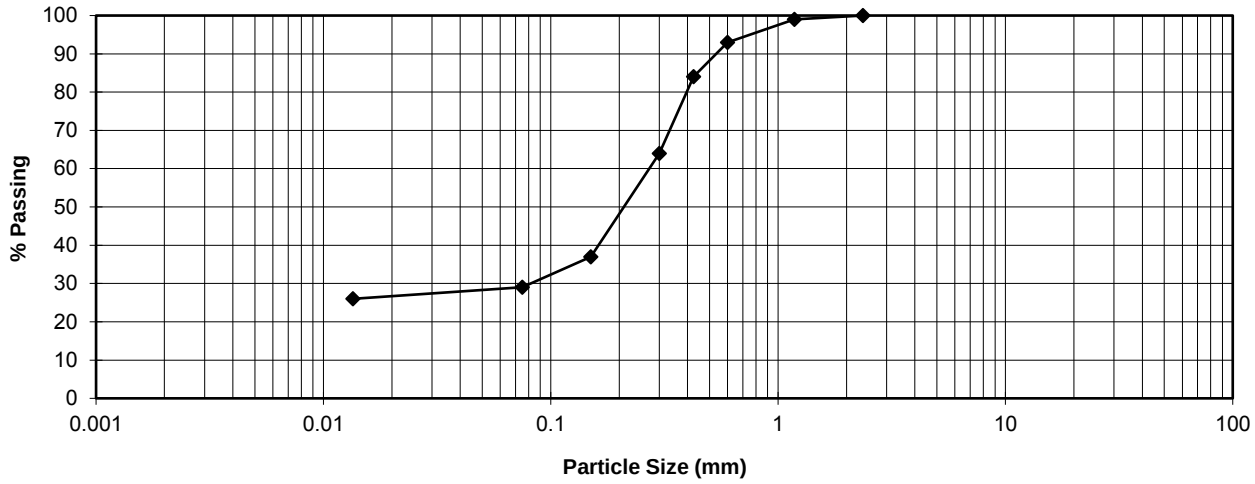
Particle Size Distribution & Plasticity Index tests

Mining &
Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3278
Sample No:	P14/3278
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP102
Sample Depth(m): 0.9 - 1.0



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	93
0.425	84
0.300	64
0.150	37
0.075	29
0.0135	26

Plasticity index tests
AS 1289

Liquid limit 3.9.1	25	%
Plastic limit 3.2.1	11	%
Plasticity index 3.3.1	14	%
Linear shrinkage 3.4.1	5.5	%

Cracked ☐

Curled ☑

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

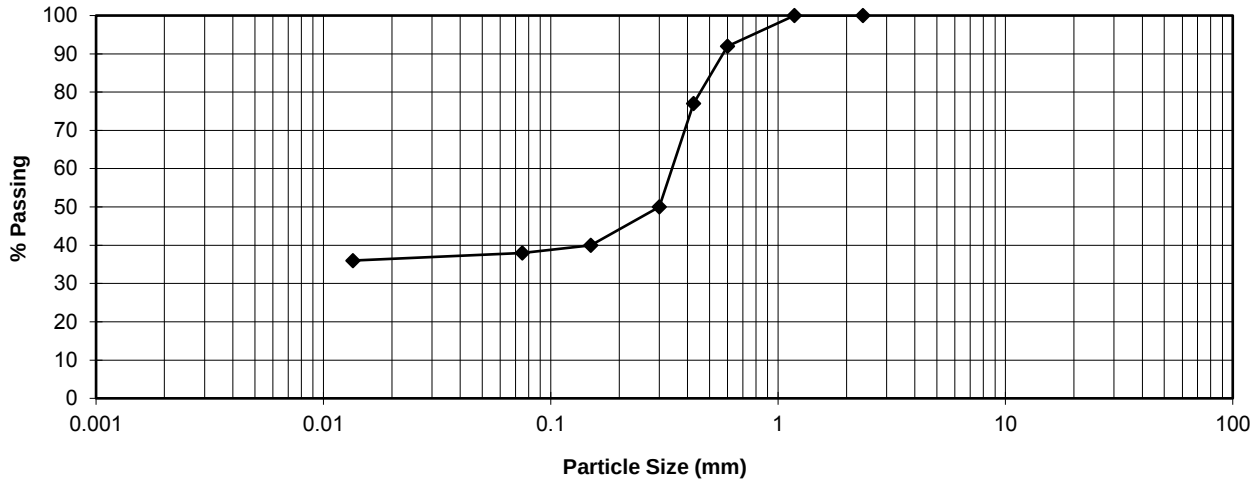
Particle Size Distribution & Plasticity Index tests

Mining &
Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3279
Sample No:	P14/3279
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP103
Sample Depth(m): 1.1 - 1.2



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	92
0.425	77
0.300	50
0.150	40
0.075	38
0.0135	36

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

Mining & Civil Geotest Pty Ltd

Ph (08) 9414 8022 Fax (08) 9414 8011
Email matt@mcgeotest.com.au
Unit 1/1 Pusey Road, JANDAKOT WA 6164

Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3280
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP103 1.1-1.5	Sample No:	P14/3280

Sample details

Sample description : Grey/Red Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.67	Moisture Content Initial (%)	21.3
Moisture Content - Initial (%)	21.1	Length/Diameter Ratio	2.4
Moisture Content - Final (%)	22.2	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	2		

Shrink-Swell Index

I_{ss} = **1.0** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

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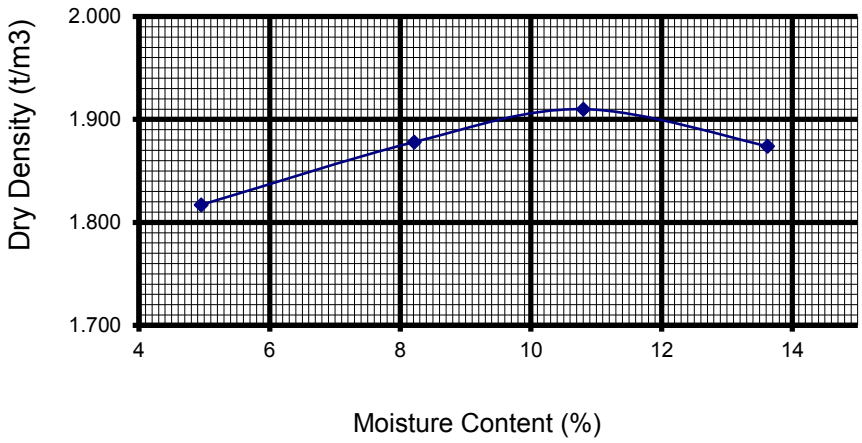
Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3281	**Project:**	Lots 50, 102 & 427 Farrall Road
Sample No:	P14/3281	**Client:**	Peet Stratton Pty Ltd
Location:	Midvale WA	**Date of Issue:**	17 September 2014
	TP104 0.5 - 0.6	**Job No:**	60017

Maximum Dry Density t/m^3:	1.910	**Conditions at Test**	
Optimum Moisture Content %:	10.8	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	11.3
Mass of hammer kg	4.9	Entire Moisture Ratio %	104.5
Number of layers	5	Top 30mm Moisture Content %	12.3
Number of blows/layer	15	Top 30mm Moisture Ratio %	114.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.819	C.B.R. at 5.0 mm Penetration %	40
Moisture Content %	10.3	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.819
Moisture Ratio %	95.5	Moisture Content %	11.8
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	109.0

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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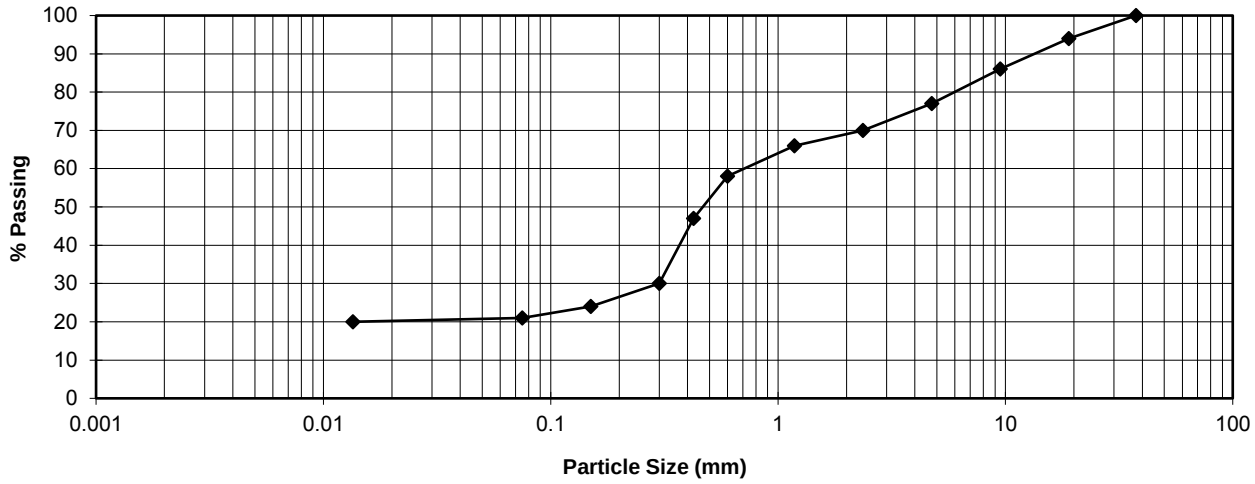
Job No:	60017
Report No:	60017-P14/3282
Sample No:	P14/3282
Issue Date:	17 September 2014

Client:	Peet Stratton Pty Ltd	Sample ID:	TP104
Project:	Lots 50, 102 and 427 Farrall Road	Sample Depth(m):	1.6 - 1.7
Location:	Midvale, WA		



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	100
19.0	94
9.5	86
4.75	77
2.36	70
1.18	66
0.600	58
0.425	47
0.300	30
0.150	24
0.075	21
0.0135	20

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

AS PSDPI May 2009

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Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3283
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP104 1.6-2.0	Sample No:	P14/3283

Sample details

Sample description : Grey/Red Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.70	Moisture Content Initial (%)	19.1
Moisture Content - Initial (%)	19.3	Length/Diameter Ratio	2.2
Moisture Content - Final (%)	21.4	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **1.0** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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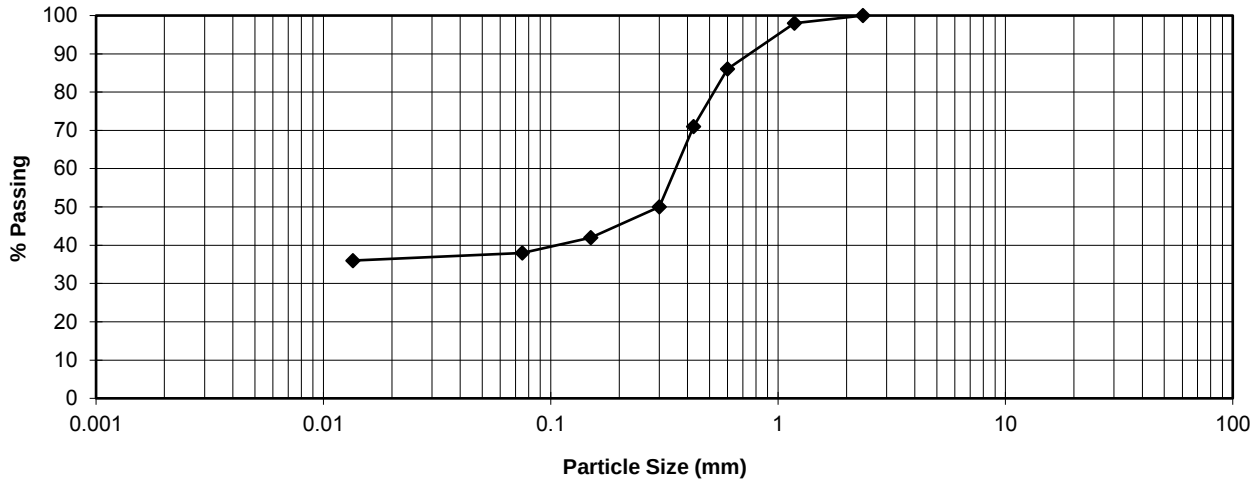
Job No:	60017
Report No:	60017-P14/3284
Sample No:	P14/3284
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP105
Sample Depth(m): 0.9 - 1.0



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	98
0.600	86
0.425	71
0.300	50
0.150	42
0.075	38
0.0135	36

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

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Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3285
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP105 0.9-1.2	Sample No:	P14/3285

Sample details

Sample description : Grey/Light Brown Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.64	Moisture Content Initial (%)	18.9
Moisture Content - Initial (%)	18.8	Length/Diameter Ratio	2.2
Moisture Content - Final (%)	21.9	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **1.7** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

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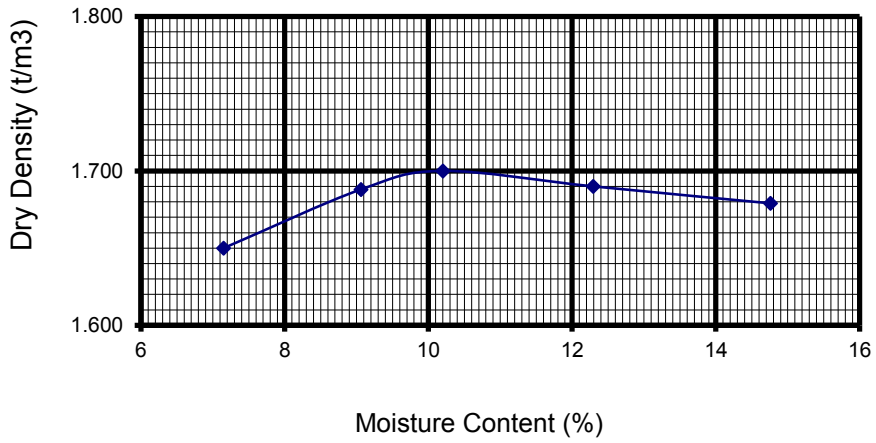
Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3286	**Project:**	Lots 50, 102 & 427 Farrall Road
Sample No:	P14/3286	**Client:**	Peet Stratton Pty Ltd
Location:	Midvale WA	**Date of Issue:**	17 September 2014
	TP106 0.5 - 0.6	**Job No:**	60017

Maximum Dry Density t/m^3:	1.700	**Conditions at Test**	
Optimum Moisture Content %:	10.2	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	16.9
Mass of hammer kg	4.9	Entire Moisture Ratio %	165.5
Number of layers	5	Top 30mm Moisture Content %	16.0
Number of blows/layer	15	Top 30mm Moisture Ratio %	156.5
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.618	C.B.R. at 2.5 mm Penetration %	18
Moisture Content %	9.9	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.618
Moisture Ratio %	96.5	Moisture Content %	17.2
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	168.5

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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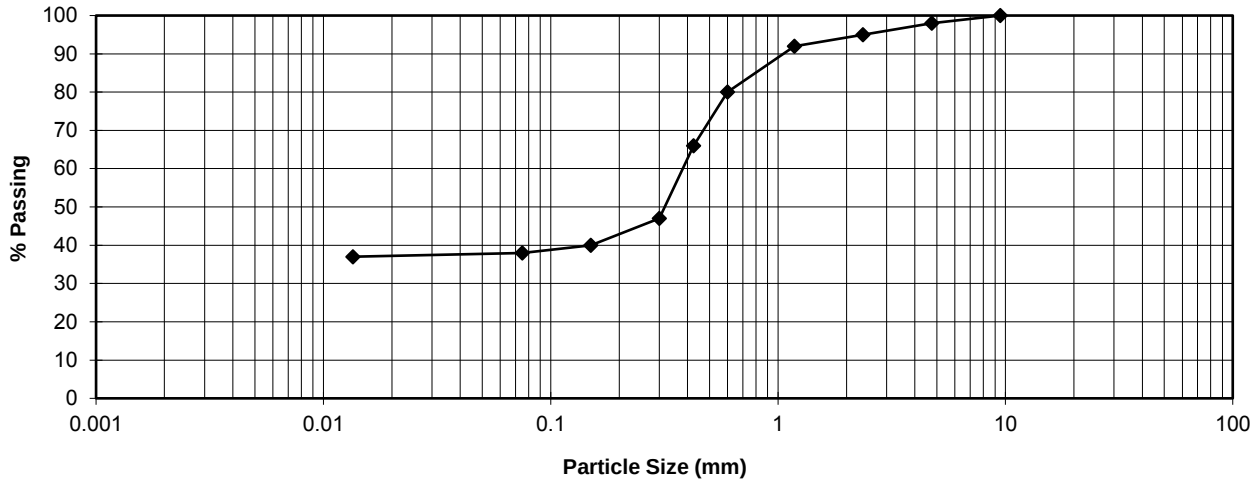
Job No:	60017
Report No:	60017-P14/3287
Sample No:	P14/3287
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP107
Sample Depth(m): 0.9 - 1.0



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	98
2.36	95
1.18	92
0.600	80
0.425	66
0.300	47
0.150	40
0.075	38
0.0135	37

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

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Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3288
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP107 0.9-1.6	Sample No:	P14/3288

Sample details

Sample description : Grey/Light Brown Sandy Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.67	Moisture Content Initial (%)	17.9
Moisture Content - Initial (%)	19.0	Length/Diameter Ratio	2.3
Moisture Content - Final (%)	21.6	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **0.9** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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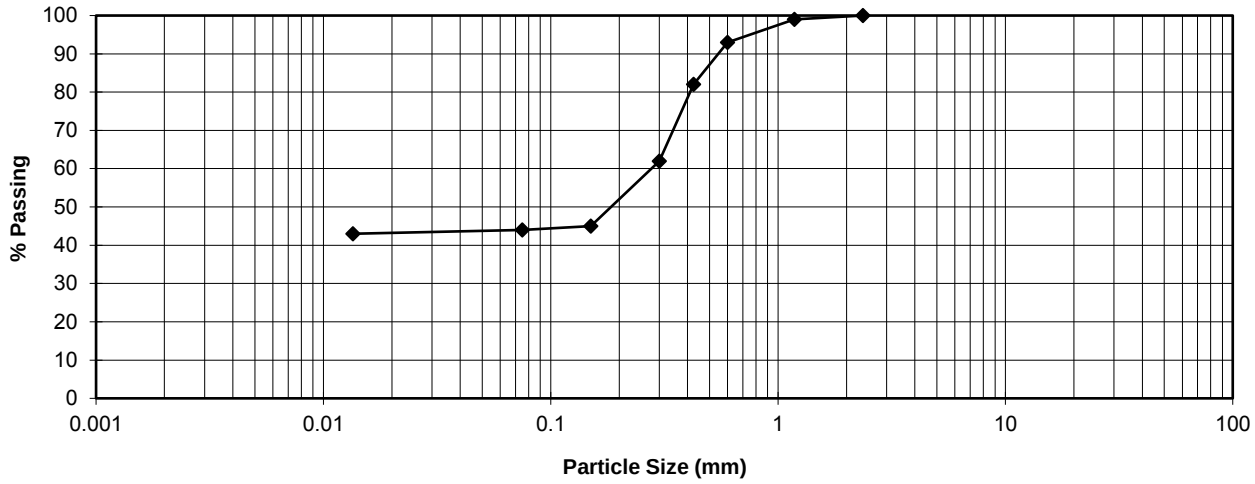
Job No:	60017
Report No:	60017-P14/3289
Sample No:	P14/3289
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP108
Sample Depth(m): 1.0- 1.1



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	93
0.425	82
0.300	62
0.150	45
0.075	44
0.0135	43

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk
AS PSDPI May 2009

Mining & Civil Geotest Pty Ltd

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Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3290
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP108 1.0-1.39	Sample No:	P14/3290

Sample details

Sample description : Grey/Yellow Sandy Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.79	Moisture Content Initial (%)	14.9
Moisture Content - Initial (%)	14.7	Length/Diameter Ratio	2.6
Moisture Content - Final (%)	16.2	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **1.7** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

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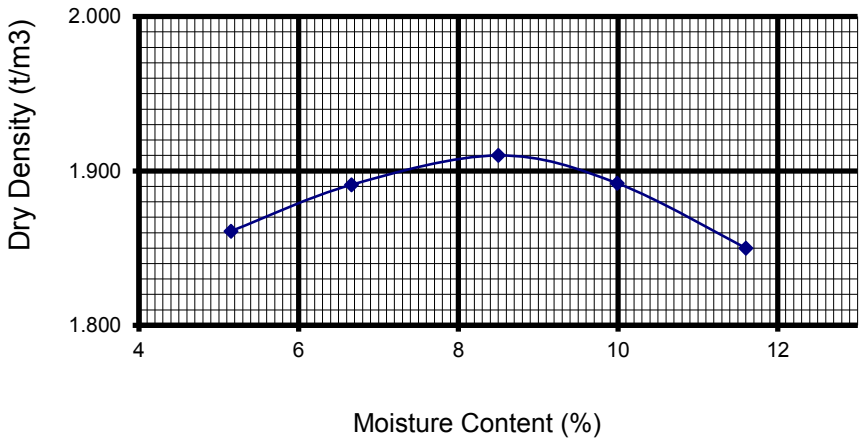
Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3291	**Project:**	Lots 50, 102 & 427 Farrall Road
Sample No:	P14/3291	**Client:**	Peet Stratton Pty Ltd
Location:	Midvale WA	**Date of Issue:**	17 September 2014
	TP109 0.5 - 0.6	**Job No:**	60017

Maximum Dry Density t/m^3:	1.910	**Conditions at Test**	
Optimum Moisture Content %:	8.5	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	11.7
Mass of hammer kg	4.9	Entire Moisture Ratio %	137.0
Number of layers	5	Top 30mm Moisture Content %	12.7
Number of blows/layer	15	Top 30mm Moisture Ratio %	150.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.818	C.B.R. at 2.5 mm Penetration %	20
Moisture Content %	8.4	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.818
Moisture Ratio %	99.5	Moisture Content %	12.1
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	142.0

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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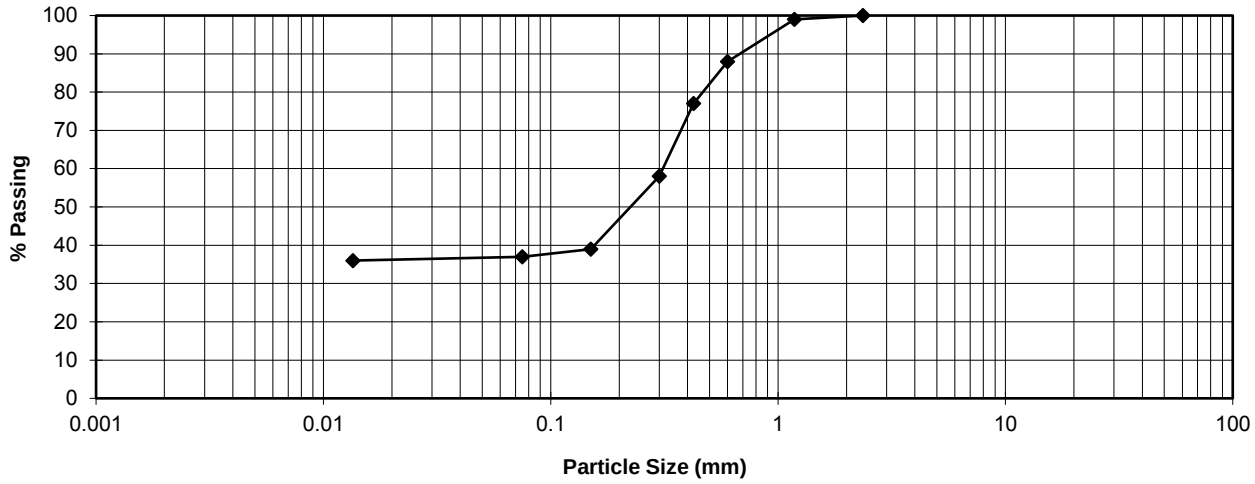
Job No:	60017
Report No:	60017-P14/3292
Sample No:	P14/3292
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP109
Sample Depth(m): 0.9 - 1.0



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	88
0.425	77
0.300	58
0.150	39
0.075	37
0.0135	36

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

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Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3293
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP109 0.9-1.3	Sample No:	P14/3293

Sample details

Sample description : Grey/Yellow Sandy Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.74	Moisture Content Initial (%)	16.5
Moisture Content - Initial (%)	16.6	Length/Diameter Ratio	2.5
Moisture Content - Final (%)	17.7	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **1.8** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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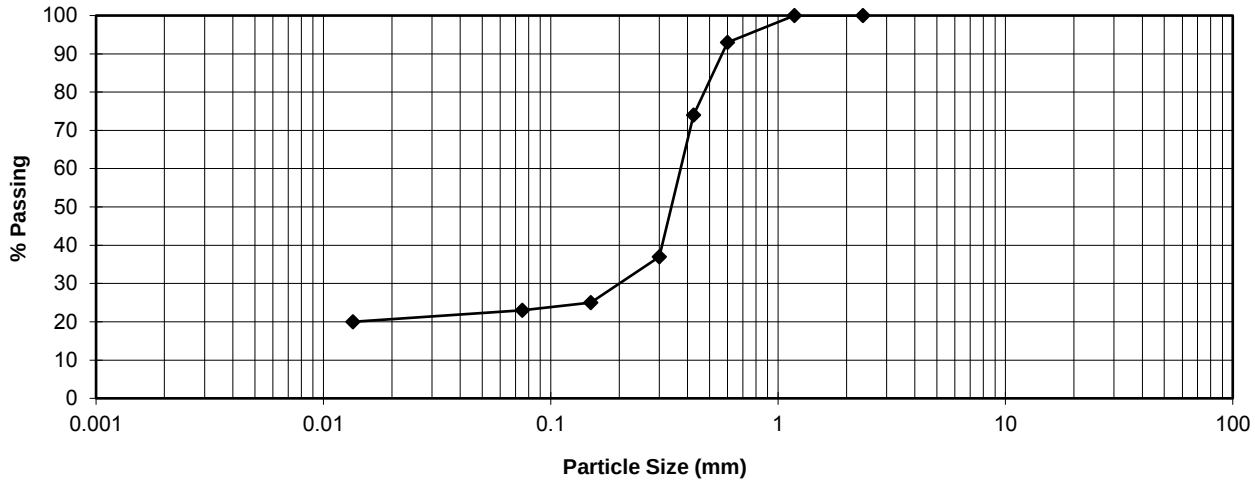
Job No:	60017
Report No:	60017-P14/3294
Sample No:	P14/3294
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP110
Sample Depth(m): 0.9 - 1.0



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	93
0.425	74
0.300	37
0.150	25
0.075	23
0.0135	20

Plasticity index tests
AS 1289

Liquid limit 3.9.1	28	%
Plastic limit 3.2.1	15	%
Plasticity index 3.3.1	13	%
Linear shrinkage 3.4.1	5.0	%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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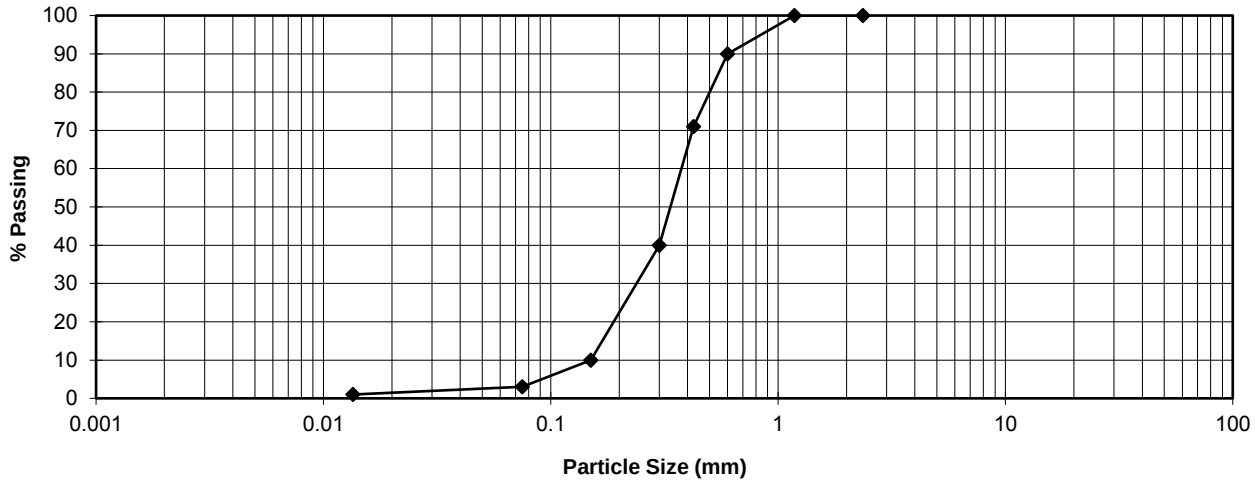
Job No:	60017
Report No:	60017-P14/3295
Sample No:	P14/3295
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP111
Sample Depth(m): 1.5 - 1.6



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	90
0.425	71
0.300	40
0.150	10
0.075	3
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining &
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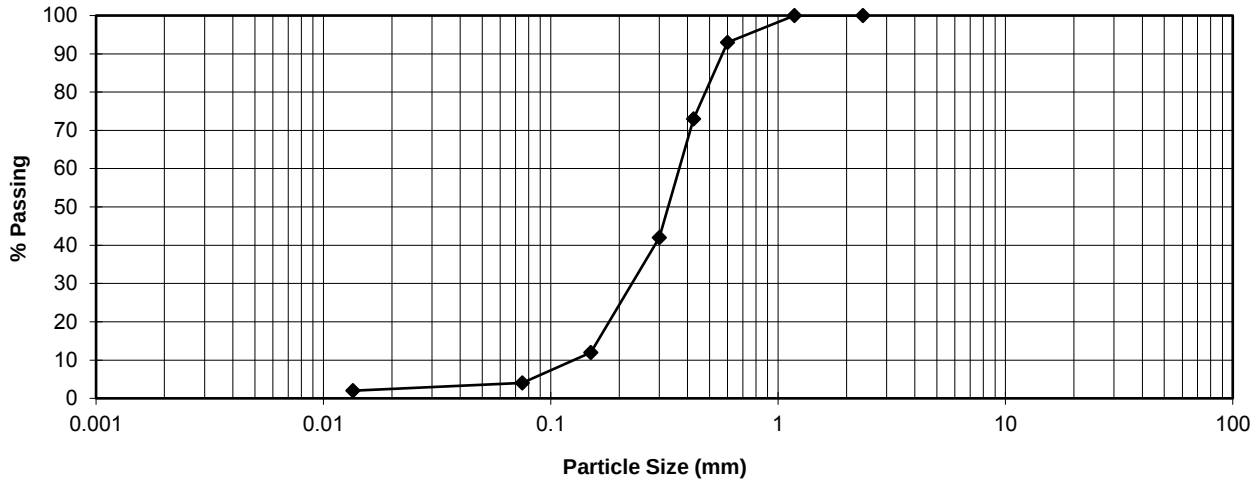
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3296
Sample No:	P14/3296
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP112
Sample Depth(m): 2.0 - 2.1



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	93
0.425	73
0.300	42
0.150	12
0.075	4
0.0135	2

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Mining &
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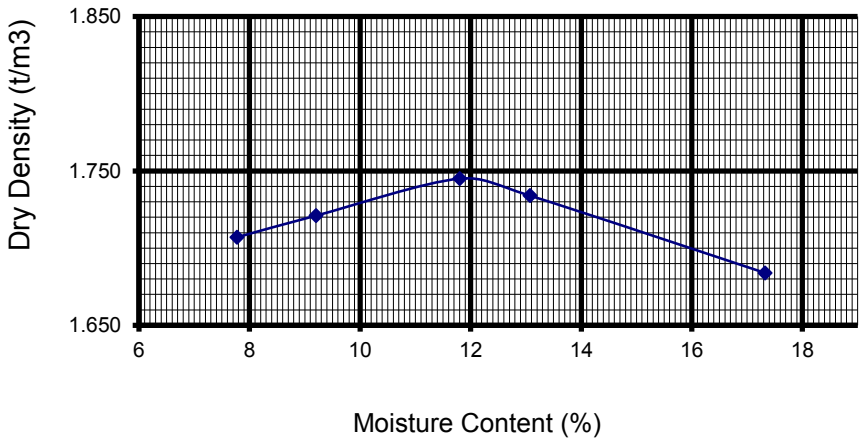
Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3297	**Project:**	Lots 50, 102 & 427 Farrall Road
Sample No:	P14/3297	**Client:**	Peet Stratton Pty Ltd
Location:	Midvale WA	**Date of Issue:**	17 September 2014
	TP114 0.3 - 0.4	**Job No:**	60017

Maximum Dry Density t/m^3:	1.745	**Conditions at Test**	
Optimum Moisture Content %:	11.8	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	16.4
Mass of hammer kg	4.9	Entire Moisture Ratio %	139.5
Number of layers	5	Top 30mm Moisture Content %	16.2
Number of blows/layer	15	Top 30mm Moisture Ratio %	137.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.656	C.B.R. at 2.5 mm Penetration %	20
Moisture Content %	11.8	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.656
Moisture Ratio %	100.0	Moisture Content %	17.7
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	149.5

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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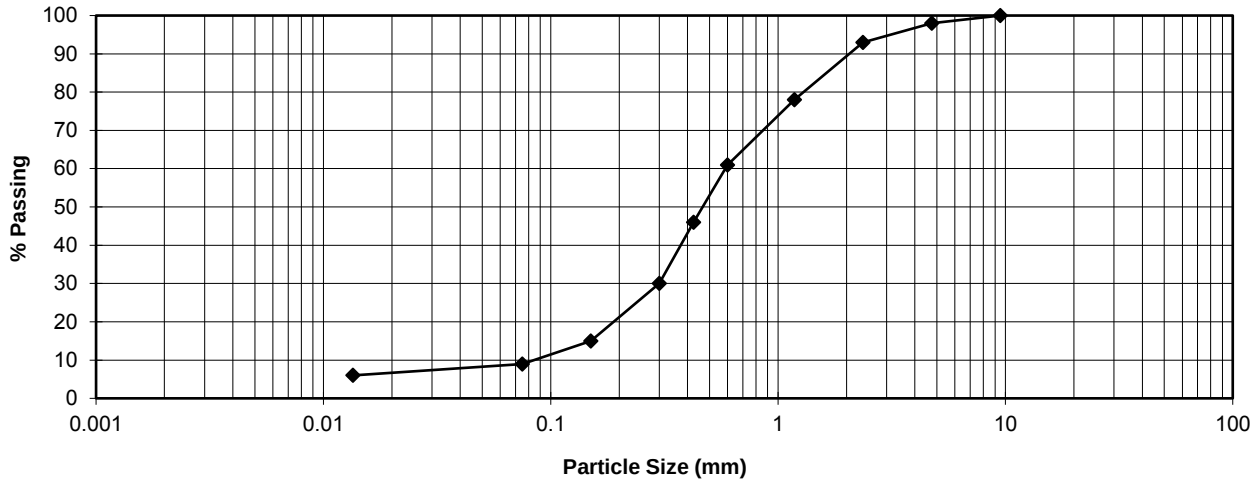
Job No:	60017
Report No:	60017-P14/3298
Sample No:	P14/3298
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP115
Sample Depth(m): 0.6 - 0.7



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	98
2.36	93
1.18	78
0.600	61
0.425	46
0.300	30
0.150	15
0.075	9
0.0135	6

Plasticity index tests
AS 1289

Liquid limit 3.9.1	SIC	%
Plastic limit 3.2.1	NP	%
Plasticity index 3.3.1	NP	%
Linear shrinkage 3.4.1	*0.0	%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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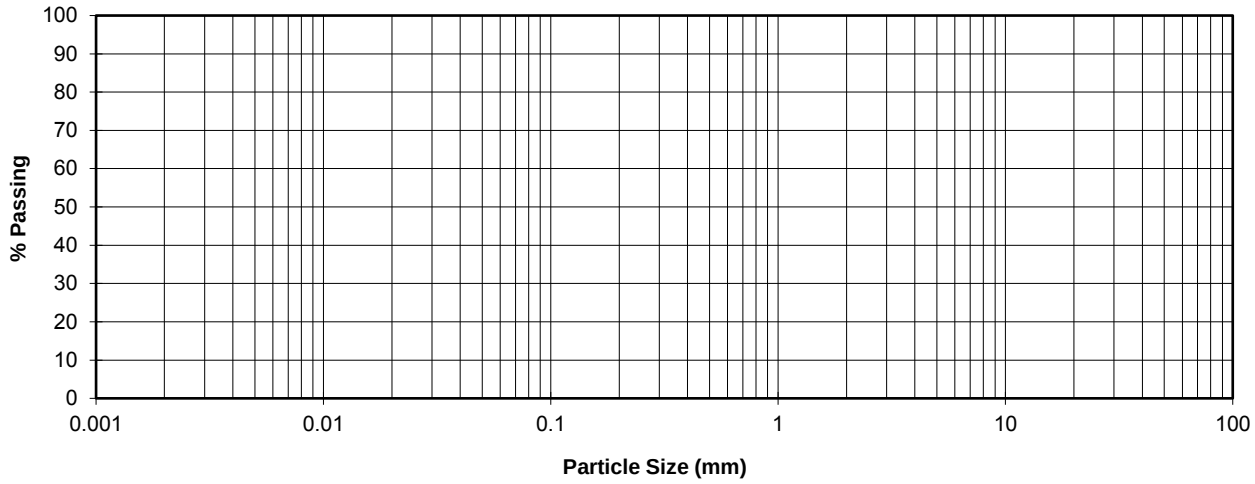
Job No:	60017
Report No:	60017-P14/3299
Sample No:	P14/3299
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP116
Sample Depth(m): 0.2 - 0.3



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	
0.0135	

Plasticity index tests
AS 1289

Liquid limit 3.9.1	27	%
Plastic limit 3.2.1	12	%
Plasticity index 3.3.1	15	%
Linear shrinkage 3.4.1	6.0	%

Cracked ☐

Curled ☑

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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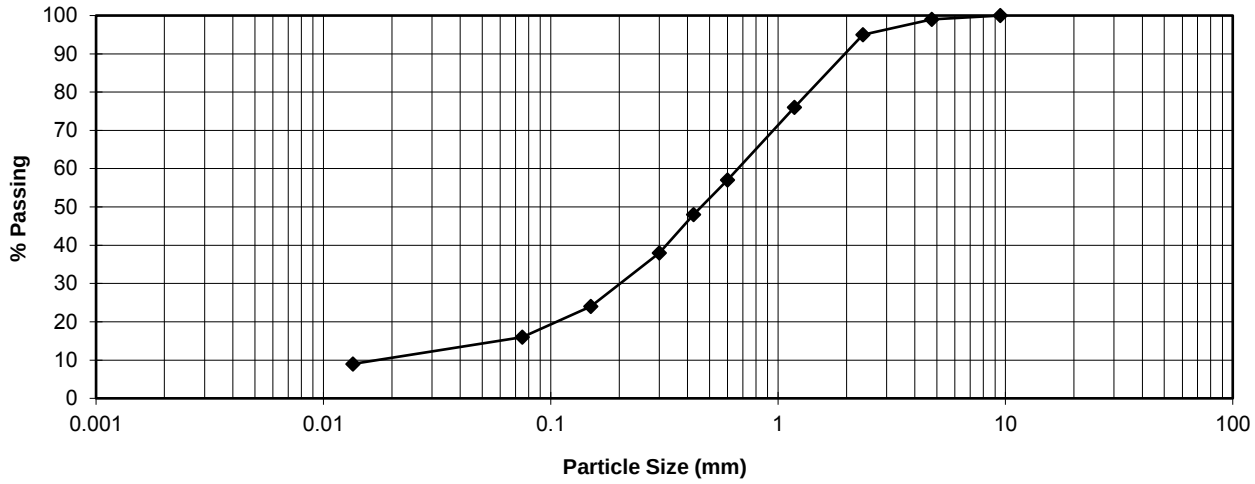
Job No:	60017
Report No:	60017-P14/3300
Sample No:	P14/3300
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP117
Sample Depth(m): 0.5 - 0.6



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	99
2.36	95
1.18	76
0.600	57
0.425	48
0.300	38
0.150	24
0.075	16
0.0135	9

Plasticity index tests
AS 1289

Liquid limit 3.9.1	SIC	%
Plastic limit 3.2.1	NP	%
Plasticity index 3.3.1	NP	%
Linear shrinkage 3.4.1	*0.0	%

Cracked ☐

Curled ☑

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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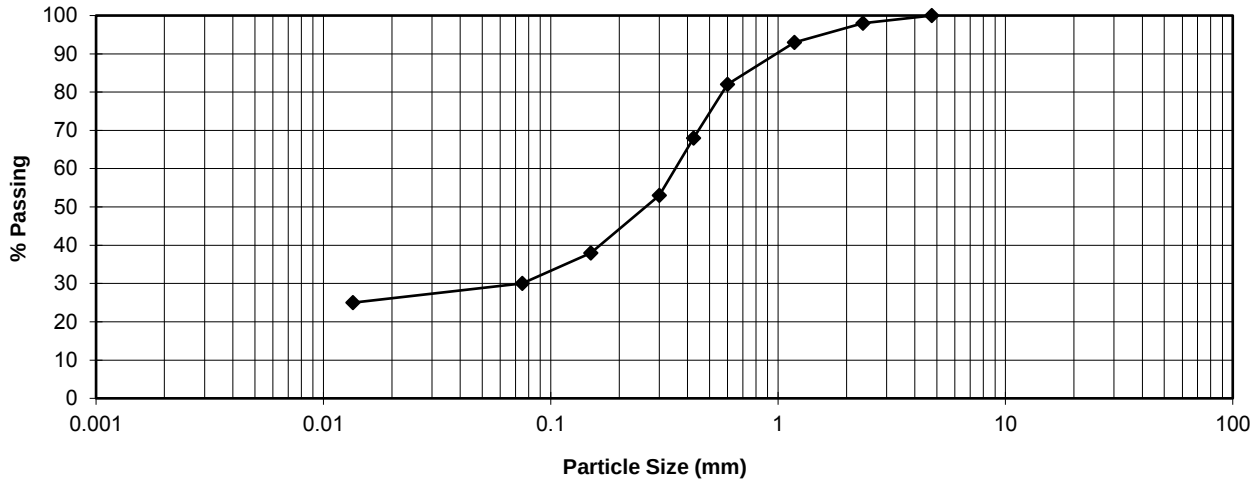
Job No:	60017
Report No:	60017-P14/3301
Sample No:	P14/3301
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP120
Sample Depth(m): 1.65 - 1.75



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	98
1.18	93
0.600	82
0.425	68
0.300	53
0.150	38
0.075	30
0.0135	25

Plasticity index tests
AS 1289

Liquid limit 3.9.1	39	%
Plastic limit 3.2.1	13	%
Plasticity index 3.3.1	26	%
Linear shrinkage 3.4.1	9.0	%

Cracked ☐

Curled ☑

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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Approved signature

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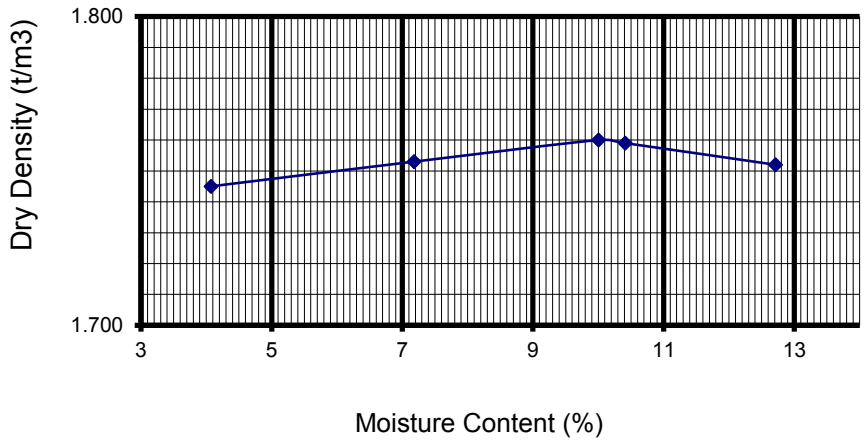
Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3302	**Project:**	Lots 50, 102 & 427 Farrall Road
Sample No:	P14/3302	**Client:**	Peet Stratton Pty Ltd
Location:	Midvale WA	**Date of Issue:**	17 September 2014
	TP121 0.4 - 0.5	**Job No:**	60017

Maximum Dry Density t/m^3:	1.760	**Conditions at Test**	
Optimum Moisture Content %:	10.0	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	16.6
Mass of hammer kg	4.9	Entire Moisture Ratio %	166.0
Number of layers	5	Top 30mm Moisture Content %	16.7
Number of blows/layer	15	Top 30mm Moisture Ratio %	166.5
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.676	C.B.R. at 2.5 mm Penetration %	25
Moisture Content %	10.1	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.676
Moisture Ratio %	100.5	Moisture Content %	20.0
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	200.0

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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unit1/1 Pusey Road, Jandakot, WA 6164
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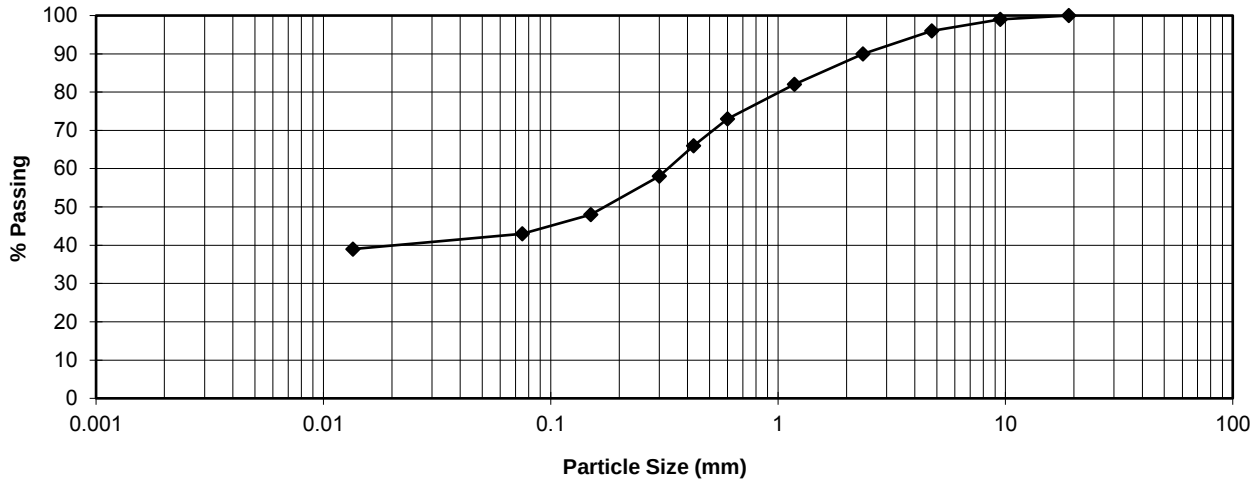
Job No:	60017
Report No:	60017-P14/3303
Sample No:	P14/3303
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP121
Sample Depth(m): 1.0 - 1.1



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	99
4.75	96
2.36	90
1.18	82
0.600	73
0.425	66
0.300	58
0.150	48
0.075	43
0.0135	39

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

AS PSDPI May 2009

Mining & Civil Geotest Pty Ltd

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Unit 1/1 Pusey Road, JANDAKOT WA 6164

Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3304
		Date of issue:	17 September 2014
Client:	Peet Stratton Pty Ltd	Date tested:	4 September 2014
Project:	Lots 50, 102 & 427 Farrall Road	Tested by:	W Old
Location:	Midvale WA	Checked:	M van Herk
Sample:	TP121 0.9-1.3	Sample No:	P14/3304

Sample details

Sample description : Brown Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.72	Moisture Content Initial (%)	18.6
Moisture Content - Initial (%)	19.0	Length/Diameter Ratio	2.7
Moisture Content - Final (%)	20.4	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **1.4** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

Mining &
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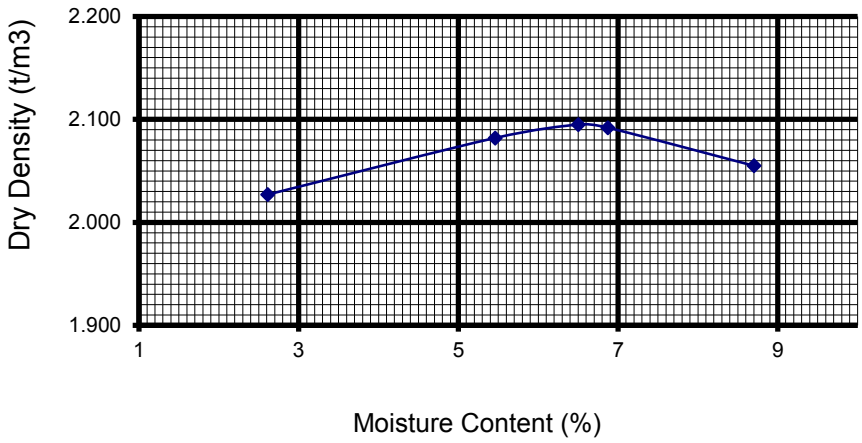
Email matt@mcgeotest.com.au

Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3305	**Project:**	Lots 50, 102 & 427 Farrall Road
Sample No:	P14/3305	**Client:**	Peet Stratton Pty Ltd
Location:	Midvale WA	**Date of Issue:**	17 September 2014
	TP122 0.4 - 0.5	**Job No:**	60017

Maximum Dry Density t/m^3:	2.095	**Conditions at Test**	
Optimum Moisture Content %:	6.5	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	9.7
Mass of hammer kg	4.9	Entire Moisture Ratio %	150.0
Number of layers	5	Top 30mm Moisture Content %	11.0
Number of blows/layer	14	Top 30mm Moisture Ratio %	169.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.992	C.B.R. at 2.5 mm Penetration %	20
Moisture Content %	6.5	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.992
Moisture Ratio %	99.5	Moisture Content %	11.2
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	171.5

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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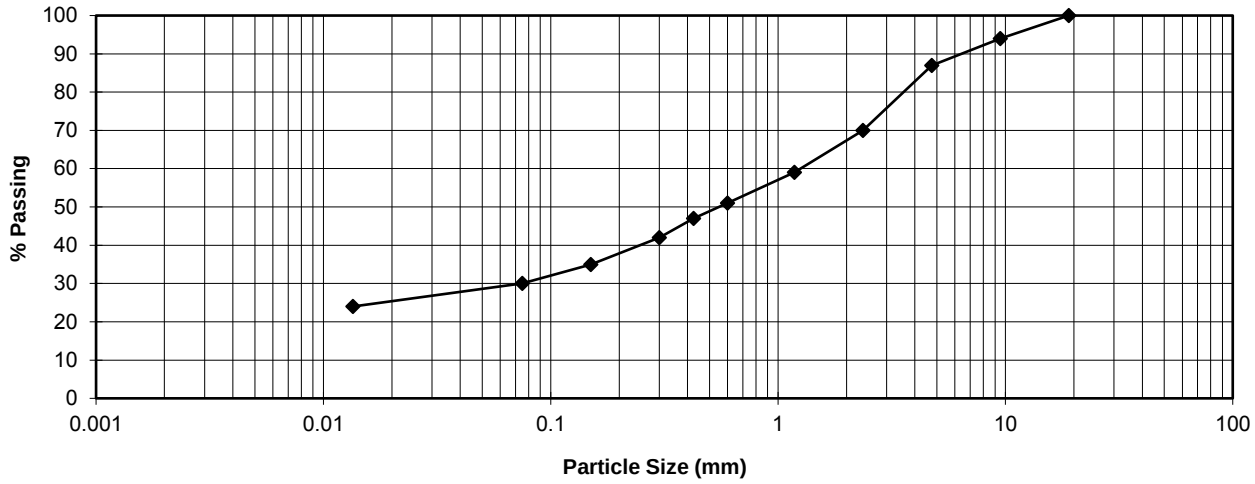
Job No:	60017
Report No:	60017-P14/3306
Sample No:	P14/3306
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP122
Sample Depth(m): 1.0 - 1.1



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	94
4.75	87
2.36	70
1.18	59
0.600	51
0.425	47
0.300	42
0.150	35
0.075	30
0.0135	24

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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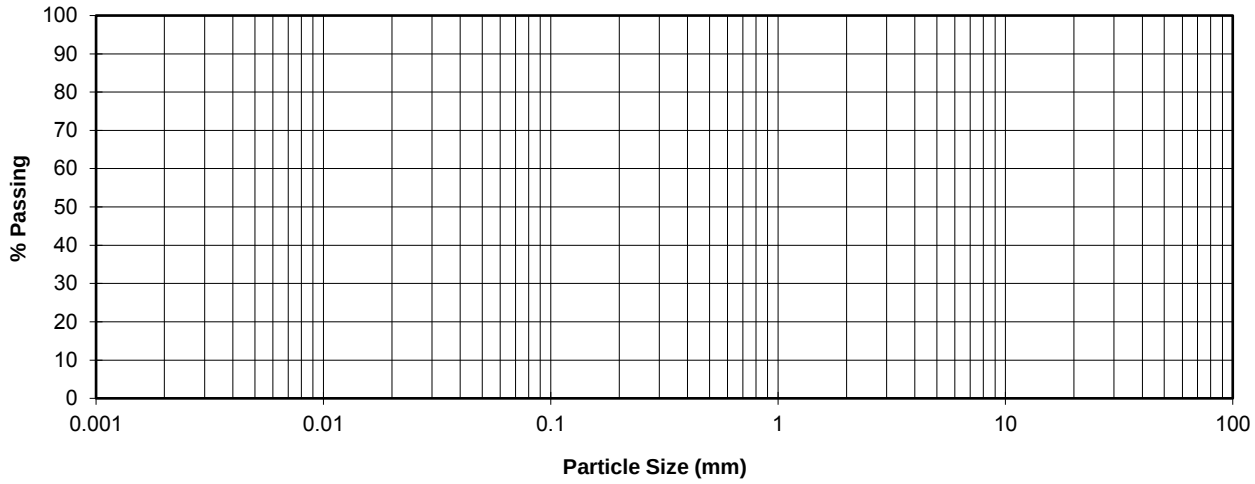
Job No:	60017
Report No:	60017-P14/3307
Sample No:	P14/3307
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP122
Sample Depth(m): 1.0 - 1.2



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	
0.0135	

Plasticity index tests
AS 1289

Liquid limit 3.9.1	38	%
Plastic limit 3.2.1	15	%
Plasticity index 3.3.1	23	%
Linear shrinkage 3.4.1	10.5	%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
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Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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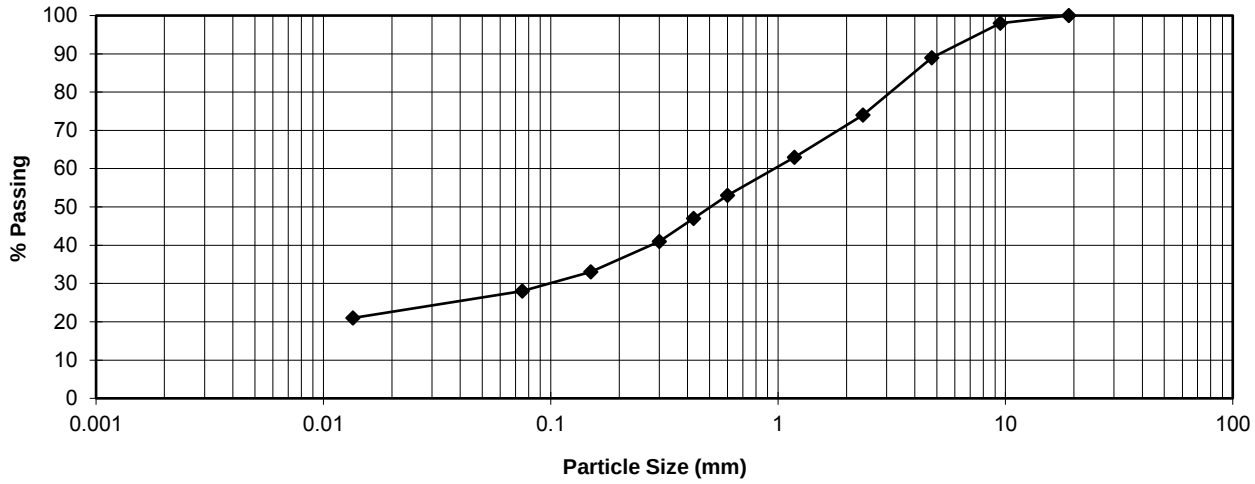
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3308
Sample No:	P14/3308
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP124
Sample Depth(m): 0.7 - 0.8



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	98
4.75	89
2.36	74
1.18	63
0.600	53
0.425	47
0.300	41
0.150	33
0.075	28
0.0135	21

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining & Civil
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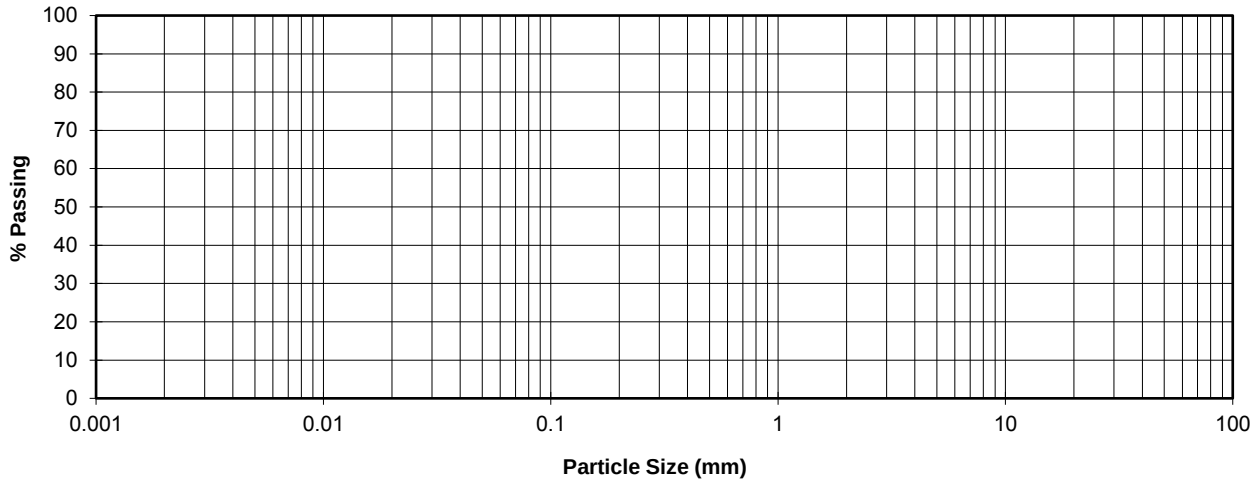
Job No:	60017
Report No:	60017-P14/3309
Sample No:	P14/3309
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP124
Sample Depth(m): 0.7 - 0.95



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	
0.0135	

Plasticity index tests
AS 1289

Liquid limit 3.9.1	40	%
Plastic limit 3.2.1	17	%
Plasticity index 3.3.1	23	%
Linear shrinkage 3.4.1	10.5	%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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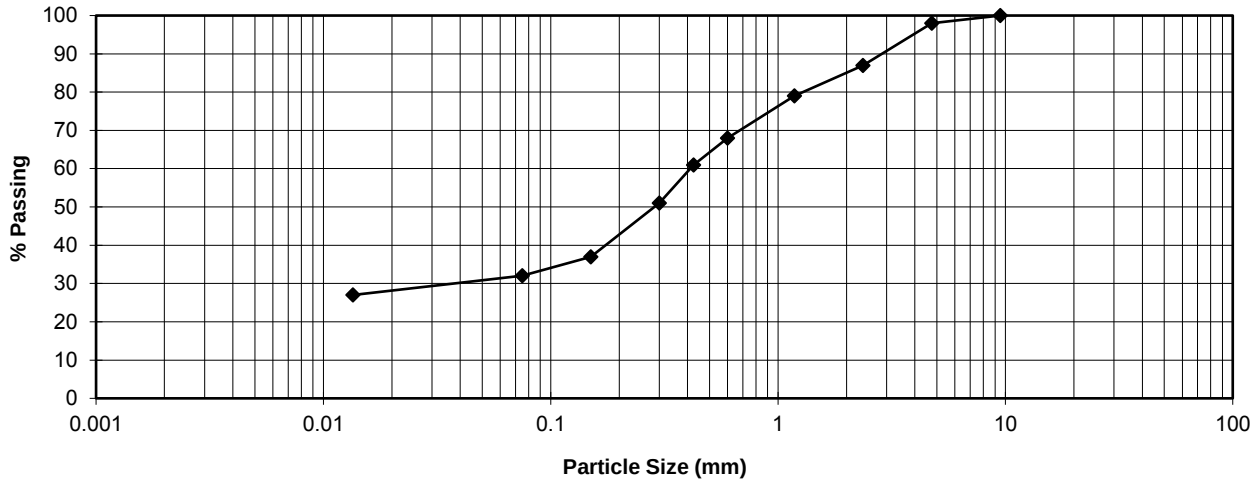
Job No:	60017
Report No:	60017-P14/3310
Sample No:	P14/3310
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: TP125
Sample Depth(m): 1.1 - 1.2



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	98
2.36	87
1.18	79
0.600	68
0.425	61
0.300	51
0.150	37
0.075	32
0.0135	27

Plasticity index tests
AS 1289

Liquid limit 3.9.1	39	%
Plastic limit 3.2.1	13	%
Plasticity index 3.3.1	26	%
Linear shrinkage 3.4.1	9.5	%

Cracked ☐

Curled ☑

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

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Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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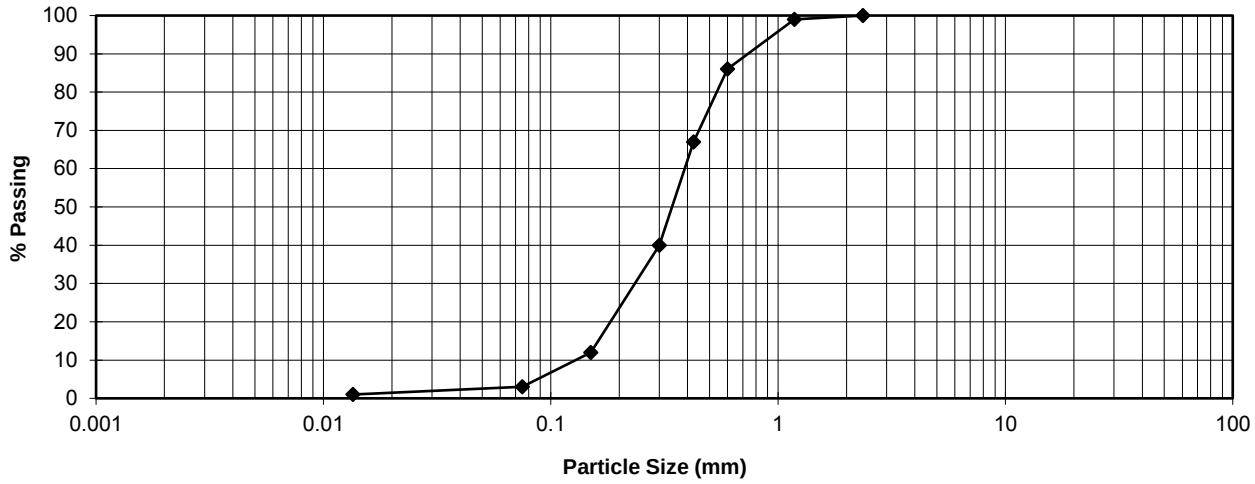
Job No:	60017
Report No:	60017-P14/3311
Sample No:	P14/3311
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH126
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	86
0.425	67
0.300	40
0.150	12
0.075	3
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

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Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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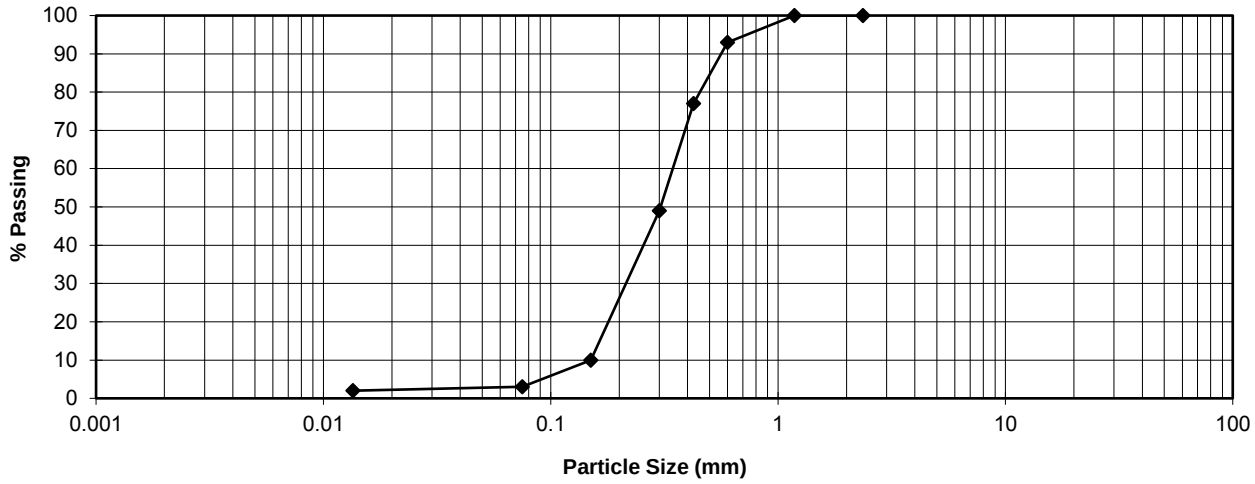
Job No:	60017
Report No:	60017-P14/3312
Sample No:	P14/3312
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH127
Sample Depth(m): 0.45 - 0.70



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	93
0.425	77
0.300	49
0.150	10
0.075	3
0.0135	2

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

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Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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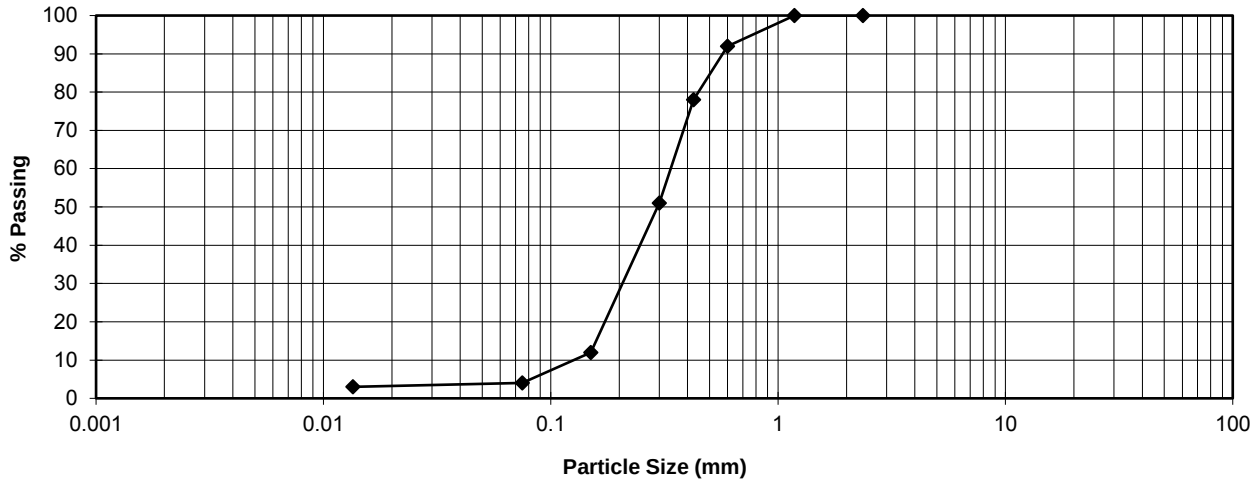
Job No:	60017
Report No:	60017-P14/3313
Sample No:	P14/3313
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH128
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	92
0.425	78
0.300	51
0.150	12
0.075	4
0.0135	3

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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Particle Size Distribution & Plasticity Index tests

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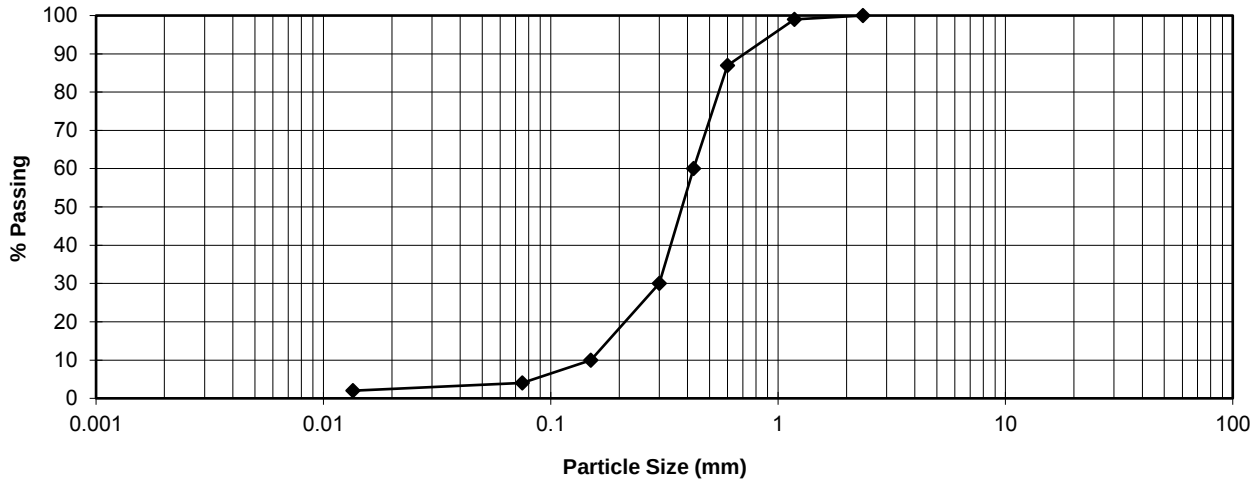
Job No:	60017
Report No:	60017-P14/3314
Sample No:	P14/3314
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH129
Sample Depth(m): 0.85 - 1.00



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	87
0.425	60
0.300	30
0.150	10
0.075	4
0.0135	2

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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AS PSDPI May 2009

Particle Size Distribution & Plasticity Index tests

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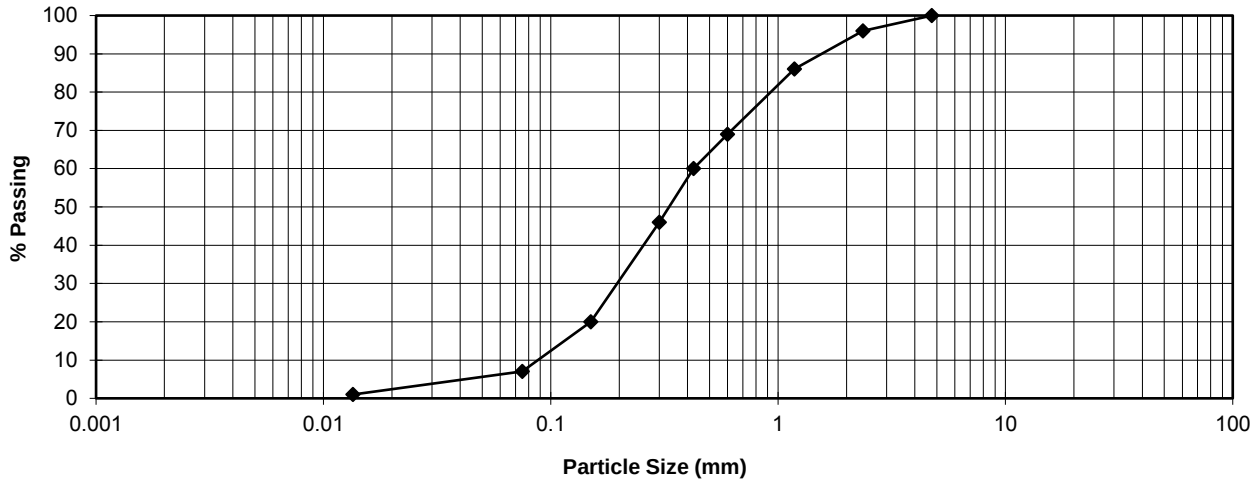
Job No:	60017
Report No:	60017-P14/3315
Sample No:	P14/3315
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH130
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	96
1.18	86
0.600	69
0.425	60
0.300	46
0.150	20
0.075	7
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
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Matthew van Herk

AS PSDPI May 2009

Particle Size Distribution & Plasticity Index tests

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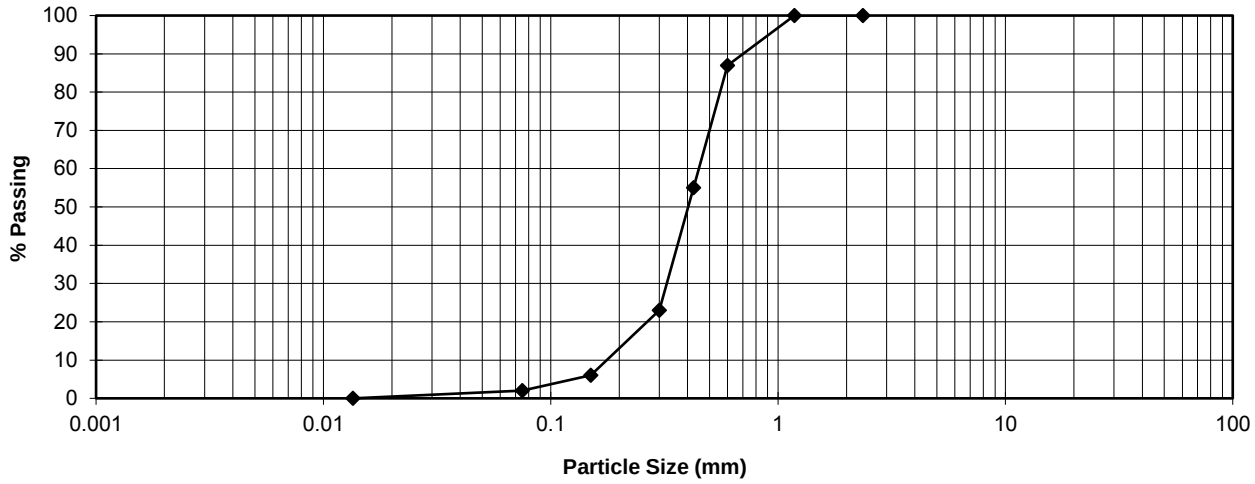
Job No:	60017
Report No:	60017-P14/3316
Sample No:	P14/3316
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH131
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	87
0.425	55
0.300	23
0.150	6
0.075	2
0.0135	0

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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AS PSDPI May 2009

Particle Size Distribution & Plasticity Index tests

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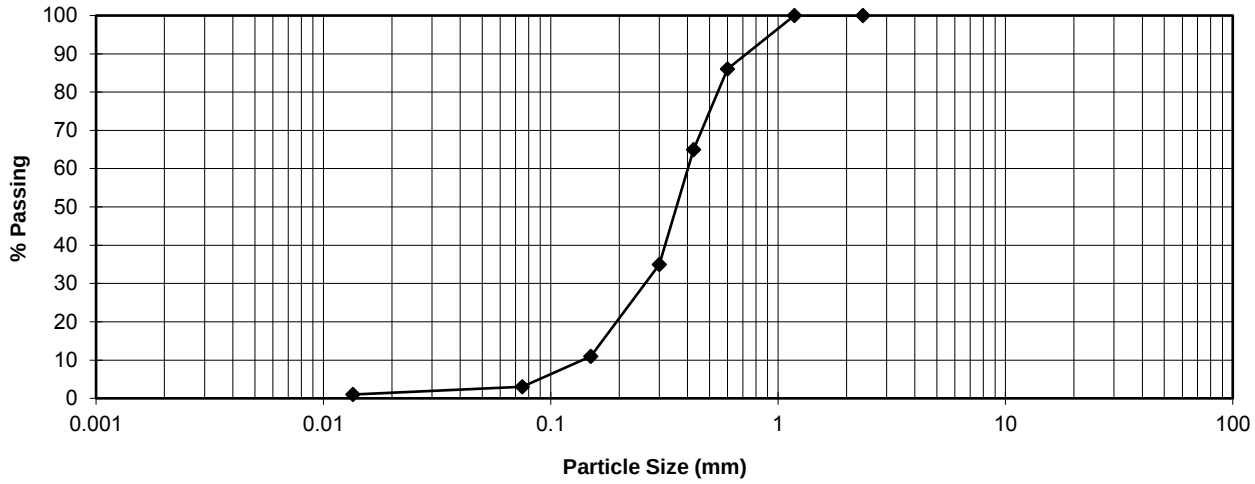
Job No:	60017
Report No:	60017-P14/3317
Sample No:	P14/3317
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH132
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	86
0.425	65
0.300	35
0.150	11
0.075	3
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
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Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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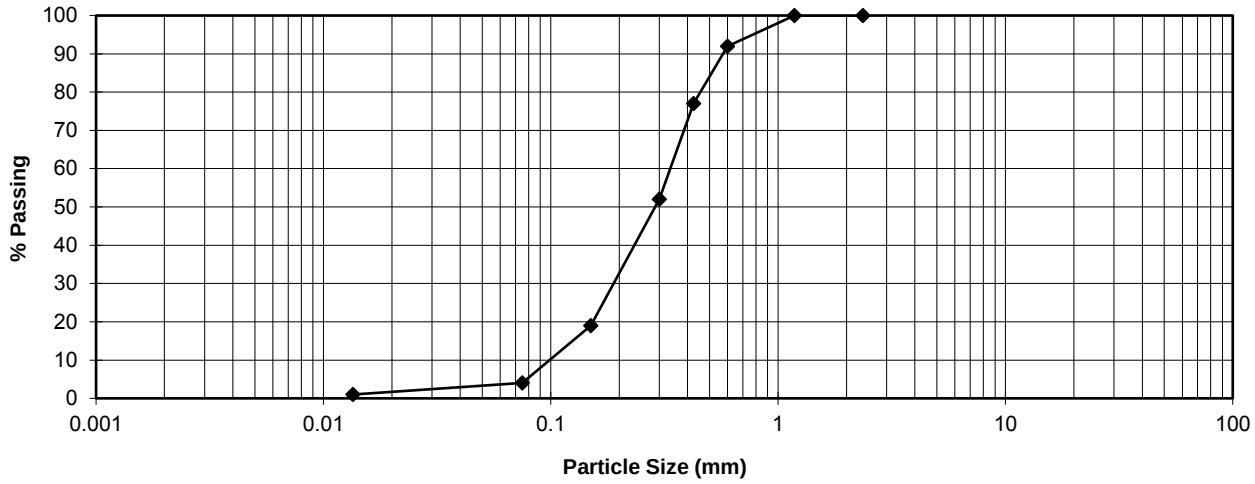
Job No:	60017
Report No:	60017-P14/3318
Sample No:	P14/3318
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH133
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	92
0.425	77
0.300	52
0.150	19
0.075	4
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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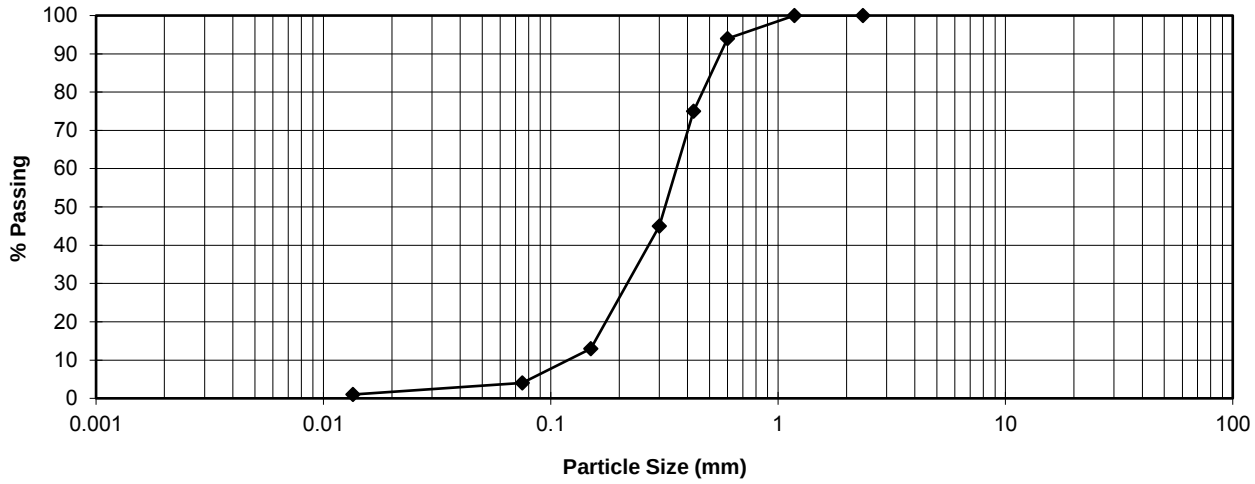
Job No:	60017
Report No:	60017-P14/3319
Sample No:	P14/3319
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH134B
Sample Depth(m): 1.9 - 2.1



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	94
0.425	75
0.300	45
0.150	13
0.075	4
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

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Matthew van Herk
AS PSDPI May 2009

Particle Size Distribution & Plasticity Index tests

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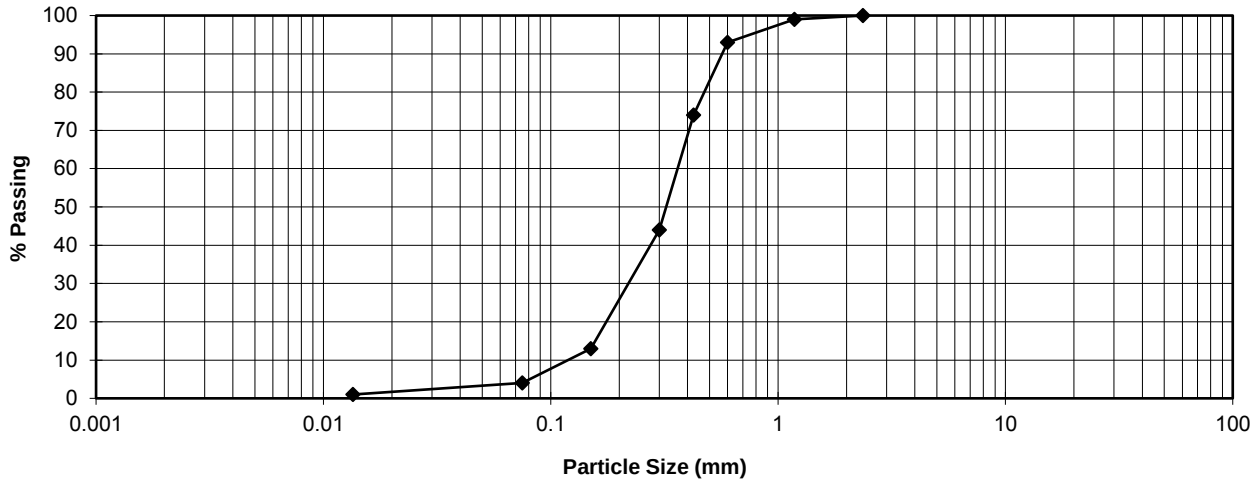
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3320
Sample No:	P14/3320
Issue Date:	17 September 2014

Client: Peet Stratton Pty Ltd
Project: Lots 50, 102 and 427 Farrall Road
Location: Midvale, WA

Sample ID: BH135
Sample Depth(m): 0.45 - 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	93
0.425	74
0.300	44
0.150	13
0.075	4
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

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Matthew van Herk

Appendix D

Acid Sulphate Soil Laboratory Results

Table D-1: Summary of Screening and SPOCAS Suite of Testing

Test Location	Sample ID	Depth (m)	Soil Description	Screening Tests[1]				SPOCAS Suite of Testing							
				pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	N_{RASS}[7] (%S)	ANC[8] (%S)	Net[9] Acidity (%S)
Assessment Criteria				**<4**	**<3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**>0.03**
TP101	1	0.5	SAND - light brown	4.8	3.6	Medium	1.2	6.7	6	<0.01	<0.01	<0.005	NT	NT	<0.01
TP101	2	1	SAND - yellow-brown	5.7	4.8	Low	0.9	6.3	6.2	<0.01	<0.01	<0.005	NT	NT	<0.01
TP101	3	1.5	SAND - yellow-brown	7.4	4.9	Low	2.5	5.5	5.8	0.016	<0.01	<0.005	NT	NT	0.02
TP105	4	0.5	SAND - light brown	6	4.5	Low	1.5	-	-	-	-	-	-	-	-
TP105	5	1	CLAYEY SAND - orange-brown mottled grey	5.9	4.5	Low	1.4	5.2	5	0.022	0.022	<0.005	NT	NT	0.02
TP105	6	1.5	GRAVELLY CLAYEY SAND - orange-brown mottled light grey	5.9	4.3	Low	1.6	-	-	-	-	-	-	-	-
TP105	7	2	GRAVELLY CLAYEY SAND - orange-brown mottled light grey	5.6	4.2	Low	1.4	5.3	5.1	0.022	0.018	<0.005	NT	NT	0.02
TP105	8	2.5	GRAVELLY CLAYEY SAND - orange-brown mottled light grey	5.8	4.2	Low	1.6	-	-	-	-	-	-	-	-
TP108	9	0.5	SAND - light yellow-brown mottled orange-brown	6.1	4.9	Low	1.2	5.9	4.7	<0.01	<0.01	<0.005	NT	NT	<0.01
TP108	10	1	CLAYEY SAND - light yellow-brown mottled orange brown and light grey	6.2	4.6	Low	1.6	5.2	5.3	0.022	0.02	<0.005	NT	NT	0.02
TP108	11	1.5	CLAYEY SAND - light yellow-brown mottled orange brown and light grey	5.4	4.2	Low	1.2	-	-	-	-	-	-	-	-
TP108	12	2	CLAYEY SAND - light yellow-brown mottled orange brown and light grey	5.3	4.1	Low	1.2	-	-	-	-	-	-	-	-
TP108	13	2.5	GRAVELLY CLAYEY SAND - orange-brown mottled light grey	5.6	3.9	Low	1.7	5.3	4.9	0.018	0.026	<0.005	NT	NT	0.02
TP108	14	3	GRAVELLY CLAYEY SAND - orange-brown mottled light grey	5.4	3.9	Low	1.5	-	-	-	-	-	-	-	-
TP111	15	0.5	SAND - light grey	5.7	4.7	Low	1	5.8	4.5	<0.01	<0.01	<0.005	NT	NT	<0.01
TP111	16	1	SAND - light grey	5.9	5.2	Low	0.7	-	-	-	-	-	-	-	-
TP111	17	1.5	SAND - light grey	5.8	4.9	Low	0.9	-	-	-	-	-	-	-	-
TP111	18	2	SAND - light grey	5.8	4.7	Low	1.1	6	4.2	<0.01	0.012	<0.005	NT	NT	<0.01
TP112	19	0.5	SAND - light yellow mottled light grey	5.9	4.7	Low	1.2	-	-	-	-	-	-	-	-
TP112	20	1	SAND - light yellow-brown mottled orange-brown	6	5	Low	1	6	5.2	<0.01	<0.01	<0.005	NT	NT	<0.01
TP112	21	1.5	SAND - light yellow-brown mottled orange-brown	6	5.1	Low	0.9	-	-	-	-	-	-	-	-
TP114	22	0.5	SAND - grey-brown	6.6	5.2	Low	1.4	-	-	-	-	-	-	-	-
TP114	23	1	SAND - light grey-brown	6.7	5	Low	1.7	-	-	-	-	-	-	-	-
TP114	24	1.5	SAND - light grey-brown	6	5	Low	1	6	4.7	<0.01	<0.01	0.005	NT	NT	<0.01
TP116	25	0.2	SAND - grey-brown	7.3	5.9	Low	1.4	-	-	-	-	-	-	-	-
TP116	26	0.5	SAND - brown	8.2	5.2	Low	3	6	6.5	<0.01	<0.01	<0.005	NT	NT	<0.01
TP118	27	0.5	SAND - light brown	7.1	3.7	Low	3.4	6.2	5.2	<0.01	<0.01	<0.005	NT	NT	<0.01

Table D-1 (continued): Summary of Screening and SPOCAS Suite of Testing

Test Location	Sample ID	Depth (m)	Soil Description	Screening Tests[1]				SPOCAS Suite of Testing							
				pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	N_{RASS}[7] (%S)	ANC[8] (%S)	Net[9] Acidity (%S)
Assessment Criteria				**<4**	**<3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**>0.03**
TP118	28	0.8	SAND - orange-brown mottled red-brown mottled dark grey	7	5.2	Medium	1.8	6.1	6	<0.01	<0.01	<0.005	NT	NT	<0.01
TP123	29	0.5	CLAYEY SAND - orange-brown mottled red-brown and light grey	6.5	4.6	Medium	1.9	-	-	-	-	-	-	-	-
TP123	30	1	CLAYEY SAND - orange-brown mottled red-brown and light grey	6.8	5.5	Low	1.3	5.5	6.1	0.012	<0.01	<0.005	NT	NT	0.01
TP125	31	0.5	SAND - light brown	6.3	4.4	Medium	1.9	-	-	-	-	-	-	-	-
TP125	32	1	CLAYEY SAND - orange-brown mottled red-brown and light grey	7.3	5.2	Low	2.1	-	-	-	-	-	-	-	-
TP125	33	1.5	CLAYEY SAND - orange-brown mottled red-brown and light grey	6.7	4.9	Low	1.8	5.5	5.9	0.014	<0.01	<0.005	NT	NT	0.02
TP125	34	2	CLAYEY SAND - orange-brown mottled red-brown and light grey	6.9	5.3	Low	1.6	-	-	-	-	-	-	-	-
TP125	35	2.5	CLAYEY SAND - orange-brown mottled red-brown and light grey	6.8	5.4	Low	1.4	5.7	6.2	<0.01	<0.01	<0.005	NT	NT	<0.01

Notes

1. Screening Tests undertaken by MPL Laboratories
2. Slight – indicates no or slight effervescence in hydrogen peroxide, Moderate – indicates moderate effervescence in hydrogen peroxide, High – indicates vigorous effervescence in hydrogen peroxide
3. Δ pH – pHF - pHFOX
4. 4. TAA – titratable actual acidity
5. TPA – titratable peroxide acidity;
6. Spos – peroxide oxidisable sulphur
7. N_{RASS} – retained acidity (reported for pHkCl < 4.5)
8. ANC – acid neutralising capacity (reported for pHkCl > 6.5).
9. Net Acidity = TAA + Spos + NASS. (It should be noted that ANC is excluded as per WA Guidelines)
10. NR – Not Reported
11. **0.03** exceedence of adopted criterion.

Part of the Envirolab Group

16 - 18 Hayden Court, Myaree, Western Australia 6154
PO Box 4023 Myaree BC, Western Australia 6960
Tel: +61 8 9317 2505 / Fax: +61 8 9317 4163
email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

SAMPLE RECEIPT ADVICE

Client:

Douglas Partners Perth
36 O'Malley St
Osborne Park WA 6017

ph: 08 9204 3511
Fax: 08 9204 3522

Attention: Rob Shapland

Sample log in details:

Your reference:	**82334**
MPL Reference:	**155325**
Date received:	4/09/2014
Date results expected to be reported:	**5/09/2014**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	Soil
Turnaround time requested:	Standard
Temperature on receipt °C	Frozen
Cooling Method:	Ice
Sampling Date Provided:	Yes
Purchase order number:	116780

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples. Perishable samples and dust filters are not retained, unless specifically requested.

Contact details:

Please direct any queries to Joshua Lim or Meredith Conroy
ph: 08 9317 2505 fax: 08 9317 4163
email: jlim@mpl.com.au or mconroy@mpl.com.au

Laboratories
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Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 155325

Client:
Douglas Partners Perth
36 O'Malley St
Osborne Park
WA 6017

Attention: Rob Shapland

Sample log in details:

Your Reference:	**82334**
No. of samples:	Soil
Date samples received:	4/09/2014
Date completed instructions received:	4/09/2014
Location	Lots 50,102 & 427 Farrell Road, Midvale

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	5/09/14
Date of Preliminary Report:	N/A
Issue Date:	5/09/14

Results Approved By:

Stacey Hawkins
Acid Soils/Acid Mine Drainage Supervisor

sPOCAS field test						
Our Reference:	UNITS	155325-1	155325-2	155325-3	155325-4	155325-5
Your Reference	----------	1	2	3	4	5
Date Sampled	----------	25/08/2014	25/08/2015	25/08/2016	25/08/2017	25/08/2018
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	4.8	5.7	7.4	6.0	5.9
pH_{FOX} (field peroxide test)*	pH Units	3.6	4.8	4.9	4.5	4.5
Reaction Rate*	-	Medium Medium	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	155325-6	155325-7	155325-8	155325-9	155325-10
Your Reference	----------	6	7	8	9	10
Date Sampled	----------	25/08/2019	25/08/2020	25/08/2021	25/08/2022	25/08/2023
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	5.9	5.6	5.8	6.1	6.2
pH_{FOX} (field peroxide test)*	pH Units	4.3	4.2	4.2	4.9	4.6
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	155325-11	155325-12	155325-13	155325-14	155325-15
Your Reference	----------	11	12	13	14	15
Date Sampled	----------	25/08/2024	25/08/2025	25/08/2026	25/08/2027	25/08/2028
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	5.4	5.3	5.6	5.4	5.7
pH_{FOX} (field peroxide test)*	pH Units	4.2	4.1	3.9	3.9	4.7
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	155325-16	155325-17	155325-18	155325-19	155325-20
Your Reference	----------	16	17	18	19	20
Date Sampled	----------	25/08/2029	25/08/2030	25/08/2031	25/08/2032	25/08/2033
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	5.9	5.8	5.8	5.9	6.0
pH_{FOX} (field peroxide test)*	pH Units	5.2	4.9	4.7	4.7	5.0
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	155325-21	155325-22	155325-23	155325-24	155325-25
Your Reference	----------	21	22	23	24	25
Date Sampled	----------	25/08/2034	26/08/2014	26/08/2015	26/08/2016	26/08/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	6.0	6.6	6.7	6.0	7.3
pH_{FOX} (field peroxide test)*	pH Units	5.1	5.2	5.0	5.0	5.9
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	155325-26	155325-27	155325-28	155325-29	155325-30
Your Reference	----------	26	27	28	29	30
Date Sampled	----------	26/08/2018	26/08/2019	26/08/2020	26/08/2021	26/08/2022
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	8.2	7.1	7.0	6.5	6.8
pH_{FOX} (field peroxide test)*	pH Units	5.2	3.7	5.2	4.6	5.5
Reaction Rate*	-	Low	Low	Medium	Medium	Low

sPOCAS field test						
Our Reference:	UNITS	155325-31	155325-32	155325-33	155325-34	155325-35
Your Reference	----------	31	32	33	34	35
Date Sampled	----------	26/08/2023	26/08/2024	26/08/2025	26/08/2026	26/08/2027
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	04/09/2014	04/09/2014	04/09/2014	04/09/2014	04/09/2014
Date analysed	-	05/09/2014	05/09/2014	05/09/2014	05/09/2014	05/09/2014
pH_F (field pH test)*	pH Units	6.3	7.3	6.7	6.9	6.8
pH_{FOX} (field peroxide test)*	pH Units	4.4	5.2	4.9	5.3	5.4
Reaction Rate*	-	Medium Medium	Low	Low	Low	Low

Method ID	Methodology Summary
INORG-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

Client Reference: 82334

QUALITY CONTROL sPOCAS field test	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			[NT]	155325-1	04/09/2014 || 04/09/2014
Date analysed	-			[NT]	155325-1	05/09/2014 || 05/09/2014
pH$_F$ (field pH test)*	pH Units		INORG-063	[NT]	155325-1	4.8 || 5.1 || RPD: 6
pH$_{FOX}$ (field peroxide test)*	pH Units		INORG-063	[NT]	155325-1	3.6 || 3.5 || RPD: 3

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	155325-11	04/09/2014 || 04/09/2014
Date analysed	-	155325-11	05/09/2014 || 05/09/2014
pH$_F$ (field pH test)*	pH Units	155325-11	5.4 || 5.5 || RPD: 2
pH$_{FOX}$ (field peroxide test)*	pH Units	155325-11	4.2 || 4.2 || RPD: 0

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	155325-21	04/09/2014 || 04/09/2014
Date analysed	-	155325-21	05/09/2014 || 05/09/2014
pH$_F$ (field pH test)*	pH Units	155325-21	6.0 || 6.0 || RPD: 0
pH$_{FOX}$ (field peroxide test)*	pH Units	155325-21	5.1 || 5.0 || RPD: 2

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	155325-31	04/09/2014 || 04/09/2014
Date analysed	-	155325-31	05/09/2014 || 05/09/2014
pH$_F$ (field pH test)*	pH Units	155325-31	6.3 || 6.2 || RPD: 2
pH$_{FOX}$ (field peroxide test)*	pH Units	155325-31	4.4 || 3.3 || RPD: 29

Report Comments:

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample; NR: Not requested
NS: Not specified; NEPM: National Environmental Protection Measure

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet of exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable
For VOCs in water samples, three vials are required for duplicate or spike analysis
Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics;
10-140% for SVOC and Speciated Phenols; and 40-120% for low level organics is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.
In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.
When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

P.O 116780

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Lots 50, 102 and 427 Farrall Road, Midvale
Project No: 82334
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

	Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes: pH_F	Analytes: pH_{FOX}	NOTES
1	TP101 0.5m	25/8/14	S	Ice/Frozen		x	x	
2	TP101 1.0m	25/8/14	S	Ice/Frozen		x	x	
3	TP101 1.5m	25/8/14	S	Ice/Frozen		x	x	
4	TP105 0.5m	25/8/14	S	Ice/Frozen		x	x	
5	TP105 1.0m	25/8/14	S	Ice/Frozen		x	x	
6	TP105 1.5m	25/8/14	S	Ice/Frozen		x	x	
7	TP105 2.0m	25/8/14	S	Ice/Frozen		x	x	
8	TP105 2.5m	25/8/14	S	Ice/Frozen		x	x	
9	TP108 0.5m	25/8/14	S	Ice/Frozen		x	x	
10	TP108 1.0m	25/8/14	S	Ice/Frozen		x	x	
11	TP108 1.5m	25/8/14	S	Ice/Frozen		x	x	
12	TP108 2.0m	25/8/14	S	Ice/Frozen		x	x	
13	TP108 2.5m	25/8/14	S	Ice/Frozen		x	x	
14	TP108 3.0m	25/8/14	S	Ice/Frozen		x	x	
	PQL (S)							
	PQL (W)							

ENVIROLAB Laboratories
Job No.- 155325
Date Rec - 4-9-14
Time Rec - 12:30
Rec By -
TAT Req - SAME 1 / 2 / 3 / STD
Temp - cool / ambient
Cooling - Ice / Ice pack / None
Security Seal - Yes / No

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: J.Khandwalla Relinquished By: J.Khandwalla Sign: Date/Time: 04/9//2014

Received By: Relinquished By: Sign: Date/Time:

** Please send results to rob.shapland@douglasparters.com.au **

Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Lots 50, 102 and 427 Farrall Road, Midvale
Project No: 82334
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

	Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes												NOTES
						pH_F	pH_{FOX}											
15	TP111 0.5m	25/8/14	S	Ice/Frozen		x	x											
16	TP111 1.0m	25/8/14	S	Ice/Frozen		x	x											
17	TP111 1.5m	25/8/14	S	Ice/Frozen		x	x											
18	TP111 2.0m	25/8/14	S	Ice/Frozen		x	x											
19	TP112 0.5m	25/8/14	S	Ice/Frozen		x	x											
20	TP112 1.0m	25/8/14	S	Ice/Frozen		x	x											
21	TP112 1.5m	25/8/14	S	Ice/Frozen		x	x											
22	TP114 0.5m	26/8/14	S	Ice/Frozen		x	x											
23	TP114 1.0m	26/8/14	S	Ice/Frozen		x	x											
24	TP114 1.5m	26/8/14	S	Ice/Frozen		x	x											
25	TP116 0.2m	26/8/14	S	Ice/Frozen		x	x											
26	TP116 0.5m	26/8/14	S	Ice/Frozen		x	x											
27	TP118 0.5m	26/8/14	S	Ice/Frozen		x	x											
	PQL (S)																	
	PQL (W)																	

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: J.Khandwalla Relinquished By: J.Khandwalla Sign: Date/Time: 04/9//2014

Received By: Relinquished By: Sign: Date/Time:

** Please send results to rob.shapland@douglasparters.com.au **

Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522

P.O 116780

Douglas Partners
Geotechnics - Environment - Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Lots 50, 102 and 427 Farrall Road, Midvale
Project No: 82334
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
28 TP118 0.8m	26/8/14	S	Ice/Frozen		x	x										
29 TP123 0.5m	26/8/14	S	Ice/Frozen		x	x										
30 TP123 1.0m	26/8/14	S	Ice/Frozen		x	x										
31 TP125 0.5m	26/8/14	S	Ice/Frozen		x	x										
32 TP125 1.0m	26/8/14	S	Ice/Frozen		x	x										
33 TP125 1.5m	26/8/14	S	Ice/Frozen		x	x										
34 TP125 2.0m	26/8/14	S	Ice/Frozen		x	x										
35 TP125 2.5m	26/8/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: J.Khandwalla Relinquished By: J.Khandwalla Sign: Date/Time: 04/9//2014

Received By: Relinquished By: Sign: Date/Time:

** Please send results to rob.shapland@douglasparters.com.au **

Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522

Part of the Envirolab Group

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email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

SAMPLE RECEIPT ADVICE

Client:

Douglas Partners Perth
36 O'Malley St
Osborne Park WA 6017

ph: 08 9204 3511
Fax: 08 9204 3522

Attention: Ryan walker

Sample log in details:

Your reference:	**82334**
MPL Reference:	**155434**
Date received:	4/09/2014
Date results expected to be reported:	**15/09/2014**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	Dried soil
Turnaround time requested:	Standard
Temperature on receipt °C	Ambient
Cooling Method:	Not applicable
Sampling Date Provided:	Yes
Purchase order number:	115467

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples. Perishable samples and dust filters are not retained, unless specifically requested.

Contact details:

Please direct any queries to Joshua Lim or Meredith Conroy
ph: 08 9317 2505 fax: 08 9317 4163
email: jlim@mpl.com.au or mconroy@mpl.com.au

mpl Laboratories
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email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 155434

Client:
Douglas Partners Perth
36 O'Malley St
Osborne Park
WA 6017

Attention: Ryan walker

Sample log in details:

Your Reference:	**82334**
No. of samples:	Dried soil
Date samples received:	4/09/2014
Date completed instructions received:	8/09/2014
Location:	Lots 50,102 & 427 Farrell Road, Midvale

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	15/09/14
Date of Preliminary Report:	N/A
Issue Date:	10/09/14

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Stacey Hawkins
Acid Soils/Acid Mine Drainage Supervisor

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	155434-1 1 4/09/2014 Soil	155434-2 2 4/09/2014 Soil	155434-3 3 4/09/2014 Soil	155434-4 5 4/09/2014 Soil	155434-5 7 4/09/2014 Soil
Date prepared	-	08/09/2014	08/09/2014	08/09/2014	08/09/2014	08/09/2014
Date analysed	-	10/09/2014	10/09/2014	10/09/2014	10/09/2014	10/09/2014
pH $_{kcl}$	pH units	6.7	6.3	5.5	5.2	5.3
TAA	moles H^+/t	<5	<5	9.8	13	13
pH $_{Ox}$	pH units	6.0	6.2	5.8	5.0	5.1
TPA	moles H^+/t	<5.0	<5.0	<5.0	13	11
S_{KCl}	%w/w S	<0.005	0.010	0.011	0.014	0.027
Ca_{KCl}	%w/w	0.024	0.022	0.005	0.017	0.005
Mg_{KCl}	%w/w	<0.005	<0.005	0.048	0.014	0.023
S_P	%w/w	<0.005	0.012	0.013	0.011	0.026
Ca_P	%w/w	0.023	0.021	0.006	0.018	0.006
Mg_P	%w/w	<0.005	<0.005	0.050	0.014	0.023
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	0.016	0.022	0.022
s-TPA	%w/w S	<0.01	<0.01	<0.01	0.022	0.018
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	0.018	0.019	0.021
a-Net Acidity	moles H^+/t	<10	<10	11	12	13
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	0.82	0.89	0.97
Net Acidity (WA)	%w/w S	<0.01	<0.01	0.018	0.019	0.021
a-Net Acidity without ANCE	moles H^+/t	<10	<10	11	12	13
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	0.82	0.89	0.97

Client Reference: 82334

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	155434-6 9 4/09/2014 Soil	155434-7 10 4/09/2014 Soil	155434-8 13 4/09/2014 Soil	155434-9 15 4/09/2014 Soil	155434-10 18 4/09/2014 Soil
Date prepared	-	08/09/2014	08/09/2014	08/09/2014	08/09/2014	08/09/2014
Date analysed	-	10/09/2014	10/09/2014	10/09/2014	10/09/2014	10/09/2014
pH $_{kcl}$	pH units	5.9	5.2	5.3	5.8	6.0
TAA	moles H^+/t	<5	13	11	<5	<5
pH $_{Ox}$	pH units	4.7	5.3	4.9	4.5	4.2
TPA	moles H^+/t	<5.0	12	16	<5.0	7.4
S_{KCl}	%w/w S	<0.005	0.013	0.017	<0.005	<0.005
Ca_{KCl}	%w/w	0.006	0.008	<0.005	0.006	<0.005
Mg_{KCl}	%w/w	<0.005	0.025	0.014	<0.005	<0.005
S_P	%w/w	<0.005	0.014	0.018	<0.005	<0.005
Ca_P	%w/w	0.007	0.009	0.005	0.006	0.005
Mg_P	%w/w	<0.005	0.025	0.013	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	6.1
s-TAA	%w/w S	<0.01	0.022	0.018	<0.01	<0.01
s-TPA	%w/w S	<0.01	0.020	0.026	<0.01	0.012
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	0.024	0.019	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	15	12	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	1.1	0.87	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	0.024	0.019	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	15	12	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	1.1	0.87	<0.75	<0.75

Client Reference: 82334

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	155434-11 20 4/09/2014 Soil	155434-12 24 4/09/2014 Soil	155434-13 26 4/09/2014 Soil	155434-14 27 4/09/2014 Soil	155434-15 28 4/09/2014 Soil
Date prepared	-	08/09/2014	08/09/2014	08/09/2014	08/09/2014	08/09/2014
Date analysed	-	10/09/2014	10/09/2014	10/09/2014	10/09/2014	10/09/2014
pH $_{kcl}$	pH units	6.0	6.0	6.0	6.2	6.1
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{Ox}$	pH units	5.2	4.7	6.5	5.2	6.0
TPA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	<0.005	<0.005	0.014	<0.005	<0.005
Ca_{KCl}	%w/w	<0.005	<0.005	0.014	0.008	0.005
Mg_{KCl}	%w/w	<0.005	<0.005	0.17	<0.005	0.007
S_P	%w/w	<0.005	0.008	0.015	<0.005	<0.005
Ca_P	%w/w	<0.005	<0.005	0.015	0.009	0.007
Mg_P	%w/w	<0.005	<0.005	0.17	<0.005	0.009
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

Client Reference: 82334

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	155434-16 30 4/09/2014 Soil	155434-17 33 4/09/2014 Soil	155434-18 35 4/09/2014 Soil
Date prepared	-	08/09/2014	08/09/2014	08/09/2014
Date analysed	-	10/09/2014	10/09/2014	10/09/2014
pH $_{kcl}$	pH units	5.5	5.5	5.7
TAA	moles H^+/t	7.4	8.6	<5
pH $_{Ox}$	pH units	6.1	5.9	6.2
TPA	moles H^+/t	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	<0.005	0.018	0.009
Ca_{KCl}	%w/w	0.016	0.025	0.016
Mg_{KCl}	%w/w	0.056	0.064	0.055
S_P	%w/w	<0.005	0.022	0.009
Ca_P	%w/w	0.019	0.023	0.015
Mg_P	%w/w	0.063	0.061	0.052
a-ANC_E	moles H^+/t	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0
s-TAA	%w/w S	0.012	0.014	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	0.007	<0.005	<0.005
a-Mg_A	moles H^+/t	5.7	<5.0	<5.0
s-Mg_A	%w/w S	0.009	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT
Fineness Factor		2	2	2
S_{NAS}	%w/w S	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT
s-Net Acidity	%w/w S	0.012	0.018	<0.01
a-Net Acidity	moles H^+/t	<10	11	<10
Liming rate	kg $CaCO_3$/t	<0.75	0.84	<0.75
Net Acidity (WA)	%w/w S	0.012	0.018	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	11	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	0.84	<0.75

Method ID	Methodology Summary
INORG-064	Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) using ASSMAC guidelines.

Client Reference: 82334

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			[NT]	155434-1	08/09/2014 || 08/09/2014
Date analysed	-			[NT]	155434-1	10/09/2014 || 10/09/2014
pH $_{kcl}$	pH units		INORG-064	[NT]	155434-1	6.7 || 6.7 || RPD: 0
TAA	moles H^+/t	5	INORG-064	[NT]	155434-1	<5 || <5
pH $_{Ox}$	pH units		INORG-064	[NT]	155434-1	6.0 || 6.0 || RPD: 0
TPA	moles H^+/t	5	INORG-064	[NT]	155434-1	<5.0 || <5.0
S_{KCl}	%w/w S	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
Ca_{KCl}	%w/w	0.005	INORG-064	[NT]	155434-1	0.024 || 0.026 || RPD: 8
Mg_{KCl}	%w/w	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
S_P	%w/w	0.005	INORG-064	[NT]	155434-1	<0.005 || 0.007
Ca_P	%w/w	0.005	INORG-064	[NT]	155434-1	0.023 || 0.024 || RPD: 4
Mg_P	%w/w	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
a-ANC_E	moles H^+/t	5	INORG-064	[NT]	155434-1	NT || NT
S_{HCl}	%w/w S	0.005	INORG-064	[NT]	155434-1	NT || NT
TSA	moles H^+/t	5	INORG-064	[NT]	155434-1	<5.0 || <5.0
s-TAA	%w/w S	0.01	INORG-064	[NT]	155434-1	<0.01 || <0.01
s-TPA	%w/w S	0.01	INORG-064	[NT]	155434-1	<0.01 || <0.01
s-TSA	%w/w S	0.01	INORG-064	[NT]	155434-1	<0.01 || <0.01
S_{POS}	%w/w S	0.005	INORG-064	[NT]	155434-1	<0.005 || 0.006
a-S_{POS}	moles H^+/t	5	INORG-064	[NT]	155434-1	<5.0 || <5.0
Ca_A	%w/w Ca	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
a-Ca_A	moles H^+/t	5	INORG-064	[NT]	155434-1	<5 || <5
s-Ca_A	%w/w S	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
Mg_A	%w/w Mg	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
a-Mg_A	moles H^+/t	5	INORG-064	[NT]	155434-1	<5.0 || <5.0
s-Mg_A	%w/w S	0.005	INORG-064	[NT]	155434-1	<0.005 || <0.005
ANC_E	% $CaCO_3$	0.05	INORG-064	[NT]	155434-1	NT || NT
s-ANC_E	%w/w S	0.005	INORG-064	[NT]	155434-1	NT || NT
Fineness Factor			INORG-064	[NT]	155434-1	2 || 2 || RPD: 0
S_{NAS}	%w/w S	0.005	INORG-064	[NT]	155434-1	NT || NT

Client Reference: 82334

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
a-S_{NAS}	moles H^+/t	5	INORG-064	[NT]	155434-1	NT II NT
s-S_{NAS}	%w/w S	0.01	INORG-064	[NT]	155434-1	NT II NT
s-Net Acidity	%w/w S	0.01	INORG-064	[NT]	155434-1	<0.01 II <0.01
a-Net Acidity	moles H^+/t	10	INORG-064	[NT]	155434-1	<10 II <10
Liming rate	kg $CaCO_3$ /t	0.75	INORG-064	[NT]	155434-1	<0.75 II <0.75
Net Acidity (WA)	%w/w S	0.01	INORG-064	[NT]	155434-1	<0.01 II <0.01
a-Net Acidity without ANCE	moles H^+/t	10	INORG-064	[NT]	155434-1	<10 II <10
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	INORG-064	[NT]	155434-1	<0.75 II <0.75

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	155434-11	08/09/2014 II 08/09/2014
Date analysed	-	155434-11	10/09/2014 II 10/09/2014
pH $_{kcl}$	pH units	155434-11	6.0 II 6.0 II RPD: 0
TAA	moles H^+/t	155434-11	<5 II <5
pH $_{Ox}$	pH units	155434-11	5.2 II 5.2 II RPD: 0
TPA	moles H^+/t	155434-11	<5.0 II <5.0
S_{KCl}	%w/w S	155434-11	<0.005 II <0.005
Ca_{KCl}	%w/w	155434-11	<0.005 II <0.005
Mg_{KCl}	%w/w	155434-11	<0.005 II <0.005
S_P	%w/w	155434-11	<0.005 II <0.005
Ca_P	%w/w	155434-11	<0.005 II <0.005
Mg_P	%w/w	155434-11	<0.005 II <0.005
a-ANC_E	moles H^+/t	155434-11	NT II NT
S_{HCl}	%w/w S	155434-11	NT II NT
TSA	moles H^+/t	155434-11	<5.0 II <5.0
s-TAA	%w/w S	155434-11	<0.01 II <0.01
s-TPA	%w/w S	155434-11	<0.01 II <0.01
s-TSA	%w/w S	155434-11	<0.01 II <0.01
S_{POS}	%w/w S	155434-11	<0.005 II <0.005
a-S_{POS}	moles H^+/t	155434-11	<5.0 II <5.0
Ca_A	%w/w Ca	155434-11	<0.005 II <0.005

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
a-Ca_A	moles H^+/t	155434-11	<5 || <5
s-Ca_A	%w/w S	155434-11	<0.005 || <0.005
Mg_A	%w/w Mg	155434-11	<0.005 || <0.005
a-Mg_A	moles H^+/t	155434-11	<5.0 || <5.0
s-Mg_A	%w/w S	155434-11	<0.005 || <0.005
ANC_E	% $CaCO_3$	155434-11	NT || NT
s-ANC_E	%w/w S	155434-11	NT || NT
Fineness Factor		155434-11	2 || 2 || RPD: 0
S_{NAS}	%w/w S	155434-11	NT || NT
a-S_{NAS}	moles H^+/t	155434-11	NT || NT
s-S_{NAS}	%w/w S	155434-11	NT || NT
s-Net Acidity	%w/w S	155434-11	<0.01 || <0.01
a-Net Acidity	moles H^+/t	155434-11	<10 || <10
Liming rate	kg $CaCO_3$ /t	155434-11	<0.75 || <0.75
Net Acidity (WA)	%w/w S	155434-11	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	155434-11	<10 || <10
Liming rate without ANCE	kg $CaCO_3$ /t	155434-11	<0.75 || <0.75

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
Airborne fibres were analysed by Approved Counter: Not applicable for this job

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample;
NS: Not specified; NEPM: National Environmental Protection Measure
DOL: Sample rejected due to particulate overload

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet of exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable
For VOCs in water samples, three vials are required for duplicate or spike analysis
Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics;
10-140% for SVOC and Speciated Phenols; and 40-120% for low level organics is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.
In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.
When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

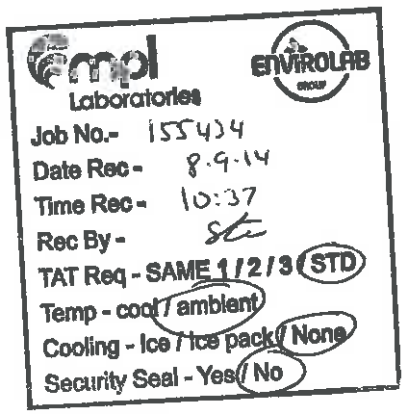
Stacey Hawkins

From: Ryan Walker [Ryan.Walker@douglaspartners.com.au]
Sent: Monday, 8 September 2014 10:37 AM
To: Stacey Hawkins
Cc: MPL Laboratory
Subject: 155325 - 82334 SPOCAS Suite Testing
Attachments: image001.jpg; PO MPL 140908.pdf

Hi Stacey,

Can I please get SPOCAS suite testing on the following samples (MPL lab number 155325):

- 1
- 2
- 3
- 5
- 7
- 9
- 10
- 13
- 15
- 18
- 20
- 24
- 26
- 27
- 28
- 30
- 33
- 35



Please find the PO attached.

Kind regards,

Ryan Walker | Environmental Engineer
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
36 O'Malley Street Osborne Park WA 6017
P: 08 9204 3511 | F: 08 9204 3522 | M: 0400 996 692 | E: Ryan.Walker@douglaspartners.com.au

Appendix E

GHD Report
Reports for Various Lots in West Stratton, Geotechnical investigation
January 2008

Table 1 Summary of Hand Augered Borehole Results

Hand Auger	Location	Depth (m)	Soil Description	Groundwater	Shear vane Testing	Laboratory Test Results
HA 01	Midland Vet 231 Morrison Rd	0.0 – 0.4	Sand fill	1.6m	0.5m: did not shear 2.0m: did not shear	Sample depth: 0.4 – 1.5m % Fines: 43, % Sand: 52, % Gravel: 5 LL: 37%, PL: 15%, PI: 22%, LS: 12%
		0.4 – 1.5	Clayey sand, brown, fine to medium grained, loose to medium dense, moist to wet, with trace of gravel			
		1.5 – 2.0	Sandy clay, brown with orange mottling, stiff to very stiff, moist to wet			
HA 02	Lot 42 114 Farrall Rd	0.0 – 0.4	Sand fill	Not encountered	0.5m: did not shear 1.4m: 100 kPa	Sample depth: 0.4 – 1.4m % Fines: 37, % Sand: 53, % Gravel: 10 LL: 28%, PL: 14%, PI: 14%, LS: 7%
		0.4 – 1.4	Clayey sandy, orange brown, fine to medium grained, loose to medium dense, with some gravel			
		1.4 – 2.0	Sandy clay, grey with orange mottling, stiff, moist, with some quartz grains.			
HA 03	263 Morison Rd	0.0 – 0.4	Sand fill	Not encountered	0.5m: 21 kPa 1.5m: did not shear	-
		0.4 – 1.75	Sandy clay, brown with orange mottling, soft to firm becoming stiff to very stiff, dry to slightly moist, with fine to medium quartz grains			
		1.75	Refusal			
HA 04	Lot 2 Morrison Rd	0.0 – 0.3	Sand fill	Not encountered	-	-
		0.3 – 1.3	Sandy clay, brown, grey with orange mottling, stiff to very stiff, moist			
		1.3	Refusal			

Hand Auger	Location	Depth (m)	Soil Description	Groundwater	Shear vane Testing	Laboratory Test Results
HA 05	Water Corporation Reserve 45020	0.0 – 2.0	Silty clayey sand, dark brown, fine to medium grained, loose to medium dense, moist to wet, with some roots and organic matter traces of fine gravel	0.8m	-	-
HA 06	Water Corporation Reserve 45020	0.0 – 2.0	Gravelly silty sand with lumps of clay, dark brown, fine to medium grained, loose to medium dense, moist to wet	1.4m	-	-
HA 07	Lot 41 Farrall Rd	0.0 – 0.4 0.4 – 2.0	Sand fill Sandy clay, greyish brown, soft to firm becoming stiff, very moist to wet	1.3m	-	-
HA 08	Lot 9 88 Farrall Rd	0.0 – 0.3 0.3 – 2.0	Sand fill Sandy clay, grey and brown, soft to firm becoming stiff, moist to wet, with fine to coarse quartz grains	1.1m	-	Sample depth: 0.4 – 1.0m % Fines: 50, % Sand: 44, % Gravel: 6 LL: 38%, PL: 16%, PI: 22%, LS: 12%
HA 09	Lot 4 Farrall Rd	0.0 – 0.4 0.4 – 2.0	Sand fill Sandy clay, grey with orange mottling, firm to stiff, moist	Not encountered	-	
HA 10	221 Morrison Rd	0.0 – 0.45 0.45 – 0.6 0.6	Sand fill Gravelly sand, yellow to brown with some red mottling, fine grained, medium dense, dry Refusal	Not encountered	-	-

Hand Auger	Location	Depth (m)	Soil Description	Groundwater	Shear vane Testing	Laboratory Test Results
HA 11	Lot 349 Orchard Ave	0.0 – 0.45	Sand fill	Not encountered	-	-
		0.45 – 0.6	Gravelly sand, yellow with some red mottling, fine grained with fine gravel and some silt, loose to medium dense, dry			
		0.6	Refusal			
HA 12	86 Farrall Rd	0.0 – 0.5	Sand fill	Not encountered	-	-
		0.5 – 0.9	Sandy clay, dark brown to black, firm to stiff, with occasional fine gravel and strong odour, moist to wet			
		0.9 – 1.3	Sandy clay, dark brown with orange mottling, stiff, moist			
		1.3 – 1.8	Gravelly clay, greenish brown with orange and red mottling, with medium gravel and some quartz grains, stiff to very stiff, moist			
		1.8 – 2.0	Gravelly clay, light brown with greenish blue mottling, with fine to medium gravel, very stiff, moist			

Table 2 Groundwater Measurements on 8 November 2007

Piezo	Depth bgl
Piezo 1	2.05m
Piezo 2	Dry
Piezo 3	1.03m
Piezo 4	0.88m
Piezo 5	0.77m
Piezo 6	0.64m
Piezo 7	0.57m
Piezo 8	0.72m

Table 3 Summary of Laboratory Test Results

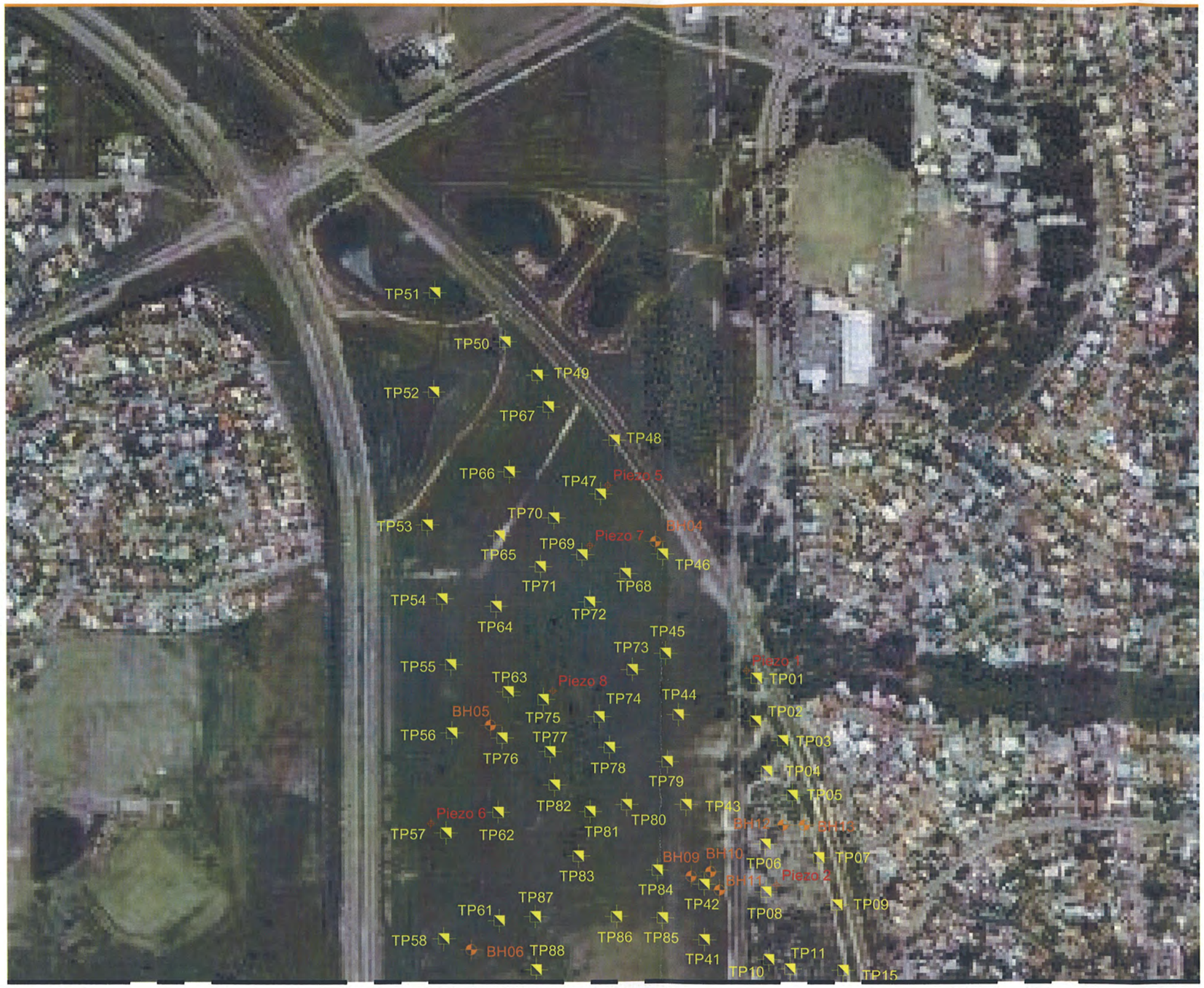
Test Pit / Hand Auger	Depth (m)	Material	% Fines (< 75µm)	% Sand	% Gravel (> 2mm)	LL (%)	PL (%)	PI (%)	LS (%)	Standard OMC (%)	Standard MDD (t/m^3)	Modified OMC (%)	Modified MDD (t/m^3)	Soaked CBR 2.5mm Penetration (%)	Soaked CBR 5mm Penetration (%)
TP 1	1.2 – 1.3	Silty sand	13	87	0	-	-	-	-	-	-	-	-	-	-
TP 1	1.6 – 1.7	Clayey sand	23	73	4	36	13	23	9	-	-	-	-	-	-
TP 1	2.2 – 2.3	Clayey sand with gravel	32	43	25	49	20	29	12	-	-	-	-	-	-
TP 2	1.2 – 1.3	Sand	5	95	0	-	-	-	-	14.4	1.683	-	-	21	13
TP 3	2.0 – 2.1	Sand	3	97	0	-	-	-	-	-	-	-	-	-	-
TP 8	1.7 – 1.8	Sand	4	96	0	-	-	-	-	-	-	15.5	1.661	-	-
TP 20	0.4 – 0.5	Sandy clay	49	42	9	57	19	38	17	16.7	1.732	-	-	4	3
TP 22	0.4 – 0.5	Silty sand	21	73	6	N/O	N/O	NP	-	-	-	-	-	-	-
TP 23	1.6 – 1.7	Sandy clay	52	46	2	45	16	29	13	-	-	-	-	-	-
TP 26	2.0 – 2.1	Clayey sand with gravel	30	44	26	40	12	28	11	-	-	-	-	-	-
TP 27	1.5 – 1.6	Sandy clay	61	35	4	60	18	42	15	17.8	1.793	-	-	3	2
TP 30	2.0 – 2.1	Clayey sand	35	62	3	34	14	20	11	-	-	-	-	-	-
TP 32	0.9 – 1.0	Clayey sand	44	52	4	35	18	17	11	-	-	-	-	-	-
TP 38	0.7 – 0.8	Clayey sand	36	63	1	37	13	24	9.5	-	-	-	-	-	-
TP 38	2.1 – 2.2	Clayey sand	27	70	3	78	13	65	5	-	-	-	-	-	-

Test Pit / Hand Auger	Depth (m)	Material	% Fines (< 75µm)	% Sand	% Gravel (> 2mm)	LL (%)	PL (%)	PI (%)	LS (%)	Standard OMC (%)	Standard MDD (t/m^3)	Modified OMC (%)	Modified MDD (t/m^3)	Soaked CBR 2.5mm Penetration (%)	Soaked CBR 5mm Penetration (%)
TP 40	1.5 – 1.6	Clayey sand	19	81	0	27	11	16	4	-	-	-	-	-	-
TP 44	1.9 – 2.0	Clayey sand	44	54	2	74	25	49	14	-	-	-	-	-	-
TP 47	1.6 – 1.7	Sand	9	91	0	-	-	-	-	-	-	-	-	-	-
TP 51	1.8 – 1.9	Clayey sand with gravel	21	50	29	49	21	28	13	-	-	-	-	-	-
TP 57	0.7 – 0.8	Clayey sand with some gravel	21	65	14	20	11	9	2	-	-	-	-	-	-
TP 66	0.8 – 0.9	Clayey sand	26	73	1	25	11	14	5						
TP 68	2.9 – 3.0	Sandy clay with gravel	47	35	18	57	23	34	12	-	-	-	-	-	-
TP 69	1.2 – 1.3	Clayey sand	25	75	0	25	11	14	3	-	-	-	-	-	-
TP 76	1.7 –1.8	Sandy clay	58	39	3	48	23	25	12	-	-	-	-	-	-
TP 86	2.4 – 2.5	Clayey sand	43	57	0	54	20	34	12	-	-	-	-	-	-
TP 89	0.9 – 1.0	Clayey sand	30	69	1	45	14	31	13	-	-	-	-	-	-
TP 91	1.4 – 1.5	Clayey sand with gravel	25	33	42	38	18	20	10	-	-	-	-	-	-
HA 1	0.4 – 1.5	Clayey sand	43	52	5	37	15	22	12	-	-	-	-	-	-
HA 2	0.4 – 1.4	Clayey sand with some gravel	37	53	10	28	14	14	7	-	-	-	-	-	-
HA 8	0.3 – 1.0	Sandy clay	50	44	6	38	16	22	12	-	-	-	-	-	-

Test Pit / Hand Auger	Depth (m)	Material	% Fines (< 75µm)	% Sand	% Gravel (> 2mm)	LL (%)	PL (%)	PI (%)	LS (%)	Standard OMC (%)	Standard MDD (t/m^3)	Modified OMC (%)	Modified MDD (t/m^3)	Soaked CBR 2.5mm Penetration (%)	Soaked CBR 5mm Penetration (%)
S-1 (Lot 14 Farrall Rd)	0.3 – 0.5	Sand	2	98	2	-	-	-	-	-	-	14.7	1.664	13	12

Legend:

LL – Liquid Limit
PL – Plastic Limit
PI – Plasticity Index
LS – Linear Shrinkage
OMC – Optimum Moisture Content
MDD – Maximum Dry Density
N/O – Not Obtainable
NP – Non Plastic



MATCHLINE FIGURE 2.2

LEGEND

TP01 = TEST PIT LOCATION

Piezo 1 = PIEZO LOCATION

BH01 = BOREHOLE LOCATION

HAO1 = HAND AUGER LOCATION

0 50 100 150m

SCALE 1:5000 AT ORIGINAL SIZE

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DEPARTMENT OF HOUSING AND WORKS
WEST STRATTON
TEST LOCATIONS ON DHW-OWNED LOTS

job no. | 61-21513
rev no. | B

Figure 2.1

scale | 1:5000 for A3 date | JANUARY 2008

10 Victoria Street Bunbury WA 6230 Australia T 61 8 9721 0700 F 61 8 9721 0777 E bunmail@ghd.com.au W www.ghd.com.au

Plot Date: 22 January, 2008 - 2:37 PM Cad File No: 61-21513-figure2.dwg

MATCHLINE FIGURE 2.1

LEGEND

- TP01 = TEST PIT LOCATION
- Piezo 1 = PIEZO LOCATION
- BH01 = BOREHOLE LOCATION
- HAO1 = HAND AUGER LOCATION

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

Plot Date: 22 January, 2008 - 2:37 PM Cad File No: 61-21513-figure2.dwg

GHD CLIENTS | PEOPLE | PERFORMANCE

DEPARTMENT OF HOUSING AND WORKS
WEST STRATTON
TEST LOCATIONS ON DHW-OWNED LOTS
scale | 1:5000 for A3 date | JANUARY 2008

job no. | 61-21513
rev no. | B

Figure 2.2

10 Victoria Street Bunbury WA 6230 Australia T 61 8 9721 0700 F 61 8 9721 0777 E bunmail@ghd.com.au W www.ghd.com.au

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TEST EXCAVATION LOG

Test Pit No.: **TP 01**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 2.9m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
		0.2				TOPSOIL Silty sand, dark grey, with fine roots and some large roots.	moist	VL				
					SP	SAND (FILL) Grey, fine to medium grained, with some building rubbles.	moist	L				
1		1.2			SM	SILTY SAND Light brown, fine to medium grained, with trace of roots.	moist	L-MD	1.20	D	% Fines: 13, % Sand: 87, %Gravel: 0	1
		1.6			SC	CLAYEY SAND Light brown, fine to coarse grained.	moist	MD	1.60	D	% Fines: 23, % Sand: 73, % Gravel: 4 LL: 36%, PL: 13%, PI: 23%, LS: 9%	
		1.8			SC	CLAYEY SAND Light brown with orange mottling, fine to medium grained.	moist	MD				
2	Seepage into pit	2.2			SC	CLAYEY SAND with GRAVEL Light brown with orange mottling, medium grained, with fine to medium laterite gravel and trace of laterite cobbles.	moist-wet	MD	2.20	D	% Fines: 32, % Sand: 43, % Gravel: 25 LL: 49%, PL: 20%, PI: 29%, LS: 12%	2
		2.9										
3						Termination Depth = 2.9m (Collapsing)						3

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TEST EXCAVATION LOG

Test Pit No.: **TP 02**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Test Results (blows per 30cm) 0 20 40 Blowcounts	Depth Scale (m)
		0.1				TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL					
					SP	SAND Light grey to grey, fine to medium grained.	dry	L-MD				0 7 13	
1									1.20	D	% Fines: 5, % Sand: 95, % Gravel: 0		1
		1.3			SM	SILTY SAND Orange yellow, fine to medium grained, with occasional fine laterite gravel and trace of medium to coarse laterite gravel.	moist	MD					
2	No groundwater encountered	2.2			SC	CLAYEY SAND Orange brown, fine to medium grained, with occasional fine to coarse laterite gravel.	moist-wet	MD					2
3		3.0				Termination Depth = 3m (Target Depth)							3

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TEST EXCAVATION LOG

Test Pit No.: **TP 03**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 2.2m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Test Results (blows per 30cm)	Depth Scale (m)
		0.2				TOPSOIL Silty sand, very dark grey, with fine roots.	moist	VL				0 7 23 possibly hit root	
1	No groundwater encountered				SP	SAND Light grey to 1.8m becoming yellowish brown to final depth, medium grained, with trace of large roots to 0.7m depth.	moist	L-MD					1
2		2.2				Laterite encountered at 2.2m.	moist		2.00	D	% Fines: 3, % Sand: 97, % Gravel: 0		2
						Termination Depth = 2.2m (Refusal)							
3													3

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TEST EXCAVATION LOG

Test Pit No.: **TP 04**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 2.8m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Test Results (blows per 30cm) 0 20 40 Blowcounts	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry					0	
		0.2			SP	SAND Greyish white, fine to medium grained, with trace of rootlets to 0.8m depth.	dry-moist	L-MD				4	
1												8	1
		1.8			SP	SAND Orange brown, fine to medium grained, with thin layers of white sand.	moist	MD					
2													2
	Seepage into pit	2.8				Termination Depth = 2.8m (Collapsing)							
3													3

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TEST EXCAVATION LOG

Test Pit No.: **TP 05**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Bucket Size (m): 0.8
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.2			SP	SAND Greyish white, fine to medium grained.	dry-moist	L-MD				
1	No groundwater encountered											1
		1.9			SP	SAND Orange brown, fine to medium grained, with some silt below 2.0m.	moist	MD				
2												2
3		3.0				Termination Depth = 3m (Target Depth)						3

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TEST EXCAVATION LOG

Test Pit No.: **TP 06**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Bucket Size (m): 0.8
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.2			SP	SAND Greyish white, fine to medium grained.	dry-moist	L-MD				
1	No groundwater encountered											1
2												2
3		3.0				Termination Depth = 3m (Target Depth)						3

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TEST EXCAVATION LOG

Test Pit No.: **TP 07**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 2.9m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Bucket Size (m): 0.8
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
		0.2				TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
1	No groundwater encountered				SP	SAND Greyish white, fine to medium grained.	dry-moist	L-MD				1
		1.5			SP	SAND Orange brown, fine to medium grained, with some coarse quartz grains.	moist	MD				
2		2.9										2
						Termination Depth = 2.9m (Collapsing)						
3												3

GENERAL LOG 6121513 (TP-1 TO TP-35).GPJ GHDPER.GDT 22/1/08

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TEST EXCAVATION LOG

Test Pit No.: **TP 08**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Bucket Size (m): 0.8
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.2			SP	SAND Greyish white, medium grained.	dry-moist	L-MD				
1	No groundwater encountered											1
									1.70	D	% Fines: 4, % Sand: 96, % Gravel: 0	
2												2
3		3.0				Termination Depth = 3m (Target Depth)						3

GHD | MANAGEMENT ENGINEERING ENVIRONMENT | GHD Pty Ltd 10 Victoria St Bunbury WA 6230

TEST EXCAVATION LOG

Test Pit No.: **TP 09**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Bucket Size (m): 0.8
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.2			SP	SAND Light yellow, fine to medium grained.	dry-moist	L-MD				
1	No groundwater encountered	1.3			SP	SAND Orange brown, fine to medium grained.	moist	MD				1
2												2
3		3.0				Termination Depth = 3m (Target Depth)						3

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TEST EXCAVATION LOG

Test Pit No.: **TP 10**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Bucket Size (m): 0.8
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.2			SP	SAND Light grey, fine to medium grained, with some coarse quartz grains.	dry	L-MD				
		0.7			SP	SAND Light brown, fine to medium grained.	dry-moist	MD				
1	No groundwater encountered											1
2												2
		3.0										
3						Termination Depth = 3m (Target Depth)						3

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TEST EXCAVATION LOG

Test Pit No.: **TP 11**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.0m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments
						TOPSOIL Silty sand, dark grey, with fine roots.	dry				
		0.2			SP	SAND Light grey, fine to medium grained.	dry-moist	L-MD-D			
1											
2						Wet below 2.7m.	wet	D			
	Seepage into pit										
3		3.0				Termination Depth = 3m (Target Depth)					

Test Results (blows per 30cm) 0 20 40 Blowcounts

0 4 8 12 12 16 20 14 15 19

Depth Scale (m): 1 2 3

GENERAL LOG 6121513 (TP-1 TO TP-35).GPJ GHDPER.GDT 22/1/08

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TEST EXCAVATION LOG

Test Pit No.: **TP 12**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 2.5m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.3			SP	SAND Light grey, fine to medium grained.	dry-moist	L-MD				
1												1
2						Wet below 2.2m.	wet	MD				2
	Flow into pit	2.5				Termination Depth = 2.5m (Collapsing)						
3												3

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TEST EXCAVATION LOG

Test Pit No.: **TP 13**

Sheet 1 of 1

Client: Department of Housing and Works
Project: Various Lots at West Stratton Geotechnical Investigation
Job No.: 61/21513

Position: Lot 14 Farrall Rd
Ground Surface Elevation: **Total Depth:** 3.2m
Commenced: 16-Oct-07 **Completed:** 16-Oct-07
Contractor: Mayday Earthmoving **Operator:** Jason

Equipment: 9 tonne tracked excavator
Excavation Width (m): 1.2
Excavation Length (m): 1.5
Bucket Size (m): 0.8
Orientation/ Bearing: Not Recorded

Logged:	HD	16-Oct-07
Processed:	DB	22-Jan-08
Checked:		

Depth Scale (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	Strata Description (type; colour; fines plasticity or particle characteristics; minor components; structure and/or origin)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/Test Records & Comments	Depth Scale (m)
						TOPSOIL Silty sand, dark grey, with fine roots.	dry	VL				
		0.3			SP	SAND Light grey, fine to medium grained.	dry-moist	L-MD				
1												1
2		2.2			SP	SAND Brown, fine to medium grained.	moist	MD				2
		2.6			SP	SAND Yellowish brown, fine to medium grained.	moist-wet	MD				
3	Flow into pit	3.2				Termination Depth = 3.2m (Target Depth)						3