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Report on
Preliminary Effluent Disposal Assessment

Proposed Boutique Tourist Development
Lot 22 Palmers Lane, Pokolbin

Prepared for
Hephzibah Hunter Valley Property Pty Ltd

In Consultation with
JW Planning Pty Ltd

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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	4 September 2017
Reviewer	4 September 2017



Douglas Partners Pty Ltd
 ABN 75 053 980 117
www.douglaspartners.com.au
 15 Callistemon Close
 Warabrook NSW 2304
 PO Box 324
 Hunter Region Mail Centre NSW 2310
 Phone (02) 4960 9600
 Fax (02) 4960 9601

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Supplementary Report on Preliminary Effluent Disposal Assessment Proposed Boutique Tourist Development Lot 22 Palmers Lane, Pokolbin

1. Introduction

This supplementary report presents the results of a preliminary effluent disposal assessment undertaken for a proposed boutique tourist development at Lot 22 Palmers Lane, Pokolbin. The investigation was commissioned by Delong Li of Hephzibah Hunter Valley Property Pty Ltd in an email dated 28 August 2017 and was undertaken with reference to Douglas Partners Pty Ltd (DP) proposal NCL170501 dated 27 August 2017. The work was undertaken in consultation with JW Planning, the planners for the development.

DP has carried out a previous preliminary effluent disposal assessment (Ref 1). Since the preparation of the previous report, further information has been provided in relation to the likely development at the site and predicted patronage. DP has also undertaken a concurrent preliminary site investigation (contamination), the results of which are contained within Ref 7.

The proposed development of the site was only in concept form at the time of preparation of this report. Stage 1 of the development includes the construction of internal access roads in the southern area of the site together with an reception/welcome building, car parking and accommodation units.

It is understood that the structures on the site are to comprise:

- Private and exclusive unit accommodation of up to 72 rooms; and
- Reception/welcome hall.

The assessment was undertaken to provide the following:

- Subsurface conditions at test locations, which were carried out as part of the Ref 1 assessment;
- Suitability of the site to accept domestic effluent together with indicative effluent treatment and disposal options, and likely disposal areas; and
- Additional investigation required to progress design of the effluent disposal for the development.

The effluent disposal assessment was carried out in accordance with NSW Government - Environment & Health Protection Guidelines: *On-site Sewage Management for Single Households* (Ref 3), AS 1547-2012: *On-site Domestic Wastewater Management* (Ref 2).

The assessment comprised the following:

- Review of the results of subsurface investigation and laboratory testing undertaken as part of Ref 1 investigation, which comprised the drilling of ten boreholes;
- A review of available data, including aerial photos, geological, topographical, orthophotos, soil landscape and acid sulfate soil mapping was undertaken to assess site constraints; and

- Supplementary site inspection by a Principal geotechnical engineer to assess site condition, soil and rock exposures and identify areas of poor ground.

Details of the field work and laboratory testing undertaken as part of the previous investigation are given in this report, together with engineering comment on the issues outlined above.

For the purposes of the investigation, the client provided DP with a survey plan of the site with 1 in 20 year and 1 in 100 year flood levels.

2. Site Description

2.1 Location

The site is identified as Lot 22 DP 791884, Palmers Lane, Pokolbin, New South Wales. Drawing 1 provides an aerial view of the site together with relevant site features discussed in the following sections.

The lot is bounded on all sides by private property with access to the site via an unsealed right of way from Palmers Lane. The adjacent properties include paddocks, timbered areas and vineyards.

The site comprises an approximately rectangular area covering about 48 ha (refer Figure 1 and Drawing 1).

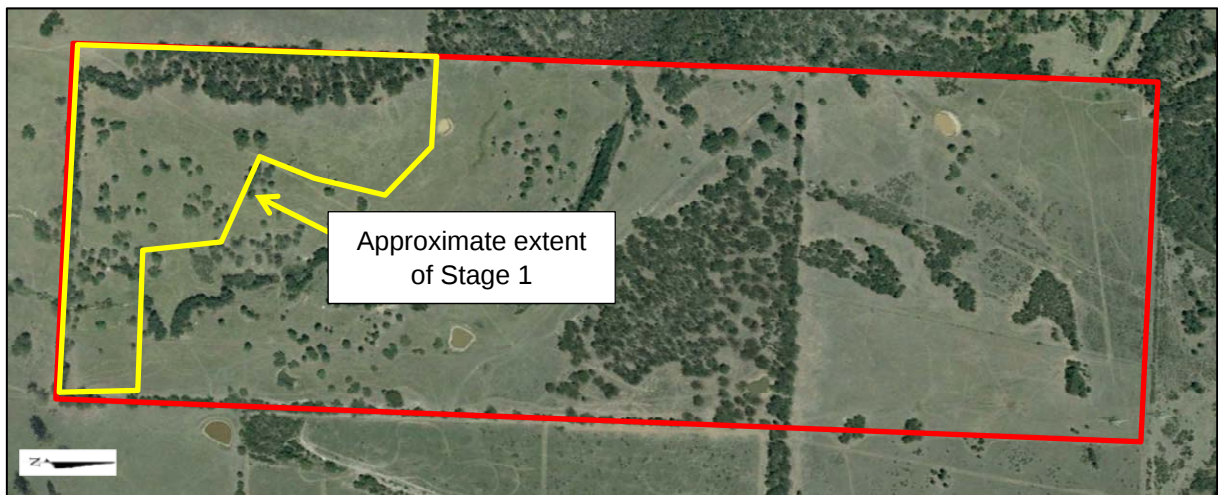


Figure 1: Aerial image of site (Google earth 2009 image)

2.2 Existing Development

The site is generally undeveloped with the exception of six farm dams. The external boundaries are delineated with barbed-wire fences and two additional internal fences segregated areas of the site. There is high-voltage power lines in an easement located in the northern area of the site, beyond the Stage 1 development area.

The dams are of particular significance to the proposed development due to buffer requirements from any proposed effluent disposal areas.

Features of existing development are shown in Figure 2 and Figure 3 below.



Figure 2: Looking north to dam in central part of site



Figure 3: Looking east to dam in south-eastern part of site

2.3 Topography

Reference to the site survey plan provided by JW Planning and drawn by WMA Water Engineering Survey, indicates that the elevation of the overall site ranges from about RL 69 AHD at the north-west corner to about RL 93 in the north-east.

The site is dominated by a low hill near the middle of the site (near the Palmers Lane access), the flank of a low ridge in the south-west corner (see Figure 4) and a creek line which runs north from the southern boundary and exits the site at the mid-point of the western boundary.

There is an outcropping of rock orientated approximately north-south through the northern area of the site, as shown in Figure 5 and Drawing 1 in Appendix D.

The site generally slopes between 0° and about 6°. There are locally steeper slopes on the banks at some locations of the creek line.



Figure 4: View from low hill in south-west corner looking north



Figure 5: Exposed bedrock in the northern area of the site

2.4 Vegetation

Vegetation on the site generally comprised grass paddocks with scattered trees. More heavily timbered areas were noted on the low hill near the middle of the site, the flank of a low ridge in the south-west corner and along the creek line. There is also some shrubs and trees on the northern flank of the low hill in the middle of the site. The extent of the vegetation can be seen in the aerial image of the site in Figure 6 below.

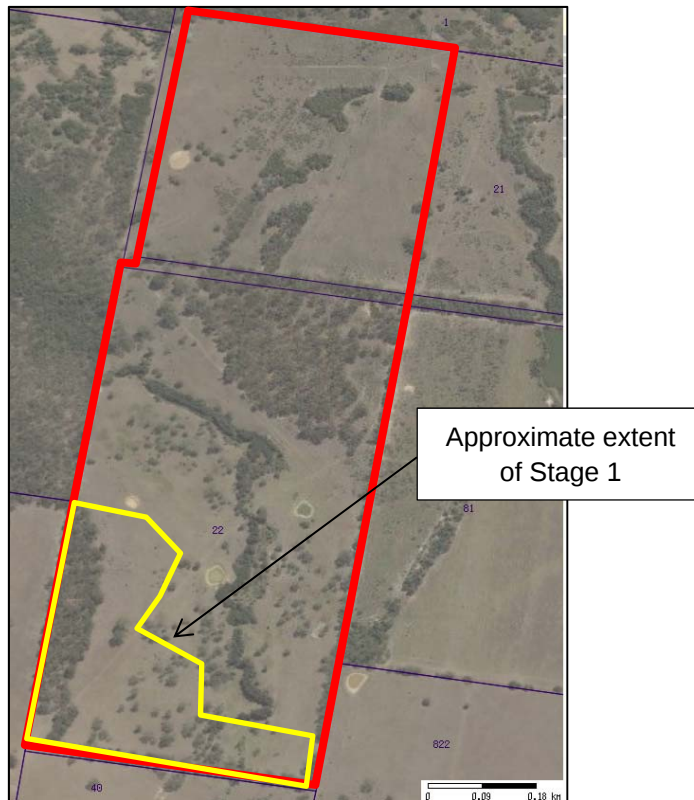


Figure 6: Extent of vegetation on site. Site boundary shown in red

3. Geological Setting, Soil Landscape and Salinity Mapping

3.1 Regional Geology

Reference to the 1:100,000 Newcastle Coalfield Geology sheet indicates that the surface geology of the site comprises Permian aged Branxton Formation rocks of the Maitland Group typically comprising conglomerate, sandstone and siltstone.

3.2 Soil Landscape

The 1:250,000 Singleton Soil Landscape Series Sheet prepared by the NSW Soil Conservation Service indicates that the site and Stage 1 is located over two soil landscape types as shown on Figure 7 and described below:

- Rothbury Soil Landscape – Red Podzolic Soils – soils which are derived from a wide range of parent rocks. Soils are generally shallow to moderately deep, loose to hardsetting soils that are poorly drained to well drained and slowly permeable to moderately permeable. Topsoils are acidic to neutral pH and subsoils are typically acidic. The soils are a moderate to high erosion hazard; and
- Pokolbin Soil Landscape – Yellow Podzolic Soils – soils which are derived from a wide range of parent rocks. Soils are generally shallow to moderately deep, hardsetting soils that are imperfectly drained to well drained and moderately permeable. Topsoils have a neutral pH and subsoils are typically acidic. The soils are a moderate erosion hazard.

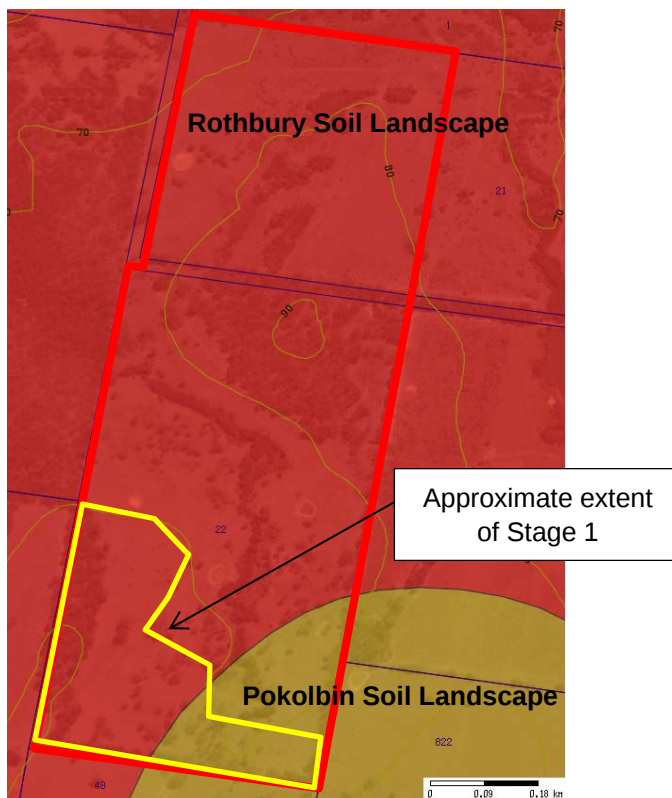


Figure 7: Approximate soil landscape boundaries at the site

3.3 Salinity

Reference to the NSW Department of Primary Industry's on-line database indicates that occurrences and indicators of salinity outbreaks have not been identified at the site.

3.4 Registered Groundwater Bore Search

An on-line records search of groundwater wells registered with the NSW Office of Water indicated that the nearest registered groundwater well is located approximately 800 m to the south of the site (Bore GW200303). This bore is registered for “domestic” and “stock” purposes in 2006 and review of the drilling records indicate that the bore was drilled to 60 m. No water bearing zone details were recorded.

4. Field Work

4.1 Methods

The field work was undertaken on 10 November 2015 during the previous investigation and comprised the drilling of 10 bores (Bores 1 to 10). The bores were drilled using a four wheel drive utility mounted push tube rig equipped with 63 mm and 38 mm diameter push tubes and taken to depths ranging from 0.87 m to 2.84 m.

The test locations were set out by a geotechnical engineer from DP from existing site features. The coordinates of the test locations were surveyed using a hand held GPS with an accuracy of about ± 5 m.

The approximate test locations are shown on Drawing 1 in Appendix D. A field engineer from DP logged the subsurface conditions encountered in the bores and collected regular samples for subsequent laboratory testing and identification purposes. Bores were backfilled and compacted with cuttings from the borehole on completion.

A site inspection was undertaken on the 30 November 2016 by a senior engineer from DP. A number of site photos were taken during the inspection, which are included in the photo plates in Appendix B. The approximate locations of the photos are shown in Drawing 1 of Appendix D.

4.2 Results

The subsurface conditions encountered are presented in detail in the borehole logs in Appendix B. These should be read in conjunction with the accompanying notes in Appendix A which explain the descriptive terms and classification methods used in the reports. The following is a summary of these subsurface conditions.

Subsurface conditions generally comprised a layer of topsoil to a depth of between 0.05 m and 0.10 m overlying very stiff to hard silts and clays, further underlain by sandstone and siltstone bedrock at depths of between 0.8 m and 1.7 m (except Bore 4). Further information of bedrock depths is presented in Table 1.

An exception to this generalised profile was encountered in Bores 4, 7 and 8, where medium dense to very dense clayey sand was encountered between depths of 0.18 m to 1.3 m, 0.6 m to 1.23 m and 0.8 m to 1.7 m respectively.

Groundwater was not observed in any of the bores during the time that they remained open. Surface water was observed in the six dams on site as well as some ponding in the creek. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

Table 1: Summary of Bores and Rock Depths

Bore	Depth to Top of Rock (m)	Depth to Refusal (m)
1	1.1	1.36
2	0.8	0.87
3	1.0	1.26
4	NE	NE
5	1.0	1.53
6	0.8	1.25
7	NR	1.23
8	1.7	2.15
9	1.3	1.35
10	1.0	1.1

Notes to Table 1:

NE – not encountered

NR – not recorded

* Elevations are based on interpolation between contours on site survey plan with 1.0 m contour interval and are approximate only

5. Laboratory Testing

Laboratory testing was undertaken on two samples retrieved from the bores and comprised pH, EC, Phosphorus Retention Index, cation analysis and Emerson stability classification.

Detailed laboratory test results are presented in Appendix C and are summarised in Table 2 below.

Table 2: Results of Effluent Suite Testing

Test Bore	Sample Depth	Soil Description	Textural Class	Soil pH (in CaCl)	EC _e (dS/m)	PSC (kg/ha)	CEC (cmol/kg)	Sodicity (ESP%)	Emerson Class
4	0.3 – 0.6	Clayey sand	Sandy loam	7.1	0.42	11230	4.4	1.4	3.1
9	0.4 – 0.6	Sandy clay	Light clay	5.7	4.42	13032	7.0	24.5	3.1

Notes to Table 2:

¹ EC_e is converted EC (1:5 – soil:water) as presented in Ref 4

PSC – phosphorus sorption capacity

CEC – cation exchange capacity

ESP – exchangeable sodium percentage

Discussion of soil limitations for effluent disposal is provided in Section 7.2.2.

6. Proposed Development

The proposed Stage 1 development is located in the southern area of the site and will include the following:

- Private and exclusive unit accommodation of up to 72 rooms; and
- Reception/welcome hall.

Stage 1 of the proposed development will be limited to the southern area of the site (refer Figure 8).

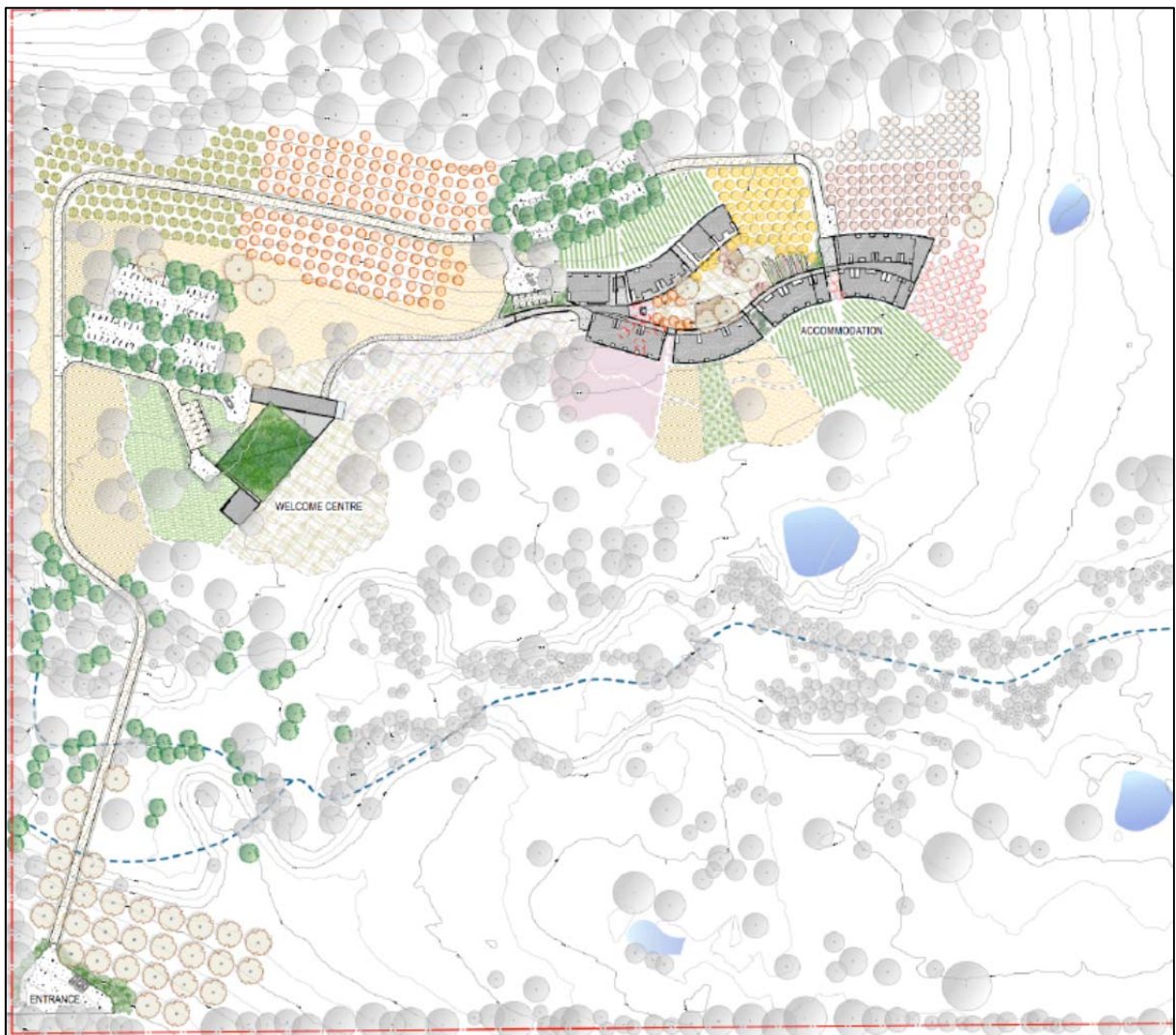


Figure 8: Concept plan for Stage 1

The domestic waste generated by the facility is proposed to be treated and applied to the land within the site. Based on information contained within the preliminary service advice (Ref 8), the preferred treatment option is individual treatment and application around the proposed building clusters.

7. Comments

7.1 Subsurface Conditions

The pertinent features of the subsurface conditions at the site are presented below:

- Bedrock was encountered within 0.8 m to 1.7 m of the surface in the pits within Stage 1 and locally at the surface elsewhere within the site (refer to Drawing 1);
- Groundwater was not observed in any of the boreholes during the time that they remained open. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

7.2 Preliminary Effluent Disposal Assessment

Consideration has been given to the treatment and disposal of the combined waste streams (blackwater and greywater) to the land surface using individual treatment and disposal systems around the building clusters.

7.2.1 Site and Soil Assessment

Site and soil characteristics observed during the field work are assigned either a minor, moderate or major limitation depending on the restrictions to the disposal area in accordance with Environment and Health Protection Guidelines (Ref 2) and are detailed in Table 3 and Table 4. The limitations for effluent disposal within the site are shown in bold, together with recommended site improvement measures where necessary.

Table 3: Site Summary Sheet

Site Feature	Relevant System(s)	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature	Recommended Site Improvements
Flood potential	All land application systems	<i>Rare, above 1 in 20 year flood contour</i>		Frequent, below 1 in 20 year flood contour	Transport of wastewater off site	Locate disposal area above 1 in 100 year flood contour
	All treatment systems	<i>Vents, openings, and electrical components above 1 in 100 year flood contour</i>		Vents, openings, and electrical components below 1 in 100 year flood contour	Transport of wastewater off site. System failure and electrocution hazard	
Exposure	All land application systems	<i>High sun and wind exposure</i>		Low sun and wind exposure	Poor evapotranspiration	None required
Slope%	Surface irrigation	<i>0-6</i>	6 - 12	>12	Run-off, erosion	None required
	Sub-surface irrigation	<i>0-10</i>	10 - 20	>20		
	Absorption system	<i>0-10</i>	10 - 20	>20		
Landform	All systems	<i>Hill crests, convex side slopes and plains</i>	Concave side slopes and footslopes	Drainage plains and incised channels	Groundwater pollution hazard. Resurfacing hazard	None required
Run-on and upslope seepage	All land application systems	None – low	Moderate	High – diversion not practical	Transport of wastewater off site	Bunding may be required
Erosion potential	All land application systems	<i>No signs of erosion potential present</i>		Signs of erosion, eg rills, mass movement and slope failure present	Soil degradation and transport, system failure	Additional erosion protection may be required
Site drainage	All land application systems	<i>No signs of surface dampness</i>		Visible signs of surface dampness, such as moisture-tolerant vegetation (sedges and ferns), and seepages, soaks and springs	Groundwater pollution hazard. Resurfacing hazard	None required
Fill	All systems	<i>No fill</i>	Fill present		Subsidence. Variable permeability	None required
Buffer distance	All land application systems	<i>All buffer distances achievable</i>		Encroachment on Buffer Distances to intermittent watercourse	Health and pollution risks	None required
Land area	All systems	<i>Area is available</i>	Area is limited	Area is not available	Health and pollution risks	None required
Rocks and rock outcrops (% of land surface containing boulders)	All land application systems	<i><10%</i>	10-20%	>20%	Limits system performance	Locate disposal area outside of area of shallow rock
Geology/ Regolith	All land application systems			Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard	None required

Table 4: Soil Summary Sheet

Soil Feature	Relevant System(s)	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature	Recommended Site Improvements
Depth to bedrock/hardpan	Surface and subsurface irrigation	>1.0	0.5 - 1.0	<0.5	Restricts plant growth (trees), excessive runoff and waterlogging	Application systems to be located in areas with 1m or greater to rock, or additional loamy material imported to create 1 m of soil to rock
	Absorption system	>1.5	1.0 - 1.5	<1.0	Groundwater pollution hazard. Resurfacing hazard	
Depth to high episodic or seasonal watertable (m)	Surface and subsurface irrigation	>1.0	0.5 - 1.0	<0.5	Groundwater pollution hazard. Resurfacing hazard	None required
	Absorption system	>1.5	1.0 - 1.5	<1.0	Potential for groundwater pollution	None required
Soil Permeability category	Surface and subsurface irrigation	2b, 3 and 4	2a and 5	1 and 6	Excessive run-off, waterlogging and percolation	Bunding may be required
	Absorption system	3 and 4		1, 2, 5 and 6		
Coarse fragments (%)	All land application systems	0 - 20	20 - 40	>40	May restrict plant growth, affect trench installation	None required
Bulk density (g/cm ³)	All land application systems				Restricts plan growth, indicator of permeability	None required
* Sandy Loam		<1.8		>1.8		
* Loam and Clay Loam		<1.6		>1.6		
*Clay		<1.4		>1.4		
pH CaCl	All land application systems	>6	4.5 - 6.0	<4.5	Reduces optimum plant growth	Adjust pH with the additoin of agricultural lime
Electrical Conductivity - ECe (dS/m)	All land application systems	<4	4 - 8	>8	Excesive salt may restrict plant growth	None required
Sodicity (exchangeable sodium percentage)	Surface and subsurface irrigation (0 - 0.4 m)	0 - 5	5 - 10	>10	Potential for structural degradation	Careful selection of plants required in application areas
	Absorption system (0 - 1.2 m)					
Cation exchange capacity (cmol+/kg) (0 - 40 cm)	Surface and subsurface irrigation	>15	5 - 15	<5	Unable to hold plant nutrients	Should be improved with the addition of gypsum
Phosphorus sorption (kg P/ha) (0-1 m for irrigation) (1 m below intended base of trench)	All systems	>6000	2000 - 6000	<2000	Unable to immobilise any excess Phosphorus	None required
Modified Emerson Aggregate Test (dispersiveness)	All land application systems	Class 3 or above	Class 2	Class 1	Potential for structural degradation	None required

7.2.2 Identified Major Site Constraints

The final location of the effluent application area will be dependent on a number of factors, including the site and soil limitations highlighted in Table 3 and Table 4 above.

The principle limitations are discussed in more detail below and are noted on Drawing 1 in Appendix D.

Depth to Rock

Rock depths of less than 1 m present a major limitation to absorption type application systems. Bedrock was encountered at a depth of 0.8 m in Bore 6, located near Stage 1 of the development, and locally at the surface (refer Drawing 1). Deeper soil was encountered in within the lower lying areas of the site, particularly to the west of the main creek line. In this regard, rock was not encountered within Bore 4, which was drilled to 2.84 m depth.

If an absorption type application system is adopted, additional importation of suitable high nutrient neutralising capacity soils could be undertaken to address this constraint in the areas where depth to bedrock was less than 1 m. Alternatively, surface or near surface irrigation could be used for application of treated effluent.

It is recommended that once the final position of the effluent disposal areas are identified, additional investigation is undertaken to assess the depth to bedrock on a more closely spaced grid and allow more detailed guidance on site improvement measures required to address this constraint.

Sodicity

The results of testing on the sample of sandy clay from Bore 9 and reference to the Local Government Salinity Initiative returned values which are indicative of sodic soil conditions. Results from the sample taken from Bore 4, however, located within Stage 1 of the development, were less sodic. Soils with high sodicity can have a tendency to lose their structure and disperse into very small particles, which can lead to clogging of the pore spaces within the soil profile, impeding water flow. This limitation should be addressed by the addition of non-sodic soils where raising of the application areas is required or by tyning in of gypsum into the sodic soils. Further assessment of suitable gypsum rates should be undertaken prior to final design of application areas.

Cation Exchange Capacity

Laboratory testing for the soils present at this site indicated a Cation Exchange Capacity (CEC) of 4.4 cmol⁺/kg for Bore 4 and 7.0 cmol⁺/kg for Bore 9 which is considered to be a major and moderate limitation respectively. The CEC may be improved by the addition of gypsum or by the addition of organic material such as ploughing in a leafy green crop.

Soil Permeability

The soil permeability of the underlying soils across the site generally present a moderate and major limitation (Soil Types 2a, 4 and 5 as defined in Ref 2) for both surface and subsurface irrigation and absorption systems. Ploughing of soils should improve the soils ability to accept effluent by breaking down the soil structure and increasing soil porosity.

7.2.3 Buffer Distances and Location of Disposal Areas

Table 5 outlines the range of setback distances recommend by AS 1547:2012 (Ref 2) and the recommended setback distances for the site following an evaluation of the site and soil constraints, as outlined in Table R2 of AS 1547:2012. Reference has also been made to the recommended buffer distances provided in the Environment & Health Guidelines (Ref 3).

Table 5: Recommended Buffer Distances for On-Site Systems

Recommended Buffer Distances from AS 1547:2012	Recommended Minimum Buffer Distances Following Evaluation of Site and Soil Constraints
1.5 to 50 m to property boundaries	6 m to boundary
2.0 to >6 m to buildings / houses	6 m to downslope buildings
15 to 100 m to surface water (e.g. dams, rivers, streams, lakes etc. permanent or intermittent)	40 m to drainage lines and creeks 40 m upslope to dams
15 to 50 m to domestic groundwater well	100 m to registered groundwater bores
3 to 15 m to recreational areas (e.g. children play areas, pools etc.)	15 m to recreational areas
4 to 15 m to in-ground water tanks	10 m to in-ground water tanks (any future tanks)
3 m or 45° angle from toe of retaining walls, embankments, escarpments and cuttings	N/A

These buffer distances should be reviewed during the detailed effluent disposal assessment.

The adopted buffer distances to relevant site features and constraints have been shown on Drawing 1 in Appendix D. This drawing shows the remainder of the site which is anticipated to be suitable for disposal of treated effluent, subject to more detailed investigation once more information in relation to the proposed development is known.

7.2.4 Effluent Treatment and Application System Design Considerations

Stage 1 of the development is located to the west of the creek, within the south-western area of the site. Disposal of the treated effluent for these buildings to areas within the vicinity of Bore 4 and further to the west may be suitable.

The size of the application areas required is dependent on the level of treatment undertaken prior to application. It is recommended that the system selected for treatment of the sewage generated by the development should ensure the following characteristics from Ref 2:

- Secondary Treatment: Effluent quality with phosphate reduction to at least 10 mg/L and nitrogen reduction to 25 mg/L prior to application to the land; and
- Advanced Secondary Treatment: Effluent quality with phosphate reduction to at least 5 mg/L and nitrogen reduction to 10 mg/L prior to application to the land.

These levels are consistent with low strength effluent as defined in Department of Environment and Conservation (NSW) Use of Effluent by Irrigation (Ref 5).

If a centralised treatment system for treating and disposing of effluent from more than one building is to be considered, the following additional characteristics and features may be required:

- An upfront flow balance tank may be required to ensure that the treated effluent volume being applied to the land does not exceed the daily irrigation rate;
- Disinfection to reduce pathogens to an acceptable level prior to application;
- The reliability of the treatment system/s could be enhanced by the addition of filtration such as sand filtration or activated carbon;
- Contingency for periods of treatment or disposal process failure. It will be necessary to have reliable contingency plans in place to respond to periods of treatment or disposal process failure. This may involve being able to take the effluent off site by means of pump out systems; and
- Accommodation for periods of extreme wet weather when the ground becomes saturated. Surface flow of wastewater needs to be prevented by appropriate means during wet weather.

The system selected for use should be approved by the NSW Health Department. Given the expected volume of effluent to be treated at the development, careful design of the treatment system will be required prior to discharge to the application area/s.

Owing to the site and soil limitations present at the site, it is recommended that the treated effluent could be applied to the land surface via either surface or sub-surface irrigation or possibly evapotranspiration.

7.2.5 Recommended Site Improvements

The final site improvements required will be dependent on the location of the application areas and the effluent disposal system adopted. As discussed in Section 7.2.2 above, the predominant constraint to effluent disposal includes the presence of shallow bedrock (as encountered at 0.8 m in Bore 6 and observed in some areas of the site, albeit generally to the north of the Stage 1 area), low cation exchange capacity, high sodicity and low soil permeability. A number of moderate limitations were also identified during the assessment and are highlighted in Tables 2 and 4 of Section 7.2.1.

The recommended site improvements are likely to include the following and should be reassessed following more detailed investigation within the selected effluent disposal area:

- Importation (or on site sourcing) of loamy soils to raise the absorption area so that the depth to bedrock is at least 1.0 m, where required;
- CEC may be improved by the addition of gypsum or by the addition of organic material such as ploughing in a leafy green crop. This will also assist with improving sodicity; and
- Ploughing of soils should improve the soils ability to accept effluent by breaking down the soil structure and increasing soil porosity, however, would increase potential for erosion in the short term.

7.2.6 Hydraulic Loading for Design

Based on information provided by JW Planning, it is understood that the predicted patronage of the facility would be up to 218 persons at any time on the site, based on the following:

- 72 rooms within the accommodation centre (say 150 persons);
- Welcome Hall/Function Centre (50 persons, based on public visitors additional to guests in rooms);
- Eighteen (18) staff per shift.

The design for hydraulic loading is based on the following cases:

- Case 1 accommodation (all 72 rooms);
- Case 2 accommodation (clusters of 10 rooms) and
- Case 3 welcome hall/function centre (say 50 persons plus 18 staff).

The hydraulic loading calculation is based on the following assumptions:

- The units will have non-reticulated water supply (tank water);
- An average occupancy rate of 3 persons per room and a 70% occupancy rate;
- It is noted that the Australian Standard does not provide guidance on design flow allowances for hotel style accommodation or reception/function centres and is normally based on a per room or per fixture basis. Therefore the daily waste stream volumes have been based on guidance in AS1547 for New Zealand and also reference to the Northern Territory Code of Practice for On-site Wastewater Management (Ref 6), which provides daily flow allowances for non-residential premises.
- The daily flow allowances for the various developments, as follows:
 - 150 L/person/day for accommodation rooms;
 - 30 L/person/day for the welcome hall (based on reception rooms loading); and
 - 30 L/person for non-resident staff.

Based on these assumptions, the waste stream volume for the three cases outlined above is shown in Table 6 below.

Table 6: Estimated Design Waste Stream Volume

Case	Wastestream Volume (greywater and blackwater) (L/day)
Case 1 – 72 room accommodation	22,500
Case 2 – 10 room accommodation cluster	3,150
Case 3 – welcome hall/function centre	2,000

7.2.7 Indicative Sizing of Disposal Areas

The area required for effluent disposal is determined by considering the hydraulic conductivity of the soil receiving the effluent and the ability of the soil to accept the nutrient loading associated with the effluent. These calculations are referred to as the hydraulic balance and nutrient balance respectively.

The areas required have been calculated based on the following design parameters:

- Rainfall data from Cessnock (Nulkaba);
- Evaporation data from Cessnock (Nulkaba);
- Procedures outlined in Environment and Health Protection Guidelines (Ref 2) and AS 1547 – 2012 (Ref 2);
- Soil depth of at least 1 m over the entire disposal area;
- Design irrigation rate (DIR) of 3 mm / day from Table 4.2A4 (Ref 2); and
- Design loading rate (DLR) of 10 mm / day from Table 4.2A4 (Ref 2).

Using the parameters and assumptions outlined above, the indicative minimum disposal areas required were calculated using an in-house computer program. The areas required for an irrigation or evapotranspiration application area for Cases 1 to 3 are shown below in Table 7 to Table 9.

Table 7: Surface or Sub-Surface Irrigation System (Case 1 – 72 Room Accommodation)

Effluent Treatment	Wastestream (Combined)	Nitrogen Balance Area (m ²)	Phosphorus Balance Area (m ²)	Hydraulic Balance Area (m ²)	
				Surface or Sub-surface Irrigation	Evapo-transpiration
Secondary	22500 L/day	15625	9654	7822	4355
Advanced secondary	22500 L/day	6250	4827	7822	4355

Notes to Table 7:

Bold values indicate minimum area required

Table 8: Surface or Sub-Surface Irrigation System (Case 2 – 10 Room Accommodation Cluster)

Effluent Treatment	Wastestream (Combined)	Nitrogen Balance Area (m ²)	Phosphorus Balance Area (m ²)	Hydraulic Balance Area (m ²)	
				Surface or Sub-surface Irrigation	Evapo-transpiration
Secondary	3150 L/day	2188	1352	1100	610
Advanced secondary	3150 L/day	875	676	1100	610

Notes to Table 8:

Bold values indicate minimum area required

Table 9: Surface or Sub-Surface Irrigation System (Case 3 – Welcome Hall/Function Centre)

Effluent Treatment	Wastestream (Combined)	Nitrogen Balance Area (m ²)	Phosphorus Balance Area (m ²)	Hydraulic Balance Area (m ²)	
				Surface or Sub-surface Irrigation	Evapo-transpiration
Secondary	2000 L/day	1389	858	696	389
Advanced secondary	2000 L/day	556	429	696	389

Notes to Table 9:

Bold values indicate minimum area required

The indicative effluent disposal areas provided in Table 7 to Table 9 are based on the assumption that the application areas will be regraded to maintain a soil cover over the bedrock of at least 1.0 m depth. They are also based on the implementation of the site improvements outlined in Section 7.2.5.

The results of the calculations for irrigation and evapotranspiration indicate that the areas required from the nitrogen balance are far greater than those required for the hydraulic balance with the exception of irrigation of advanced secondary treated effluent in some cases.

Construction of the application area to cater for the hydraulic balance may be applicable provided that sufficient measures are in place to prevent nutrient from being exported from the effluent disposal area/s to the local environment, and subject to Council approval.

7.2.8 Reserve Area Requirements

Typically, a reserve effluent disposal area is nominated during the assessment to allow for resting of the effluent disposal area and / or future expansion. AS 1547 - 2012 (Ref 2) states the requirement for a reserve area is typically associated with effluent generated from septic tanks and the need for a reserve area may be “reduced or even eliminated if an improved wastewater treatment” is utilised (page 63 of AS 1547 - 2012 (Ref 2)). In the event that secondary quality effluent is produced using a system with sufficient reliability, a reserve area may not be required, subject to Council approval.

7.3 Possible Beneficial Reuse of Treated Effluent

Based on the potential volume of treated effluent being produced by the development and the rural setting it may be possible to utilise the treated effluent for beneficial reuse.

Reference to the Department of Environment and Conservation (NSW), Use of Effluent by Irrigation (Ref 5) and consideration of the proposed development at the site indicates that provided the effluent meets the environmental performance objectives as laid out in Ref 4, the following uses may be possible for the treated effluent:

- Landscape watering;
- Irrigation of pasture, crops, orchard, vineyards or plantation forests; and
- Irrigation of recreation grounds.

Significant additional investigation would be required to further assess the potential for such beneficial reuse, including intensive subsurface investigation, laboratory testing of the soil, design of the effluent treatment system and modelling of the environmental aspects of the irrigation. However, a preliminary assessment of the potential of the site for such irrigation was undertaken and the following comments made:

- The ESP results for the soils encountered in the previous investigation ranged from 1.4% to 24.5%. Ref 5 indicates that *"soils with an ESP of greater than 5 are at risk of showing the adverse structural impacts associated with sodicity"*;
- The electrical conductivity of the soils tested measured between 0.42 and 4.42 dS/m which is generally suited to application of effluent;
- A number of areas of the site have slope of less than 5%, which according to Ref 5 present nil or slight limitations to application of effluent via sprinklers or trickle/microspray methods;
- Areas of the site could be selected with sufficient buffer distances to surface waters, such as the creek. For low strength effluent, a buffer distance of 50 m is suggested in Ref 5 provided sufficient mitigation measures are implemented, such as tree and shrub planting; and
- Ongoing effluent, soil and surface water monitoring prior to and throughout the life of the irrigation system.

In the event that such beneficial reuse is to be considered further, additional investigation should be undertaken in the likely application areas and existing surface waters.

7.4 Additional Investigation

In order to progress the design of effluent disposal for the development the following additional investigation is recommended once the type of system is selected and the location of the application area finalised:

- Additional bores and laboratory testing within the application area/s to better determine the depth to bedrock and allow estimation of the required volume of soil to maintain at least 1.0 m of soil over the bedrock;
- Consideration of alternate disposal options such as artificial wetlands which could provide an aesthetic feature for the site;
- Liaison with Council in relation to the acceptability of the proposed effluent disposal system and the need to formulate the protocols and management plans for the on-going maintenance and operation of the effluent disposal systems at the site, particularly for any centralised systems;
- More detailed assessment in the event that beneficial re-use of the treated effluent is to be considered further, as discussed above.

8. References

1. Douglas Partners Pty Ltd, *Report on Preliminary Effluent Disposal Investigation, Proposed Boutique Tourist Development, Lot 22 Palmers Lane, Pokolbin*, Project 81850.00, dated November 2015
2. AS 1547-2012: *On-site domestic-wastewater management*, Standards Australia.
3. NSW Government - Environment & Health Protection Guidelines: *On-site Sewage Management for Single Households*, January 1998.
4. Local Government Salinity Initiative, *Site Investigations for Urban Salinity*.
5. Department of Environment and Conservation (NSW), *Environmental Guidelines, Use of Effluent by Irrigation* December 2004.
6. Environmental Health Program Directorate, *Code of Practice for Small On-Site Sewage and Sullage Treatment Systems and The Disposal or Reuse of Sewage Effluent*, November 1996.
7. Douglas Partners Pty Ltd, *Report on Preliminary Site Investigation (Contamination), Proposed Tourist Development, Lot 22 Palmers Road, Pokolbin*, Project 81850.02, dated September 2017.
8. Northrop Consulting Engineers, "Preliminary Servicing Advice", H12 Tourist Development, Pokolbin, Job NL167098. Revision 2, dated 24 May 2017

9. Limitations

Douglas Partners (DP) has prepared this report for this project at Lot 22 Palmers Road, Pokolbin with reference to Douglas Partners Pty Ltd (DP) proposal NCL170501 dated 27 August 2017 and acceptance by Delong Li of Hephzibah Hunter Valley Property Pty Ltd in an email dated 28 August 2017.

The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Hephzibah Hunter Valley Property Pty Ltd and JW Planning for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. 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 on the site only at the specific sampling and 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 human 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 affected by undetected variations in ground conditions across the site between and beyond the sampling and / or testing 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 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 stated 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.

Douglas Partners Pty Ltd

Appendix A

About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.



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

Sampling Methods

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.



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.

Symbols & Abbreviations

Douglas Partners



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

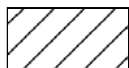
Soils



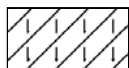
Topsoil



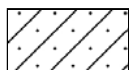
Peat



Clay



Silty clay



Sandy clay



Gravelly clay



Shaly clay



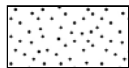
Silt



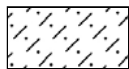
Clayey silt



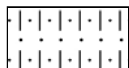
Sandy silt



Sand



Clayey sand



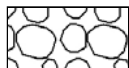
Silty sand



Gravel



Sandy gravel

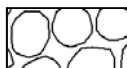


Cobbles, boulders



Talus

Sedimentary Rocks



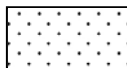
Boulder conglomerate



Conglomerate



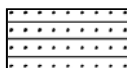
Conglomeratic sandstone



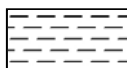
Sandstone



Siltstone



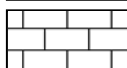
Laminite



Mudstone, claystone, shale

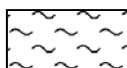


Coal

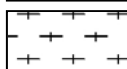


Limestone

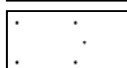
Metamorphic Rocks



Slate, phyllite, schist

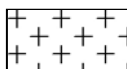


Gneiss

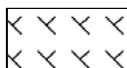


Quartzite

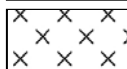
Igneous Rocks



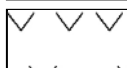
Granite



Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

Appendix B

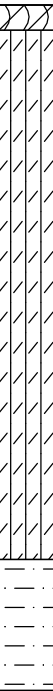
Borehole Logs (Bores 1 to 10) from previous investigation
Results of Dynamic Penetrometer Tests
Photos Plates 1 to 8 – Site Photos

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339690
NORTHING: 6375049
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.05	TOPSOIL - Brown silt, some fine to medium sized subrounded gravel, trace fine grained sand, humid										
		CLAYEY SILT - Hard, orange-brown clayey silt, trace fine grained subrounded gravel and fine grained sand in parts, M-Wp - M<Wp			0.2		pp >400					
				D								
					0.6		pp >400					
		From 0.8m, grading to siltstone										
	1				1.0		pp >400	1				
	1.1	SILTSTONE - Extremely low strength, extremely weathered, orange-brown mottled pale grey siltstone with soil like properties in parts		D	1.2							
	1.36	Bore discontinued at 1.36m, push tube refusal										
	2							2				

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 1.36m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

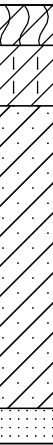
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket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

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339379
NORTHING: 6375133
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.08	TOPSOIL - Brown silt, some fine to medium sized subrounded gravel, trace fine grained sand, humid										
	0.2	SILTY CLAY - Hard, brown / red-brown silty clay, M<Wp			0.15		pp >400					
		SANDY CLAY - Hard, orange-brown and red-brown mottled grey fine grained sandy clay with some fine sized subrounded gravel M ≤ Wp			0.3							
		From 0.6m, grading to sandstone		D	0.6							
	0.8	PEBBLY SANDSTONE - Very low strength, highly weathered, pale grey pebbly fine to coarse grained sandstone										
	0.87	Bore discontinued at 0.87m, push tube refusal										
1									1			
2									2			

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 0.87m

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339449
NORTHING: 6375045
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.05	TOPSOIL - Brown / grey-brown fine grained sandy silt with rootlets, humid										
		SILTY CLAY - Hard, red-brown mottled orange-brown silty clay with some fine grained sand in parts, M<Wp - M~Wp			0.2		pp >400					
					0.3							
				D								
					0.6		pp >400					
		From 0.8m, some medium to coarse sized subangular sandstone gravel			0.9		pp >400					
1	1.0	SANDSTONE / SILTSTONE - Extremely low to very low strength, highly weathered orange-brown mottled grey, fine grained sandstone / siltstone with soil like properties in parts						1				
	1.26	Bore discontinued at 1.26m, push tube refusal										
2								2				

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 1.26m

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339435
NORTHING: 6374836
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
		TOPSOIL - Grey-brown silty fine grained sand with rootlets, damp		D	0.0							
	0.18	CLAYEY SAND - Medium dense, orange-brown, fine to coarse grained clayey sand with some fine to medium sized subrounded and subangular gravel in parts, damp / M>Wp		D	0.18							
					0.3							
					0.6							
	1											
	1.3	SILTY CLAY - Very stiff to hard, grey / dark grey mottled orange silty clay, M>Wp			1.4		pp = 300-400					
					1.7		pp=300>400					
	2				2.0		pp = 300-350					
	2.2	SILTY CLAY - Stiff to very stiff, orange-brown mottled grey silty clay with some fine grained sand, M>Wp			2.4		pp = 200-250					
					2.7		pp = 200-270					
	2.84	Bore discontinued at 2.84m, push tube refusal										

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson **LOGGED:** Benson **CASING:** Uncased

TYPE OF BORING: 63mm diameter tube to 1.4m, then 38mm tube to 2.84m

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339392
NORTHING: 6374726
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Dark brown fine grained sandy silt with trace some fine sized subrounded gravel, some rootlets, humid			0.1							
		SANDY CLAY - Hard, orange-brown fine grained sandy clay, some silt, M-Wp - M>Wp		D	0.2		pp >400					
					0.4		pp >400					
	0.5	SILTY CLAY - Hard, pale grey mottled red-brown silty clay with some fine grained sand, M>Wp		D	0.5		pp >400					
					0.6		pp >400					
					0.8		pp >400					
1	1.0	SILTSTONE - Extremely low strength, extremely weathered, pale grey siltstone						1				
	1.53	Bore discontinued at 1.53m, push tube refusal										
2								2				

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson **LOGGED:** Benson **CASING:** Uncased

TYPE OF BORING: 63mm diameter tube to 1.4m, then 38mm tube to 1.53m

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339323
NORTHING: 6374594
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

[illegible]

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 1.25m

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

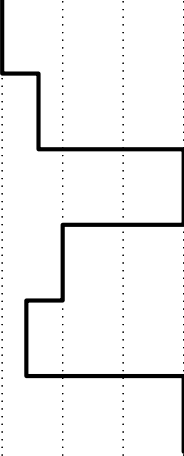


BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339620
NORTHING: 6374575
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.1	TOPSOIL - Grey-brown silt with trace to some fine to coarse grained sand and rootlets, humid		D	0.2		pp >400						
		SANDY CLAY - Hard, orange-brown mottled pale grey fine to coarse grained sandy clay with some silt, M<Wp											
	0.6	CLAYEY SAND - Dense, orange-brown clayey fine to medium grained sand with sandy clay in parts, humid, damp, M>Wp			0.5		pp >400						
		From 0.9m, dense to very dense											
	-1								-1				
1.23		Bore discontinued at 1.23m, push tube refusal											

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 1.23m

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



BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339440
NORTHING: 6375265
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Dark brown fine grained sandy silt with rootlets, damp										
		SANDY CLAY - Very stiff to hard, orange-brown mottled grey-brown fine grained sandy clay with some fine to medium sized subangular gravel in parts, M-Wp		D	0.2		pp >400					
					0.3							
					0.5		pp = 200-400					
					0.6							
					0.7		pp >400					
	0.8	CLAYEY SAND - Medium dense, orange-brown clay and fine to medium grained sand, damp										
	1											
	1.7	SANDSTONE - Extremely low strength, extremely weathered, pale grey mottled orange-brown fine grained sandstone with soil like properties in parts										
	2											
	2.15	Bore discontinued at 2.15m, slow progress in soil										

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson **LOGGED:** Benson **CASING:** Uncased

TYPE OF BORING: 63mm diameter tube to 1.4m, then 38mm tube to 2.15m

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 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	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339683
NORTHING: 6375302
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Generally comprising dark brown silt some fine grained sand and rootlets, damp										
		SANDY CLAY - Very stiff to hard, orange-brown fine grained sandy clay, M>Wp			0.2		pp >400					
					0.4		pp= 400 ->400					
				D	0.6		pp= 300->400					
					0.8		pp = 300-400					
	0.9	CLAYEY SAND - Medium dense, pale orange-brown clayey fine grained sand, damp										
	1											
	1.3	SANDSTONE - Extremely low strength, extremely weathered, orange-brown fine grained sandstone										
	1.35	Bore discontinued at 1.35m, push tube refusal										
	2											

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 1.35m

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	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)

BOREHOLE LOG

CLIENT: RMA Investment Group
PROJECT: Preliminary Effluent Disposal Assessment
LOCATION: Lot 22 Palmers Lane, Pokolbin

SURFACE LEVEL: --
EASTING: 339482
NORTHING: 6375464
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 81850.00
DATE: 10/11/2015
SHEET 1 OF 1

[illegible]

RIG: 4WD Ute Mounted Push Tube **DRILLER:** Benson

LOGGED: Benson

CASING: Uncased

TYPE OF BORING: 63mm diameter tube to 1.1m

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



Results of Dynamic Penetrometer Tests

Client RMA Investigations Group
Project Preliminary Effluent Disposal Assessment
Location Lot 22 Palmers Lane, POKOLBIN

Project No. 81850.00
Date 12/11/2015
Page No. 1 of 1

Test Locations	1	2	3	4	5	6	7	8	9	10
RL of Test (AHD)										
Depth (m)	Penetration Resistance Blows/150 mm									
0.00 – 0.15	4	1	4	2	2	2	5	1	2	2
0.15 – 0.30	4	4	4	2	2	3	8	2	5	3
0.30 – 0.45	5	6	6	2	3	6	20	3	5	3
0.45 – 0.60	7	6	6	5	3	4	10	2	5	4
0.60 – 0.75	8	9	8	5	3	4	7	2	3	3
0.75 – 0.90	16	20	20/130	2	3	5	20	4	5	3
0.90 – 1.05	7			7	4	7		8	7	6
1.05 – 1.20										
1.20 – 1.35										
1.35 – 1.50										
1.50 – 1.65										
1.65 – 1.80										
1.80 – 1.95										
1.95 – 2.10										
2.10 – 2.25										
2.25 – 2.40										
2.40 – 2.55										
2.55 – 2.70										
2.70 – 2.85										
2.85 – 3.00										
3.00 – 3.15										
3.15 – 3.30										
3.30 – 3.45										
3.45 – 3.60										

Test Method AS 1289.6.3.2, Cone Penetrometer ☒
 AS 1289.6.3.3, Sand Penetrometer ☐

Tested By IDB
Checked By IDB

Remarks Ref = Refusal, 25/110 indicates 25 blows for 110 mm penetration



Photo 1



Photo 2



Preliminary Site Assessment		PROJECT:	81850.01
Lot 22 Palmers Lane		Plate	1
Pokolbin		REV:	A
Client	Hephzibah Hunter Valley Property Pty Ltd	DATE:	12-Dec-16



Photo 3: Timber exposed in surficial filling



Photo 4: Existing Dam



Photo 5: Dam Embankment



Photo 6



Photo 7: Clay exposed in creekline



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12



Photo 13



Photo 14



Photo 15

Appendix C

Laboratory Test Results

Sample Drop Off: 16 Chilvers Road
 Thornleigh NSW 2120

Mailing Address: PO Box 357
 Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 37091 **Sample N°:** 1 **Date Received:** 12/11/15 **Report Status:** ☐ Draft ☒ Final

Client Name: Douglas Partners (Newcastle)	Project Name: Ref: 81850 Prelim Eff Disposal Assessment
Client Contact: Ian Benson	SES Quote N°:
Client Job N°:	Sample Name: Bore 4 0.3-0.6
Client Order N°: 123029	Description: Soil
Address: PO Box 324	Test Type: pHEC_S, ECEC_NH4Cl, PRI, mEAT
Hunter Region Mail Centre NSW 2310	

TEST	RESULT	COMMENTS
pH in water 1:5	8.1	
pH in CaCl ₂ 1:5	7.4	
EC mS/cm 1:5	0.03	Very low

CATION ANALYSIS					
TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.05		0.06	1.4	
Potassium	0.46		0	0	
Calcium	0.21		3.4	79.1	
Magnesium	0.53		0.84	19.5	
Aluminium			0.089	2.1	
ECEC			4.4		
Ca/Mg			4.4		

Phosphate Retention Index (%): 13.30 Low **PRI (mgP/kg)**: 623.9 **PRI (kg/ha)**: -

PHYSICAL CHARACTERISTICS		Comment
Texture:	-	Field Density (g/mL):
Colour:	-	Emerson Stability Class: H20 Class 3.1
Size:	-	High SAR/Low Ionic Strength: 6
Aggregate strength:	-	Med SAR/High Ionic Strength: 6
Structural unit:	Did not test	Particle Size Analysis (PSA)
Approx. Clay Content (%):	Did not test	> 2mm Gravel
Potential infiltration rate:	Did Not Test	2 - 0.2 mm Coarse Sand
Gravel Content:	Soil is	0.2 - 0.02 mm Fine Sand
Additional comments:		0.02 - 0.002 mm Silt
		< 0.002 mm Clay

Recommendations

Analysed by SESL Australia NATA #15633

No commentary requested.

Method References:
 pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992).
 Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983).
 Emerson's Aggregate Test: Charman & Murphy (1991). Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Tests are performed under a quality system certified as complying with ISO 9001: 2000. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Consultant: Andrew Jacovides

Authorised Signatory: Kelly Lee

Date Report Generated
 20/11/2015




Sample Drop Off: 16 Chilvers Road
 Thornleigh NSW 2120
Mailing Address: PO Box 357
 Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 37091	Sample N°: 2	Date Received: 12/11/15	Report Status: ☐ Draft ☒ Final
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Client Name: Douglas Partners (Newcastle) Client Contact: Ian Benson Client Job N°: Client Order N°: 123029 Address: PO Box 324 Hunter Region Mail Centre NSW 2310	Project Name: Ref: 81850 Prelim Eff Disposal Assessment SES Quote N°: Sample Name: Bore 9 0.4-0.6 Description: Soil Test Type: pHEC_S, ECEC_NH4Cl, PRI, mEAT
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TEST	RESULT	COMMENTS
pH in water 1:5	6.1	
pH in CaCl ₂ 1:5	5.7	
EC mS/cm 1:5	0.52	High

CATION ANALYSIS					
TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	2.18		1.7	24.5	
Potassium	1.47		0	0	
Calcium	0		0.029	0.4	
Magnesium	1.36		5.2	75	
Aluminium			<0.03	0.1	
ECEC			7		
Ca/Mg			0		

Phosphate Retention Index (%): 13.70 Low	PRI (mgP/kg): 724.0	PRI (kg/ha): -
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PHYSICAL CHARACTERISTICS		Comment
Texture:	-	
Colour:	-	
Size:	-	
Aggregate strength:	-	
Structural unit:	Did not test	
Approx. Clay Content (%):	Did not test	
Potential infiltration rate:	Did Not Test	
Gravel Content:	Soil is	
Additional comments:		
Field Density (g/mL):		
Emerson Stability Class:		H20 Class 3.1
High SAR/Low Ionic Strength:		6
Med SAR/High Ionic Strength:		6
Particle Size Analysis (PSA)		
> 2mm		Gravel
2 - 0.2 mm		Coarse Sand
0.2 - 0.02 mm		Fine Sand
0.02 - 0.002 mm		Silt
< 0.002 mm		Clay

Recommendations

Analysed by SESL Australia NATA #15633 No commentary requested.
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Method References:
 pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992).
 Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983).
 Emerson's Aggregate Test: Charman & Murphy (1991). Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour -
 PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Tests are performed under a quality system certified as complying with ISO 9001: 2000. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Consultant: Andrew Jacovides

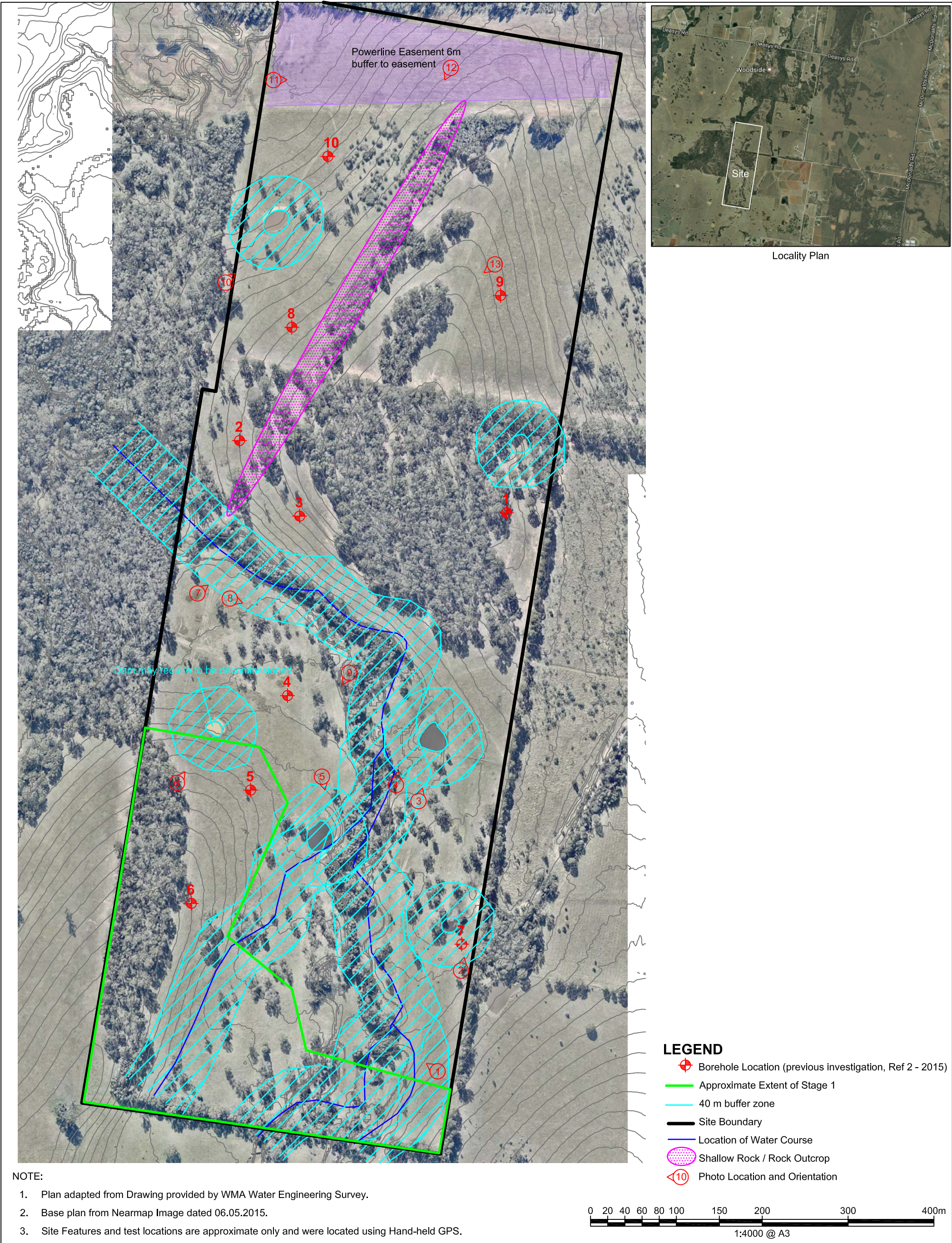
Authorised Signatory: Kelly Lee

Date Report Generated
 20/11/2015




Appendix D

Drawing 1 – Test Location Plan and Site Constraints



 Douglas Partners <i>Geotechnics Environment Groundwater</i>	TITLE: Test Location Plan and Site Photos Preliminary Effluent Disposal Assessment Lot 22 Palmers Lane, Pokolbin				OFFICE: Newcastle
					DRAWN BY: PLH
					DATE: 04.09.2017
CLIENT: Hephzibah Hunter Valley Property Pty Ltd	PROJECT No: 81850.02	DRAWING No: 1	REVISION: 0	SCALE: 1:4000@A3 Sheet	