Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Preliminary Salinity Investigation and Salinity Management Plan

Catherine Field Planning Proposal
Charlesworth Close, Springfield Road, Camden Valley Way & Catherine Field Road, Catherine Field NSW

Prepared for
Springfield Rd Pty Ltd

Project 208526.00
April 2022

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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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		11 April 2022
Reviewer	p.p. Chris Kline	11 April 2022

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Table of Contents

Report on Preliminary Salinity Investigation and Salinity Management Plan Rezoning Proposal Land East of Springfield Road, Catherine Field, NSW

1. Introduction

Douglas Partners Pty Ltd (DP) has been engaged by Springfield Rd Pty Ltd to carry out a Salinity Investigation and prepare a Preliminary Salinity Management Plan (SMP) to inform rezoning of a parcel of land located between Springfield Road, and Catherine Fields Road, Catherine Field, NSW. The site is shown on Drawing 1, Appendix A.

The Catherine Field Planning Proposal (the Proposal) is a Proponent-led proposal that seeks to rezone approximately 104 hectares of land within the Catherine Field Precinct to enable urban development for new housing, open space and recreation, riparian protection, major roads and stormwater management. The site is located wholly within the Camden Local Government Area and is approximately 42 kilometres south-west of the Sydney CBD.

The draft Indicative Structure Plan delivers approximately 2080 dwellings and a population of around 5,800 people. There will be a range of housing types at varying densities throughout the site. The site is identified for low and medium density residential development with single dwellings on lots ranging in size up from 250 square metres and averaging around 350 square metres and attached and semi-attached housing, typical of recently developed urban growth areas in other parts of Sydney.

The Proposal will provide a range of social infrastructure, including open space, recreation and community facilities for the future community, and deliver road and utilities infrastructure to service the broader South West Growth Area.

Saline soils affect much of the Western Sydney Region. Buildings and infrastructure located on shales of the Wianamatta Group are particularly at risk. Salinity can affect urban structures in a number of ways, including corrosion of concrete, break-down of bricks and mortar, corrosion of steel (including reinforcement), break-up of roads, attach on buried infrastructure, reduced ability to grow vegetation and increased erosion potential.

The salinity investigation was carried out to provide preliminary information on subsurface soil salinity conditions to inform the rezoning application and assist in conceptual planning of the development.

2. Scope of Work

The following scope of work was undertaken for this SMP:

- Review of existing relevant information including in-house and published geotechnical, geological, soils and survey information;
- Carry out a site walk over in accessible portions of the site (refer to Section 3) to observe for evidence of potentially saline soil conditions;
- Using a backhoe, excavate six test pits across the accessible portion of the site (refer to Section 3) to a maximum depth of 3 m (or prior refusal);
- Soil samples were collected for salinity and related testing, generally at 0.5 m depth intervals to a maximum depth of 3 m or prior refusal;
- Classification of selected samples for soil texture;
- Laboratory analysis for electrical conductivity (EC 1:5) and pH on selected soil samples at a NATA accredited analytical laboratory, for salinity classifications and concrete/steel aggressivity classifications;
- Laboratory analysis for additional salinity, aggressivity and erodibility indicators, including chloride and sulphate and Emerson crumb dispersibility tests at a NATA accredited analytical laboratory; and
- Preparation of this SMP report discussing the methodology and findings of the assessment, and recommended management strategies.

3. Site Information

Site Address	Charlesworth Close, Springfield Road, Camden Valley Way & Catherine Field Road, Catherine Field NSW
Precinct	'Catherine Field Precinct' within the South West Growth Area
Legal Description	Note lots below with names in brackets were in accessible portions of the site. The remainder of the site was subject to a desktop study only. Lots 1331 and 1332 on Deposited Plan (D.P.) 826048 Lots 1 and 2 on D.P. 861247 Lot 131 on D.P. 27602 Lots 1301 and 1302 on D.P. 736633 Lots 119 to 129 on D.P. 27602 Lot 20 on D.P. 1171869 Lot 2 on D.P. 27602 Lot 100 on D.P. 1149669 Lots 1 to 5 on D.P. 203127 Lots 30 and 31 on D.P. 1175280 Lot 8 on D.P. 203127 Lots 100 and 101 on D.P. 1173578 Lots 1 to 4 on D.P. 215520 Lots 4001 to 4003 on D.P. 1121133 Lot 302 on D.P. 716446 ('Lot 302') Lots 10 and 11 on D.P. 618175 ('Lots 10 and 11') Lots 204 to 208 on D.P. 259147 ('Lot 204') Lot 101 on D.P. 547859 Lots 301 and 302 on D.P. 709378 Lots 2 to 4 on D.P. 518572 (of which Lots 3 and 4 were in accessible portion of the site) Charlesworth Close
Area	105 ha
Zoning	RU4 Primary Production Small Lots
	R5 Large Lot Residential
Local Council Area	Camden Council
Current Use	Rural residential
Surrounding Uses	North –Catherine Fields Road, Residential, Rural East –Camden Valley Way, Residential, Rural South –Springfield Road, Residential, Rural West – Residential, Rural

4. Environmental Setting

4.1 Topography

The surrounding regional topography shows gently undulating rises.

Regional topographic data indicates that the site topography ranges as follows:

- From 96 to 112 m relative to the Australian Height Datum (AHD) along the creek line in the centre of the site running from its low point in the north west to its entry point in the south east.
- Between 90 and 130 m AHD across the remainder of the site, with the lowest elevation generally in the west/north west and the highest elevations in the west and the south west.

4.2 Site Geology and Soil Landscapes

Reference to Geological Survey of NSW, Sydney (1985) *Wollongong – Port Hacking,* 1:100,000 Geological Sheet 9029-9129, 1st Edition indicates the site is underlain by Bringelly Shale (geological code 'Rwb') of the Wianamatta Group of Middle Triassic age. Bringelly shale comprises of shale, carbonaceous claystone, laminite, lithic sandstone and rare coal.

Reference to the *Wollongong-Port Hacking 1: 100, 000 Soils Landscape Sheet 9029*, 1990, indicates that the site is underlain by Blacktown soils (mapping unit bt), which is a residual soils group associated with gently undulating rises, broad rounded crests, and ridges with gently inclined slopes. The unit comprises of shallow to moderately deep (<100 cm) red and brown podzolic soils on crests, upper slopes and in well-drained areas. In areas of greater depth (150-300 cm), there are yellow podzolic soils and soloths on lower slopes and in areas of poor drainage (Sydney). Local relief is to 30 m, slopes are usually <5%. These soils are typically of low fertility, are moderately reactive, with high plasticity in the subsoil, and generally have poor soil drainage.

4.3 Salinity Risk Mapping

Reference to Department of Infrastructure, Planning and Natural Resources (DIPR, 2002) map titled *Salinity Potential in Western Sydney* indicates the central portion of the site running south east to north west (along the dam and creek alignment) is primarily mapped as "high salinity potential" (orange) with a small portion of the alignment in the north west mapped as "known salinity potential" (red). The remainder of the site to the north and south of the creek alignment is mapped as "moderate salinity potential" (yellow). Refer to Figure 1 below.

Figure 1: Site salinity mapping (from DIPR, 2002; red boundary is the site boundary)

4.4 Acid Sulphate Soils

Published acid sulphate soils risk mapping indicates that the site is classified as Cq (p4), extremely low probability occurrence.

4.5 Surface Water and Groundwater

The site is traversed by two unnamed creek lines, both tributaries of and join Rileys Creek approximately 1.4 km north of the site. Rileys Creek is a tributary of South Creek which is located approximately 5.9 km north of the site. Several smaller dams are present throughout the site on individual lots which likely drain via surface and subsurface (groundwater) flow into the two creeks.

A search of the publicly available registered groundwater bore database indicated that there is one registered groundwater bores within a 1 km radius of the site. The bore (reference GW038092) is located approximately 900 m west of the site, recorded as type 'bore open through rock' for the purpose of exploration and was drilled to a total depth of 240 m bgl. The recorded standing water level was 29.2 m bgl and the bore yielded (at the time of installation) fresh water.

Based on the regional topography and the flow direction of nearby water courses, the anticipated flow direction of groundwater beneath the site is towards the north west. Given the local geology (i.e., Blacktown soils and underlying Wianamatta Shale), the groundwater in the low yield residual soils and underlying fractured rock beneath the site is anticipated to be of a generally poorly connected, saline and of low yield. Accordingly, there would be no significant potential beneficial uses of the groundwater. Fractured rock beneath the site is anticipated to be of a generally saline and very low yield. Accordingly, there would be no significant potential beneficial uses of the groundwater.

5. Field Work Methods

The current field work for this salinity investigation was completed on 27 October 2021 by a DP Environmental Scientist and comprised the excavation of six test pits (TP1 to TP6) in the accessible portion of the site (refer to Section 3) to depths of up to 3 m, with a JCB 4XC backhoe with a 450 mm bucket. The test pits were logged on site and representative disturbed samples were collected to assist in strata identification and for laboratory testing.

The locations of the test pits are shown on Drawing 1, attached. All field measurements and mapping for this project have been carried out using the Geodetic Datum of Australia 1994 (GDA94) and the Map Grid of Australia 1994 (MGA94), Zone 56. All reduced levels are given in relation to AHD.

6. Results

6.1 Field Work Results

The test pit logs for this assessment are included in Appendix B. All test pits terminated in natural material and the general sub-surface profile was as follows:

Topsoil/Fill:	Brown orange silty clay, clayey silt and silt with trace rootlets and siltstone and sandstone gravels was present at the top of the soil profile in all test pits and ranging between 0.3 and 0.7 m below ground level (bgl) to the base of the strata.
Silty Clay	Red mottled orange brown silty clay with trace shale gravels was present in all test pits and ranging between 0.9 and 1.8 m below ground level (bgl) to the base of the strata
Sandy Clay	Orange mottled grey sandy shale was observed below silty clay in test pits 3 and 4 to the base of the test pit (3 m depth). Sandstone gravels (possible alluvial deposit) were visible from 2.5 m depth in both test pits.
Shale	Orange brown shale with bands of mottled orange and pale grey clay and silty clay were observed in test pits 1, 2, 5 and 6 to the base of the test pit (3 m, except for test pits 1 and 5 which refused on shale at 1.6 and 1.8 m bgl respectively).

No free groundwater was observed during excavation of test pits. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

No signs of efflorescence or salt scalding were noted during the fieldwork.

6.2 Laboratory Results

The laboratory test results and assessments of aggressivity, salinity, sodicity and dispersibility are summarised in Table C1 in Appendix C. Aggressivity to concrete was determined using pH values and sulphate ion concentrations, and aggressivity to steel was determined using pH values, chloride ion concentrations and calculated resistivities. The salinity class was inferred from ECe values using the method of Richards (1954) and dispersion potentials were derived from Emerson Class Number Tests.

The detailed laboratory test reports and chain of custody documents are provided in Appendix D.

Table 1 below summarises the total test sample numbers and the range of test results obtained.

Table 1: Summary of Parameters Tested and Results Obtained

Parameter		Units	Samples	Minimum	Maximum
pH		pH units	31	5.0	9.0
Chlorides		(mg/kg)	9	20	1900
Sulphates		(mg/kg)	9	41	390
Aggressivity	to Concrete	[AS2159]	31	Non-Aggressive	Mildly Aggressive
	to Steel	[AS2159]	31	Non-Aggressive	Moderately Aggressive
Resistivity		Ω.cm	31	770	23,641
ECe [M x EC1:5] where M is textural factor		(dS/m)	31	0.3	7.8
Salinity Class		[after Richards 1954]	17	Non-Saline	Moderately Saline
Dispersibility		[from Emerson Crumb Test]	2	Some	Dispersive

6.2.1 Aggressivity

Figure 3 below, presents variations of aggressivity with depth at each test pit location, based on pH profiles, and the corresponding aggressivity class ranges as per the Australian Standard AS 2159 (2009). Due to the absence of free groundwater in all test pits, and the clay/silt composition of the soils, all samples were classed as Condition B as defined by AS 2159.

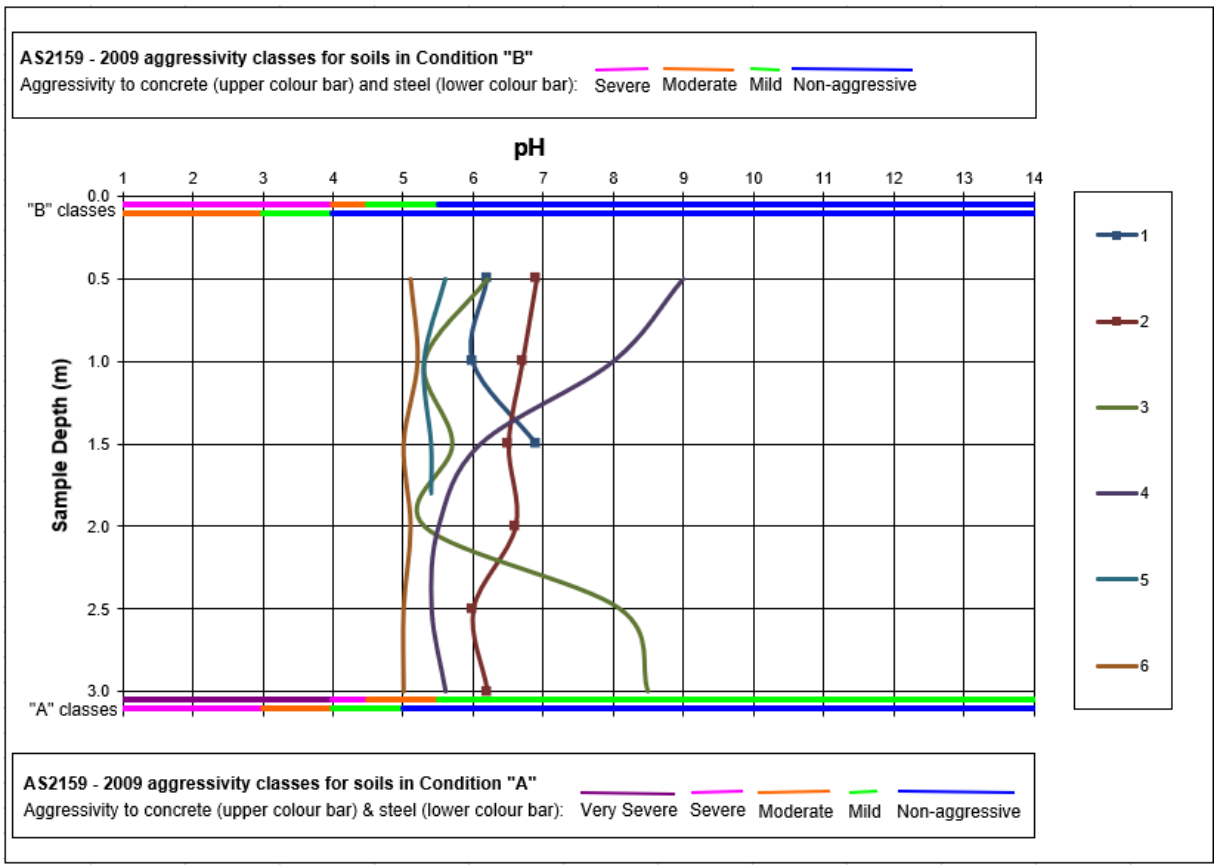


Figure 3. Vertical Soil pH Profiles and Aggressivity Classes

Table C1 (Appendix C) indicates that approximately 32% of soil samples were non-aggressive to concrete and 68% were mildly aggressive.

The pH profiles of Figure 1 indicate that the materials throughout the site, at all investigated depths, are non-aggressive to steel. The chloride concentration guidelines of AS2159 support this non-aggressive classification. However, based on resistivity criteria (Appendix C), samples were classified as non-aggressive to moderately aggressive to steel.

6.2.2 Salinity

Figure 4 below presents variations of salinity with depth at each test pit location, based on ECe profiles, and the corresponding salinity classifications of Richards (1954).

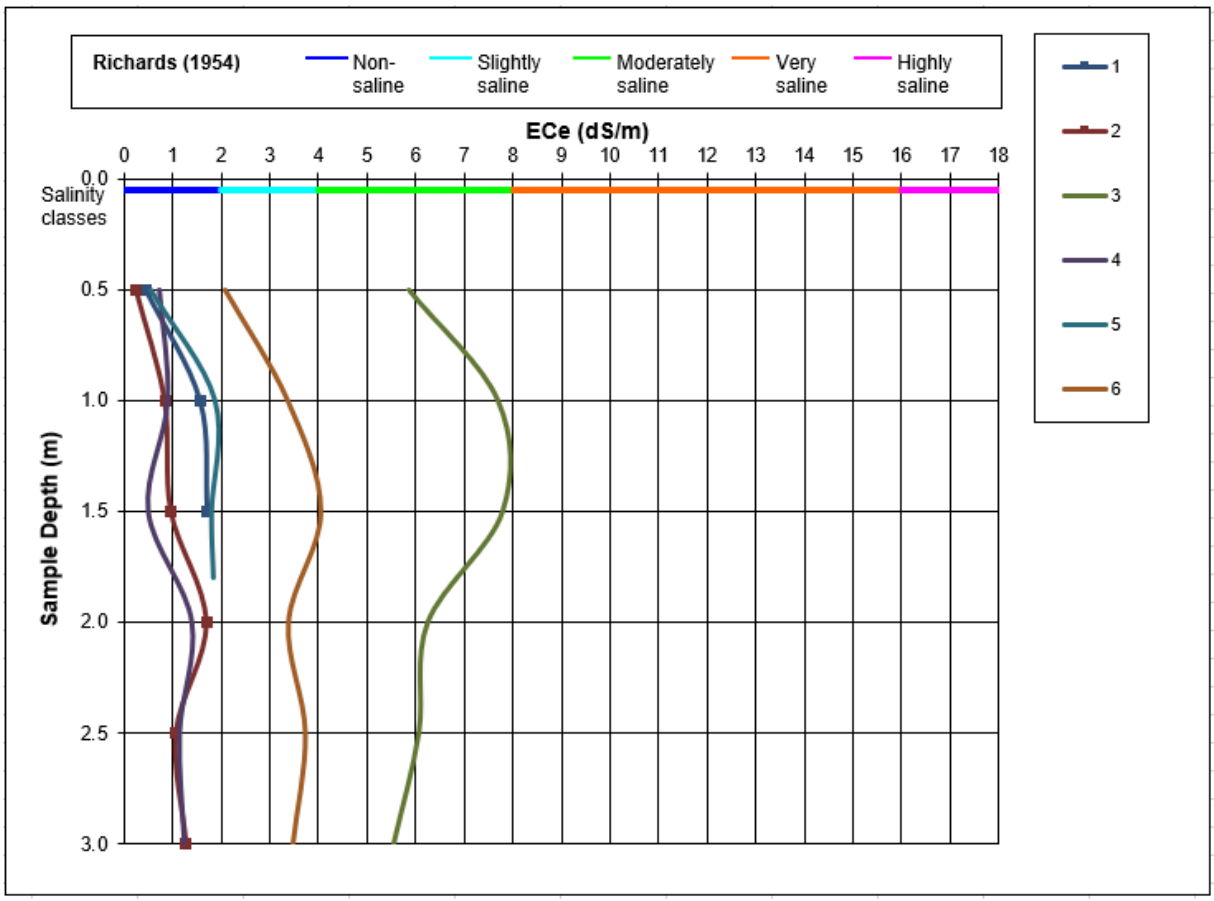


Figure 4: Vertical Soil Salinity Profiles and Salinity Classes

Table C1 (Appendix C) indicates that 62% of all samples were non-saline, 16% were slightly saline and 22% were moderately saline.

6.2.3 Dispersibility

The dispersion potential of the soils, tested by the Emerson Class Number test classified the soils as some dispersion (Class 2) and dispersive (Class 3). Therefore, soils at the site have the potential to exhibit poor drainage which increases the tendency for water logging to occur.

7. Impacts on the Proposed Development

The current investigation included intrusive investigations in the accessible portion of the site. Soil salinity and aggressivity in the remainder of the site may vary from conditions observed in the current investigation.

Mild aggressivity to concrete, mild to moderate aggressivity to steel and the presence of moderately saline soils were observed in the current investigation. The regional salinity mapping indicates that soils elsewhere across the development (particularly north west of the accessible portion of the site, along the central creek alignment) are likely generally consistent, and some parts (e.g. along the creek line) may exhibit more saline and aggressive soil conditions. Both observed soil conditions for the accessible portion of the site, and desktop study information for the remainder of the site are naturally occurring features of the local landscape and are not considered significant impediments to the proposed development, provided appropriate remediation or management techniques are employed.

Salinity and aggressivity affects the durability of concrete and steel by causing premature breakdown of concrete and corrosion of steel. This has impacts on the longevity of structures in contact with these materials. As a result, management will be required (refer Section 8).

In addition, sodic soils are present in the region and have low permeability due to infilling of interstices with fine clay particles during the weathering process, restricting infiltration of surface water and potentially creating perched water tables, seepage in cut faces or ponding of water in flat open areas. In addition, sodic soils tend to erode when exposed. Management of sodic soils is therefore required to prevent these adverse effects.

8. Preliminary Salinity Management Plan

The preliminary intrusive salinity investigation identified that there are soils underlying the site that are mildly aggressive to concrete, moderately aggressive to steel and moderately saline, it is likely that other portions of the site (not yet investigated) will be highly saline. The regional salinity mapping indicates that soils elsewhere across the site are likely generally consistent with those observed in the intrusive investigation, and some parts (e.g. along the creek line) may exhibit more saline and aggressive soil conditions.

The following indicative management strategies are confined to the management of those factors with a potential to impact on the development. These indicative management strategies are based on the above encountered aggressivity and salinity conditions at the site. Undertaking further investigations will make it possible to target the specific areas where salinity exists and may reduce or increase the salinity classifications and management requirements.

A. Management should focus on capping of the upper surface of the sodic soils, both exposed by excavation and placed as filling, with a more permeable material to prevent ponding, to reduce capillary rise, to act as a drainage layer and to reduce the potential for erosion.

B. With respect to any imported fill material required, testing should be undertaken prior to importation, to determine the salinity characteristics of the material, which should be non-aggressive and non-saline to slightly saline where possible but in any case, not more aggressive or more saline than the adopted site classifications.

C. Sodic soils can also be managed by maintaining vegetation where possible and planting new salt tolerant species. The addition of organic matter, gypsum and lime can also be considered where appropriate. After gypsum addition, reduction of sodicity levels may require some time for sufficient infiltration and leaching of sodium into the subsoils, however capping of exposed sodic material should remain the primary management method. Topsoil added at the completion of bulk earthworks is, in effect, also adding organic matter which may help infiltration and leaching of sodium.

D. Avoiding water collecting in low lying areas, in depressions, or behind fill. This can lead to water logging of the soils, evaporative concentration of salts, and eventual breakdown in soil structure resulting in accelerated erosion.

E. Any pavements should be designed to be well drained of surface water. There should not be excessive concentrations of runoff or ponding that would lead to waterlogging of the pavement or additional recharge to the groundwater through any more permeable zones in the underlying filling material.

F. Surface drains should generally be provided along the top of batter slopes to reduce the potential for concentrated flows of water down slopes possibly causing scour.

G. Salt tolerant grasses and trees should be considered for landscaping, to reduce soil erosion as in Strategy A above and to maintain the existing evapo – transpiration and groundwater levels. Reference should be made to an experienced landscape planner or agronomist.

In addition to the above, DP have also provided the following indicative management strategies for the installation of services or construction of pavements and structures/buildings. These strategies should be complementary to standard good building practices, including cover to reinforcement within concrete and correct installation of a brick damp course (where used), so that it cannot be bridged to allow moisture to move into brick work and up the wall. These strategies are based on the observed classifications from the preliminary investigation, further assessment of other areas of the site must be undertaken prior to Development Application.

H. Based on the results of the intrusive investigation, soils that are mildly aggressive to concrete and moderately saline have been identified within the accessible portion of the site. Soil conditions across the remainder of the site are likely generally consistent, and some parts (e.g. along the creek line) may exhibit more saline and aggressive soil conditions. The durability requirements for a range of soil conditions (including those observed in this investigation) are provided in Tables 2 and 3 should be taken into account by the designer.

Table 2 – Recommended Durability Requirements for Concrete Foundations and Piles

Site Salinity Classification	Site Soil Aggressivity to Concrete Classification	Recommended Durability Requirement (as per AS3600)		
		Minimum Concrete Strength (MPa)	Minimum Cover to Reinforcement (mm)	Minimum Cure Time (days)
Non-saline to Slightly Saline	Non-aggressive Soils	20	ND	3
	Mildly Aggressive Soils	25		
	Moderately Aggressive Soils	32		7
Moderately Saline	Non-aggressive Soils	25	45	3
	Mildly Aggressive Soils			
	Moderately Aggressive Soils	32		7
Very Saline	Non-aggressive Soils	32	50	7
	Mildly Aggressive Soils			
	Moderately Aggressive Soils			
Highly Saline	Non-aggressive Soils	40	55	7
	Mildly Aggressive Soils			
	Moderately Aggressive Soils			

Table 3: Recommended Durability Requirements for Concrete Piles

Concrete Aggressivity	Recommended Durability Requirement (as per AS2159)	
	Minimum Concrete Strength (MPa)	Minimum Cover to Reinforcement (mm)
Non Aggressive	32	45
Mildly aggressive	32	60
Moderately Aggressive	40	65

I. Wet cast concrete pipes and currently manufactured spun concrete pipes are understood to have estimated compressive strengths of 50 MPa and 60 to 70 MPa, respectively, in excess of the requirements for mass concrete. Reference to the maximum and minimum test results of Table 1 (Section 7 of this report) and to Tables E1 and 3.1 of AS 4058 – 2007 "Precast concrete pipes" indicates that the site falls within the AS 4058 Clay/Stagnant (low sulphate) soil type (chlorides ≤20 000 ppm, pH≥4.5 and sulphates ≤1000 ppm) and (in the absence of tidal water flow) falls within the AS 4058 Normal durability environment. Under these conditions, AS 4058 – compliant reinforced concrete pipes of general purpose Portland cement, with a minimum cover to reinforcement of 10 mm, are expected to have a design life in excess of 100 years. Any concrete pipes installed within the site should employ AS 4058 – compliant steel reinforced pipes of general purpose Portland cement, with minimum cover to reinforcement of 10 mm, or should be fibre reinforced.

J. Resistivity results indicate soils within the site moderately aggressive to steel. The following corrosion allowances (as per AS 2159 – 2009) should be taken into account by the designer:

   - Moderate: uniform corrosion allowance 0.02 – 0.04 mm/year.

   In instances where a coating is applied to the pile, if the design life of the pile is greater than the design life for the coating, consideration must be given to corrosion of the pile in accordance with the above list.

9. Conclusion

The scope of the current investigation included a desktop study, a site walk over and an intrusive investigation in accessible portions of the site. The scope of the current investigation is adequate to provide a preliminary assessment of soil aggressivity and salinity conditions for rezoning purposes.

The salinity and aggressivity conditions at the site are typical of such conditions observed in soils in the general region. The findings of this SMP indicate the site is suitable from rezoning from a salinity perspective and provides indicative management advice to inform future development designs. Additional investigation should be undertaken to further inform such designs, and the future DA and should be undertaken as follows:

- Across the whole site, including lots not accessible at the time of this investigation; and
- in development areas which are to be excavated deeper than 3 m below current ground level, where direct sampling and testing of salinity has not been carried out.

The indicative salinity management strategies provided will need to be further refined, modified and/or extended following additional investigations at DA stage. The further investigations will make it possible to target the specific areas where salinity exists and may reduce the salinity classifications and management requirements.

It is considered that the indicative management strategies described herein are appropriate to assess for rezoning purposes, the required mitigation measures in response to the levels of salinity, aggressivity and sodicity conditions at the site.

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report (or services) for this project at Land East of Springfield Road, Catherine Field in accordance with DP's proposal 208526.00.P.001 dated 8 September 2021 and acceptance received from Joseph Jacob at Springfield Rd Pty Ltd. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Springfield Rd Pty Ltd 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/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 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.

The assessment of atypical safety hazards arising from this advice is restricted to the (geotechnical/environmental/groundwater) components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

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
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

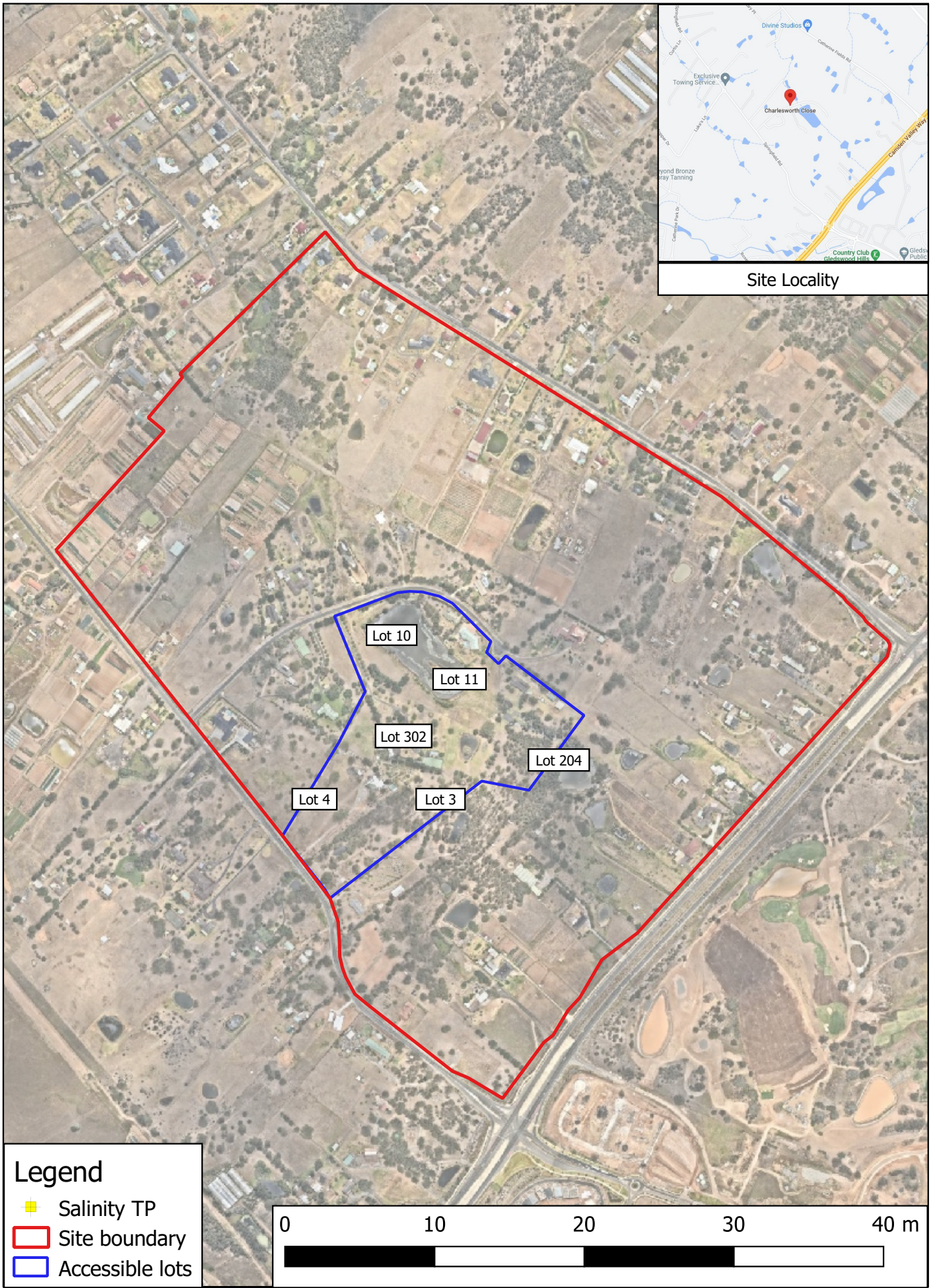
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later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



Site Locality

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Layout and Locality**
Catherine Field, NSW

N
MGA

CLIENT: Urbanco Group Pty Limited		PROJECT #: 208526.00		DRAWING No: 1
OFFICE: Macarthur	DRAWN BY: EME	DATE: 8 March 2022	SCALE: As Shown	REVISION: 2

Appendix B

Test Pit Logs

TEST PIT LOG

CLIENT: Urbanco Group Pty Limited
PROJECT: Rezoning Proposal
LOCATION: Land East of Springfield Road
Catherine Field, NSW

SURFACE LEVEL: 105.4 mAHD
EASTING: 294190
NORTHING: 6235206

PIT No: 1
PROJECT No: 208526.00
DATE: 27/10/2021
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 mm)
105	0.3	FILL/TOPSOIL: Clayey SILT ML, low plasticity, trace siltstone gravel and rootlets, w<PL							
		Silty CLAY CH: high plasticity, red mottled orange, w~PL		D	0.5				
104	0.9	SHALE: orange brown, low strength, extremely weathered		D	1.0				
		- becoming medium to high strength, slightly weathered below 1.4m		D	1.5				
	1.6	Pit discontinued at 1.6m - refusal on shale							

RIG: JCB 4CX backhoe - 450mm bucket

LOGGED: AWB

SURVEY DATUM: MGA94 Zone 56

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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Urbanco Group Pty Limited
PROJECT: Rezoning Proposal
LOCATION: Land East of Springfield Road
Catherine Field, NSW

SURFACE LEVEL: 104.8 mAHD
EASTING: 294053
NORTHING: 6235296

PIT No: 2
PROJECT No: 208526.00
DATE: 27/10/2021
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 mm)
104	0.4	FILL/TOPSOIL: Clayey SILT ML, low plasticity, brown, trace siltstone gravel and rootlets, w~PL							
		Silty CLAY CH: high plasticity, red mottled pale brown, trace shale gravel, w~PL, residual		D	0.5				
	0.9	SHALE: orange brown, with mottled orange and pale grey clay bands, very low to low strength, extremely weathered		D	1.0				
103				D	1.5				
	1.8	Silty CLAY CH: high plasticity, mottled pale grey and orange, with shale gravel and cobbles, w~PL, residual		D	2.0				
102	2.3	SHALE: grey and red, with red clay bands, low strength, extremely weathered		D	2.5				
	3.0	Pit discontinued at 3.0m - limit of investigation		D	3.0				
101									

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

RIG: JCB 4CX backhoe - 450mm bucket

LOGGED: AWB

SURVEY DATUM: MGA94 Zone 56

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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Urbanco Group Pty Limited
PROJECT: Rezoning Proposal
LOCATION: Land East of Springfield Road
Catherine Field, NSW

SURFACE LEVEL: 101.6 mAHD
EASTING: 294022
NORTHING: 6235218

PIT No: 3
PROJECT No: 208526.00
DATE: 27/10/2021
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 mm)
101	0.0	FILL/TOPSOIL: Clayey SILT ML, trace siltstone gravel, root/branch and rootlets, w~PL		D	0.5				
	0.6	Silty CLAY CI: medium plasticity, mottled brown and grey, w>PL, possible fill, reworked natural		D	1.0				
	1.1	Silty CLAY CH: high plasticity, mottled grey and orange, w>PL, alluvial		D	1.5				
100	1.7	Sandy CLAY CH: high plasticity, orange mottled grey, w>PL		D	2.0				
99		- becoming mottled grey and orange, with sandstone gravel, w>PL, alluvial below 2.5m		D	2.5				
	3.0	Pit discontinued at 3.0m - limit of investigation		D	3.0				
98									

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

RIG: JCB 4CX backhoe - 450mm bucket

LOGGED: AWB

SURVEY DATUM: MGA94 Zone 56

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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Urbanco Group Pty Limited
PROJECT: Rezoning Proposal
LOCATION: Land East of Springfield Road
Catherine Field, NSW

SURFACE LEVEL: 99.3 mAHD
EASTING: 293844
NORTHING: 6235373

PIT No: 4
PROJECT No: 208526.00
DATE: 27/10/2021
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 mm)
99	0.0	FILL/TOPSOIL: Silty CLAY CI, medium plasticity, brown, with siltstone gravel and sand, trace sandstone gravel and rootlets, w~PL, possible reworked natural		D	0.5				
	0.7	Silty CLAY CI: medium plasticity, red mottled brown		D	1.0				
98	1	- becoming CH, high plasticity below 1.3m		D	1.5			▽	
	1.8	Sandy CLAY CH: high plasticity, red mottled grey, w>PL		D	2.0				
97	2	- with sandstone gravel below 2.5m		D	2.5				
	3.0	Pit discontinued at 3.0m - limit of investigation		D	3.0				
96	3								

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

RIG: JCB 4CX backhoe - 450mm bucket

LOGGED: AWB

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater seepage at 1.5m

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: Urbanco Group Pty Limited
PROJECT: Rezoning Proposal
LOCATION: Land East of Springfield Road
Catherine Field, NSW

SURFACE LEVEL: 106.6 mAHD
EASTING: 293792
NORTHING: 6235130

PIT No: 5
PROJECT No: 208526.00
DATE: 27/10/2021
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 mm)
106	0.4	FILL/TOPSOIL: Clayey SILT ML, low plasticity, brown, trace siltstone gravel and rootlets, w<PL							
		Silty CLAY CH: high plasticity,red mottled pale brown, w<PL		D	0.5				
	0.9	SHALE: orange brown, with mottled grey and orange clay bands, very low to low strength, extremely weathered		D	1.0				
105		- becoming medium strength, slightly weathered below 1.5m		D	1.5				
	1.8	Pit discontinued at 1.8m - refusal on shale		D	1.8				
104									
103									

5 10 15 20

1 2 3

RIG: JCB 4CX backhoe - 450mm bucket

LOGGED: AWB

SURVEY DATUM: MGA94 Zone 56

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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Urbanco Group Pty Limited
PROJECT: Rezoning Proposal
LOCATION: Land East of Springfield Road
Catherine Field, NSW

SURFACE LEVEL: 108.8 mAHD
EASTING: 293765
NORTHING: 6234954

PIT No: 6
PROJECT No: 208526.00
DATE: 27/10/2021
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 mm)
108	0.4	FILL/TOPSOIL: Clayey SILT ML, low plasticity, brown, trace siltstone gravel, roots and rootlets, w<PL							
		Silty CLAY CH: high plasticity, red mottled brown, with shale gravel, w<PL		D	0.5				
	1	- becoming mottled pale grey and red below 0.9m		D	1.0				1
				D	1.5				
107	1.7	SHALE: red and pale grey, low strength, extremely weathered							
	2			D	2.0				2
		- grey clay band at 2.5m		D	2.5				
106	3								3
	3.0	Pit discontinued at 3.0m - limit of investigation		D	3.0				
105									

RIG: JCB 4CX backhoe - 450mm bucket

LOGGED: AWB

SURVEY DATUM: MGA94 Zone 56

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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Appendix C

Summary Table

Test Bore or Pit	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class				
					By inversion of EC1:5		Aggr. to Concrete - from sample pH	Aggr. to Concrete - from Sulphate conc.	Aggr. to Steel - from sample pH	Aggr. to Steel - from Chloride conc.	Aggr. to Steel - from sample Resistivity
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]				
1	0.5	6.2			13831	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	1.0	6	160	47	4496	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
.	1.5	6.9			4102	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
2	0.5	6.9	20	77	23641	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
	1.0	6.7			9506	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	1.5	6.5			7231	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	2.0	6.6	260	98	4726	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
	2.5	6			6523	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
.	3.0	6.2	220	48	5461	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
3	0.5	6.2			1535	B	Non-Aggressive		Non-Aggressive		Mild
	1.0	5.3			909	B	Mild		Non-Aggressive		Moderate
	1.5	5.7	1900	390	770	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Moderate
	2.0	5.3			1120	B	Mild		Non-Aggressive		Mild
	2.5	8.1			1319	B	Non-Aggressive		Non-Aggressive		Mild
.	3.0	8.5			1443	B	Non-Aggressive		Non-Aggressive		Mild
4	0.5	9			8091	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	1.0	8			9328	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	1.5	6.1			11723	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	2.0	5.5	180	41	4958	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
	2.5	5.4			6046	B	Mild		Non-Aggressive		Non-Aggressive
.	3.0	5.6			5577	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
5	0.5	5.6			11198	B	Non-Aggressive		Non-Aggressive		Non-Aggressive
	1.0	5.3	200	92	4272	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
	1.5	5.4			3888	B	Mild		Non-Aggressive		Non-Aggressive
.	1.8	5.4			3810	B	Mild		Non-Aggressive		Non-Aggressive
6	0.5	5.1	250	66	3372	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
	1.0	5.2			2370	B	Mild	Non-Aggressive	Non-Aggressive		Non-Aggressive
	1.5	5			1969	B	Mild		Non-Aggressive		Mild
	2.0	5.1	540	200	2065	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive
	2.5	5			1872	B	Mild		Non-Aggressive		Mild
.	3.0	5			2010	B	Mild		Non-Aggressive	Non-Aggressive	Non-Aggressive

Test Bore or Pit	Sample Depth (m bgl)	Emerson Crumb Class Number	Dispersion? (from Emerson Class) [AS1289.3.8.1]	Soil Texture Group (for detailed soil logs see Report Appendix) [after DLWC]	Textural Factor (M) [after DLWC]	$EC_{1:5}$ [Lab.] (microS/cm)	EC_e [M x $EC_{1:5}$] (deciS/m)	Sample Salinity Class (Based on sample ECe) [Richards 1954]
1	0.5			Heavy clay	6	72.3	0.4	Non-Saline
	1.0			Medium clay	7	222.4	1.6	Non-Saline
.	1.5			Medium clay	7	243.8	1.7	Non-Saline
2	0.5			Heavy clay	6	42.3	0.3	Non-Saline
	1.0			Light medium clay	8	105.2	0.8	Non-Saline
	1.5			Medium clay	7	138.3	1.0	Non-Saline
	2.0			Light medium clay	8	211.6	1.7	Non-Saline
	2.5			Medium clay	7	153.3	1.1	Non-Saline
.	3.0			Medium clay	7	183.1	1.3	Non-Saline
3	0.5			Clay loam	9	651.3	5.9	Moderately Saline
	1.0			Medium clay	7	1100	7.7	Moderately Saline
	1.5			Heavy clay	6	1299	7.8	Moderately Saline
	2.0	2	Some	Medium clay	7	892.8	6.2	Moderately Saline
	2.5			Light medium clay	8	758.1	6.1	Moderately Saline
.	3.0			Light medium clay	8	693.2	5.5	Moderately Saline
4	0.5			Heavy clay	6	123.6	0.7	Non-Saline
	1.0			Light clay	9	107.2	0.9	Non-Saline
	1.5			Heavy clay	6	85.3	0.5	Non-Saline
	2.0			Medium clay	7	201.7	1.4	Non-Saline
	2.5			Medium clay	7	165.4	1.2	Non-Saline
.	3.0			Medium clay	7	179.3	1.3	Non-Saline
5	0.5	3	Dispersive	Heavy clay	6	89.3	0.5	Non-Saline
	1.0			Light medium clay	8	234.1	1.9	Non-Saline
	1.5			Medium clay	7	257.2	1.8	Non-Saline
.	1.8			Medium clay	7	262.5	1.8	Non-Saline
6	0.5			Medium clay	7	296.6	2.1	Slightly Saline
	1.0			Light medium clay	8	421.9	3.4	Slightly Saline
	1.5			Light medium clay	8	507.8	4.1	Moderately Saline
	2.0			Medium clay	7	484.2	3.4	Slightly Saline
	2.5			Medium clay	7	534.2	3.7	Slightly Saline
.	3.0			Medium clay	7	497.6	3.5	Slightly Saline

Appendix D

Laboratory Results and Chain of Custody Documentation

Envirolab Services Pty Ltd
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www.envirolab.com.au

CERTIFICATE OF ANALYSIS 281485

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Alex Bayer, Emily Eden
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**208526.00, Catherine Field**
Number of Samples	31 Soil
Date samples received	28/10/2021
Date completed instructions received	28/10/2021

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.

Report Details

Date results requested by	05/11/2021
Date of Issue	05/11/2021

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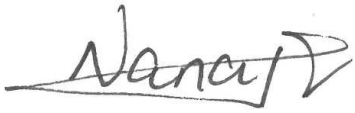
Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		281485-2	281485-4	281485-7	281485-9	281485-12
Your Reference	UNITS	TP1	TP2	TP2	TP2	TP3
Depth		1.0	0.5	2.0	3.0	15
Date Sampled		28/10/2021	28/10/2021	28/10/2021	28/10/2021	28/10/2021
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	04/11/2021	04/11/2021	04/11/2021	04/11/2021	04/11/2021
Date analysed	-	04/11/2021	04/11/2021	04/11/2021	04/11/2021	04/11/2021
Chloride, Cl 1:5 soil:water	mg/kg	160	20	260	220	1,900
Sulphate, SO4 1:5 soil:water	mg/kg	47	77	98	48	390

Misc Inorg - Soil					
Our Reference		281485-19	281485-23	281485-26	281485-29
Your Reference	UNITS	TP4	TP5	TP6	TP6
Depth		2.0	1.0	0.5	2.0
Date Sampled		28/10/2021	28/10/2021	28/10/2021	28/10/2021
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	04/11/2021	04/11/2021	04/11/2021	04/11/2021
Date analysed	-	04/11/2021	04/11/2021	04/11/2021	04/11/2021
Chloride, Cl 1:5 soil:water	mg/kg	180	200	250	540
Sulphate, SO4 1:5 soil:water	mg/kg	41	92	66	200

Method ID	Methodology Summary
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			04/11/2021	2	04/11/2021	04/11/2021		04/11/2021	[NT]
Date analysed	-			04/11/2021	2	04/11/2021	04/11/2021		04/11/2021	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	160	140	13	99	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	47	42	11	105	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the 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: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	208526.00	**Suburb:**	Catherine Field	**To:**	Envirolab
Project Name:	Salinity Investigation	**Order Number**			
Project Manager:	Emily Eden	**Sampler:**	AWB	**Attn:**	
Emails:	emily.eden@douglaspartners.com.au	alex.bayer@douglaspartners.com.au		**Phone:**	
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☐			**Email:**	
Prior Storage:	☐ Esky ☐ Fridge ☐ Shelved	Do samples contain 'potential' HBM?	Yes ☐ No ☐	(If YES, then handle, transport and store in accordance with FPM HA	

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: Chloride	Sulfate	Hold							Notes/preservation
TP1/ 0.5	1	28/10/21	S				X							
TP1/ 01.0	2	28/10/21	S		X	X								
TP1/ 1.5	3	28/10/21	S				X							
TP2/ 0.5	4	28/10/21	S		X	X								
TP2/ 1.0	5	28/10/21	S				X							
TP2/ 1.5	6	28/10/21	S				X							
TP2/ 2.0	7	28/10/21	S		X	X								
TP2/ 2.5	8	28/10/21	S				X							
TP2/ 3.0	9	28/10/21	S		X	X								
TP3/ 0.5	10	28/10/21	S				X							
TP3/ 1.0	11	28/10/21	S				X							
TP3/ 1.5	12	28/10/21	S		X	X								
TP3/ 2.0	13	28/10/21	S				X							
TP3/ 2.5	14	28/10/21	S				X							
TP3/ 3.0	15	28/10/21	S				X							
PQL (S) mg/kg													**ANZECC PQLs req'd for all water analytes** ☐	

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 281485
Date Received: 28/10/21
Time Received:
Received By: TBOO
~~Temp: Cool/Ambient~~
Cooling: Ice/icepack
Security: Intact/Broken/~~None~~

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container: **Relinquished by:** **Transported to laboratory by**

Send Results to: Douglas Partners Pty Ltd **Address:** **Phone:** **Fax:**

Signed: **Received by:** **Date & Time:** 28/10/2021 1800

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	208526.00	**Suburb:**	Catherine Field	**To:**	Envirolab
Project Name:	Salinity Investigation	**Order Number**			
Project Manager:	Emily Eden	**Sampler:**	AWB	**Attn:**	
Emails:	emily.eden@douglaspartners.com.au alex.bayer@douglaspartners.com.au			**Phone:**	
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☐			**Email:**	
Prior Storage:	☐ Esky ☐ Fridge ☐ Shelved	Do samples contain 'potential' HBM?	Yes ☐ No ☐	(If YES, then handle, transport and store in accordance with FPM HA	

Sample ID	Lab ID	Sampling Date	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: Chloride	Sulfate	Hold							Notes/preservation
TP4/ 0.5	16	28/10/21	S				X							
TP4/ 1.0	17	28/10/21	S				X							
TP4/ 1.5	18	28/10/21	S				X							
TP4/ 2.0	19	28/10/21	S		X	X								
TP4/ 2.5	20	28/10/21	S				X							
TP4/ 3.0	21	28/10/21	S				X							
TP5/ 0.5	22	28/10/21	S				X							
TP5/ 1.0	23	28/10/21	S		X	X								
TP5/ 1.5	24	28/10/21	S				X							
TP5/ 1.8	25	28/10/21	S				X							
TP6/ 0.5	26	28/10/21	S		X	X								
TP6/ 1.0	27	28/10/21	S				X							
TP6/ 1.5	28	28/10/21	S				X							
TP6/ 2.0	29	28/10/21	S		X	X								
TP6/ 2.5	30	28/10/21	S				X							
TP6/ 3.0	31	28/10/21	S				X							ANZECC PQLs req'd for all water analytes ☐

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container:	**Relinquished by:**	**Transported to laboratory by**
Send Results to: Douglas Partners Pty Ltd	**Address:**	**Phone:** **Fax:**
Signed:	**Received by:** Phey	**Date & Time:** 28/10/2021 1800

281485

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Alex Bayer, Emily Eden

Sample Login Details

Your reference	208526.00, Catherine Field
Envirolab Reference	281485
Date Sample Received	28/10/2021
Date Instructions Received	28/10/2021
Date Results Expected to be Reported	05/11/2021

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	31 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	14
Cooling Method	Ice
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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Sample ID	Misc Inorg - Soil	On Hold
TP1-0.5		✓
TP1-1.0	✓	
TP1-15		✓
TP2-0.5	✓	
TP2-1.0		✓
TP2-1.5		✓
TP2-2.0	✓	
TP2-2.5		✓
TP2-3.0	✓	
TP3-0.5		✓
TP3-1.0		✓
TP3-15	✓	
TP3-2.0		✓
TP3-2.5		✓
TP3-3.0		✓
TP4-0.5		✓
TP4-1.0		✓
TP4-1.5		✓
TP4-2.0	✓	
TP4-2.5		✓
TP4-3.0		✓
TP5-0.5		✓
TP5-1.0	✓	
TP5-1.5		✓
TP5-1.8		✓
TP6-0.5	✓	
TP6-1.0		✓
TP6-1.5		✓
TP6-2.0	✓	
TP6-2.5		✓
TP6-3.0		✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

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Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.