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School Infrastructure NSW
c/ Jacobs Group (Australia) Pty Ltd
32 Cordelia Street
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Project 213594.02
5 October 2022
R.001.Rev0
BAH

Attention: Alastair Burdon-Jones

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Salinity Management Plan
Proposed New Primary School
28 Wallarah Circuit, Gregory Hills, NSW

1. Introduction

Douglas Partners Pty Ltd (DP) has been engaged by Schools Infrastructure NSW on behalf of Jacobs Group to prepare this Salinity Management Plan (SMP) to inform the design of a proposed school to be located 28 Wallarah Circuit, Gregory Hills, NSW (hereinafter referred to as 'the site'). The site is shown on Drawing 1, Appendix A and covers an approximate area of 2.9 ha.

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.

It is understood that a primary school is proposed for the site and that a salinity management plan is required to support a State Significant Development Application (SSDA) for the construction and operation of a new primary school at Gregory Hills (SSD-41306367) and to assist in conceptual planning of the development. This report addresses the Secretary's Environmental Assessment Requirements (SEARs) issued for the project, notably Item 12.

DP has previously conducted a geotechnical assessment for the site (DP reference 2135594.00.R.001.Rev1 issued 9 September 2022 – DP (2022)) which included assessment of soil salinity. The findings of the assessment are summarised in Section 4 of this report and have been utilised to inform this salinity management plan.

2. Scope of Works

The scope of work for this SMP was as follows:

- Review and summarise salinity and aggressivity results from DP (2022) obtained for the site;

- Assessment of the results with respect to potential for salinity impacts on the development; and
- Preparation of a Salinity Management Plan (SMP) for the site providing guidance on development strategies to reduce the impact of saline materials.

3. Site Information

3.1 Site Description and Location

The site is located in Dharawal Country at 28 Wallarah Circuit, Gregory Hills NSW 2557, and is legally described as Lot 3257 DP1243285.

The site is located within the Camden Local Government Area and is within the Turner Road Precinct of the South-West Growth Centre.

The site has an area of approximately 2.926ha (by Deposited Plan). This will be reduced to 2.907 ha under approved DA2022/742/1 once Long Reef Circuit has been widened.

Topography is minimal with a fall from the south-east corner (RL116.5) to the north- west corner (RL113).

The site has three (3) street frontages:

- Wallarah Circuit (southern boundary)
- Gregory Hills Drive (northern boundary)
- Long Reef Circuit (eastern Boundary)

The site is primarily vacant land, with the exception of an existing group of trees in the southwest corner of the site that pre-date the subdivision and development of the precinct. There is also an existing electrical substation located on the south-eastern boundary.

There are easements of varying widths located to the northern boundary identified for drainage.

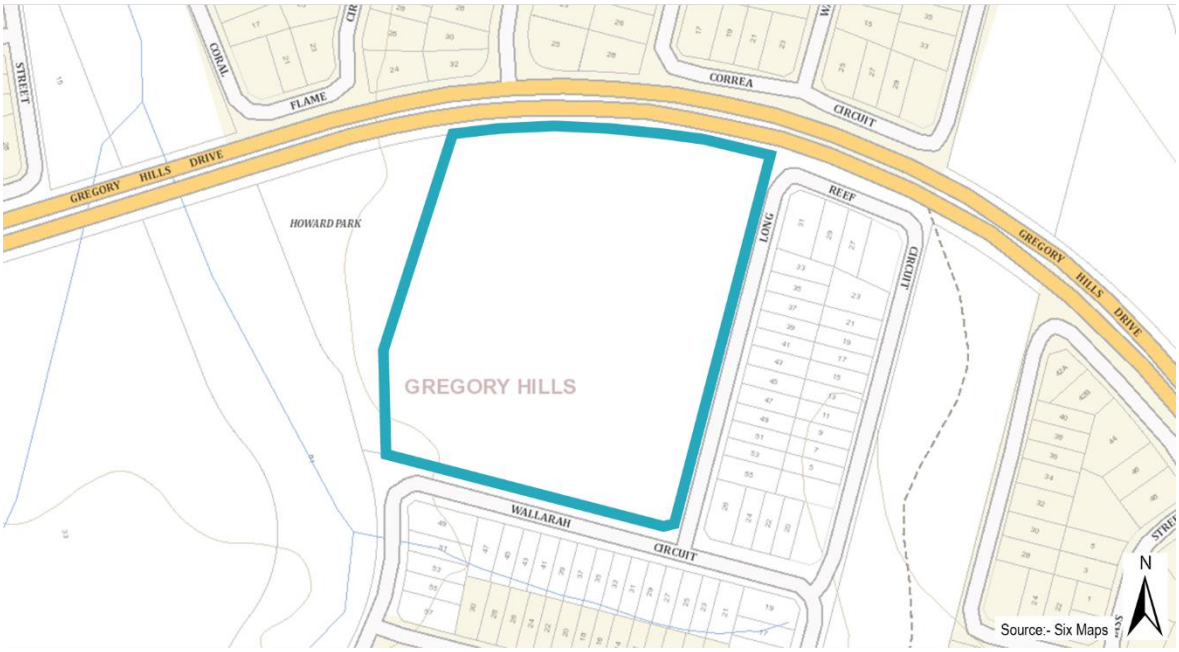

Figure 1 Locality Map (Six Maps)

Figure 2 Site Aerial Map, (Source Bennett and Trimble)

3.2 Surrounding Development

To the north, east and south of the site is emerging and recently completed residential development.

To the east of the residential area fronting Long Reef Circuit are high voltage power lines within an easement which include pedestrian paths and cycleways.

To the west of the site, beyond Sykes Creek and Howard Park, is the Gregory Hills town centre. A pedestrian bridge links Wallarah Circuit with the town centre across Sykes Creek.

Figure 3 Surrounding Development (Nearmap)

4. Salinity and Aggressivity Results from DP(2022)

DP (2022) included a review of previous reports, a site walkover, excavation of 17 test pits and drilling of six boreholes for salinity, geotechnical and contamination purposes. Selected samples from 15 test locations were tested in the laboratory for determination of aggressivity (to concrete and steel) and salinity. The detailed results are given in the laboratory report sheets included within DP (2022) and are summarised in Table A1, attached. The number of samples tested for each parameter and the range of test results obtained are summarised in Table 1.

Table 1: Summary of Test Results – Aggressivity and Salinity

Parameter		Units	Number of Tests	Range of Results
pH		pH units	25	4.9 – 9.1
Chlorides		(mg/kg)	6	22 – 300
Sulphates		(mg/kg)	6	10 – 360
Aggressivity AS2159: 2009	To Concrete	-	31	Non-aggressive to Mild
	To Steel	-	31	Non-aggressive
$EC_{1:5}$ [Lab.]		(mS/cm)	22	61.6 – 536.1
Electrical Resistivity		Ω.cm	22	6160 – 53610
EC_e [M x $EC_{1:5}$]		(dS/m)	22	0.5 – 4.7
Salinity Class		-	22	Non-saline to Moderately Saline

Where: M = soil textural factor

4.1 Aggressivity

Sample aggressivity classifications (refer Table B1, Appendix B) are based on pH, sulphate concentration, chloride concentration and calculated resistivity values and are assessed in accordance with AS 2159 *Piling Design and Installation"* (AS 2159, 2009). The absence of free groundwater in all the test locations and the inferred very low permeability of the sampled clayey soils indicate that soils at all test locations are in Condition "B" (AS 2159, 2009).

The results indicate that of the thirty-one (31) samples tested:

- Twenty-seven (27) samples were non-aggressive and four (4) samples were mildly aggressive to concrete; and
- Thirty-one (31) samples were non-aggressive to steel.

4.2 Salinity

Sample salinity classifications (refer Table B1, Appendix B) are based on calculated EC_e values using the method of Richards *"Diagnosis of Saline and Alkaline Soils"* (Richards, 1954).

The results indicate that of the twenty-two (22) samples tested for salinity, thirteen (13) were non-saline, seven (7) were slightly saline and two (2) were moderately saline.

5. Impacts on Proposed Development

The mild aggressivity to concrete and the presence of moderately saline soils 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 9).

Based on DP's experience with local area, sodic soils are also expected to be present within the site. Sodic soils 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.

6. Salinity Management Plan

The following management strategies are confined to the management of those factors with a potential to impact on the development.

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. This capping could include the addition of topsoil at the completion of any earthworks.

B. 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.

C. 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.

D. 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.

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

The following additional strategies are recommended for completion of service installation and for building construction. These strategies should be complementary to standard good building practices recommended within the Building Code of Australia, including cover to reinforcement within concrete and correct installation of a brick damp course, so that it cannot be bridged to allow moisture to move into brick work and up the wall.

F. Aggressivity results indicate soils that are mildly aggressive to concrete and moderately saline are present within the site. As such, the durability requirements provided in Table 1 should be taken into account by the designer.

Table 1 – 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)
Concrete Foundations	Moderately Saline	Mildly Aggressive	25	45	3
Concrete Piles	Moderately Saline	Mildly Aggressive	32	60	-

G. 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 in J and K above. Reference to the maximum and minimum test results of Table 1 (Section 6 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.

7. Conclusions

It is considered that the management strategies described herein when incorporated into the design and construction works are appropriate to mitigate the levels of salinity, aggressivity and sodicity identified at the site.

8. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 28 Wallarah Circuit, Gregory Hills, NSW in accordance with DP's email proposal dated 9 September 2022 and acceptance received

from Alastair Burdon-Jones from Jacobs Pty Ltd dated 16 September 2022. The work was carried out under a NSW Education School Infrastructure Consultancy Services Agreement SINSW03031/22 dated 22 April 2022. This report is provided for the exclusive use of School Infrastructure 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 the DP(2022) 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 salinity 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.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Bradley Harris
Environmental Engineer / Associate

Christopher C Kline
Principal

Attachments: About this Report
Drawing 1
Laboratory Summary Table

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

Legend

- Site Boundary
- Test Pit Location
- Cored Borehole Location

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Location Plan**
Proposed School
28 Wallarah Circuit, Gregory Hills

N
MGA

OFFICE: Macarthur
DRAWN BY: BAH
DATE: 19 September 2022

CLIENT: School Infrastructure NSW c/- Jacobs Group Pty Ltd
PROJ. #: 213594.02
DRAWING No: 1
REVISION: 0
SCALE: As Shown

Table A1: Summary Table - Laboratory Tests and Assessments

Test	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class					Soil Texture Group	Textural Factor (M)	$EC_{1:5}$	EC_e	Sample Salinity 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	(for detailed soil logs see Report Appendix)		[Lab.]	[M x $EC_{1:5}$]	(Based on sample ECe)
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]					[after DLWC]	[after DLWC]	(microS/cm)	(deciS/m)	[Richards 1954]
1	0.5	6	-	-	10390	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Loam	10	103.9	1.0	Non-Saline
2	0.4 - 0.5	7.2	-	-		B	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-	-
2	0.5	7.3	-	-	27350	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Sand	17	273.5	4.6	Moderately Saline
4	0.1	7	-	-	6290	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Sand	17	62.9	1.1	Non-Saline
4	0.5	7.1	-	-	33050	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Heavy clay	6	330.5	2.0	Non-Saline
4	1	6.9	-	-	20630	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Clay loam	9	206.3	1.9	Non-Saline
5	0.5 - 1.0	5.3	-	-	16920	B	Mild	-	Non-Aggressive	-	Non-Aggressive	Medium clay	7	169.2	1.2	Non-Saline
6	0.5	5.8	-	-	27420	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Sandy loam	14	274.2	3.8	Slightly Saline
9	0.1	8.7	-	-	22660	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Light clay	8.5	226.6	1.9	Non-Saline
9	0.5 - 1.0	8.4	-	-	33550	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Light medium clay	8	335.5	2.7	Slightly Saline
9	1.5	7.4	-	-	27190	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Light medium clay	8	271.9	2.2	Slightly Saline
9	2	6.3	-	-	19990	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Clay loam	9	199.9	1.8	Non-Saline
9	2.5	6.6	-	-	6160	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Light clay	8.5	61.6	0.5	Non-Saline
9	3	6.4	-	-	8940	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Heavy clay	6	89.4	0.5	Non-Saline
10	0 - 0.1	9.1	-	-		B	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-	-
101	1	-	160	250	-	B	-	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-
101	1.5	-	42	24	-	B	-	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-
101	2.5	-	40	10	-	B	-	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-
103	0 - 0.1	7.9	-	-	-	B	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-	-
103	0.5	5.8	-	-	23390	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Clay loam	9	233.9	2.1	Slightly Saline
104	0.5	5.9	-	-	53610	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Heavy clay	6	536.1	3.2	Slightly Saline
106	0.5	5.3	-	-	25030	B	Mild	-	Non-Aggressive	-	Non-Aggressive	Clay loam	9	250.3	2.3	Slightly Saline
108	0.5	4.9	-	-	47460	B	Mild	-	Non-Aggressive	-	Non-Aggressive	Loam	10	474.6	4.7	Moderately Saline
110	0.5	5.1	-	-	41820	B	Mild	-	Non-Aggressive	-	Non-Aggressive	Light clay	8.5	418.2	3.6	Slightly Saline
111	0.1	8.9	-	-	26080	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Medium clay	7	260.8	1.8	Non-Saline
111	0.5	8.9	-	-	25210	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Medium clay	7	252.1	1.8	Non-Saline
111	1	6.1	-	-	15630	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Heavy clay	6	156.3	0.9	Non-Saline
111	1.5	5.8	-	-	16440	B	Non-Aggressive	-	Non-Aggressive	-	Non-Aggressive	Light clay	8.5	164.4	1.4	Non-Saline
112	0.5	-	300	360	-	B	-	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-
112	1.5	-	270	290	-	B	-	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-
112	2.8	-	22	20	-	B	-	Non-Aggressive	-	Non-Aggressive	-	-	-	-	-	-