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JQZ PTY LTD

Acid Sulfate Soil Management Plan

11-17 Columbia Lane, Homebush NSW

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1. INTRODUCTION

1.1 Background

EI Australia (EI) was engaged by JQZ Pty Ltd to prepare an Acid Sulfate Soils Management Plan (ASSMP) at 11-17 Columbia Lane, Homebush NSW (‘the site’). This ASSMP will provide the framework for the on-going management and monitoring of ASS, throughout the construction and operation phases of the project. The ASSMP will be based on data acquired during previous environmental investigations conducted at the site.

As shown in **Figure 1**, the site is located approximately 13 km west of the Sydney central business district, and comprises Lot 4 & 5 in DP261926, covering a total area of approximately 6,570 m^2. The site is situated within the Local Government Area of Strathfield Municipal Council.

This ASSMP was prepared in light of the following previous investigations performed at the site:

- STS (2019) *Detailed Site Investigation,11-17 Columbia Lane, Homebush NSW.* Ref 19/1315, 21024/1934D-E, dated June 2019.

Based on the findings of the STS (2019) investigation, ASSs were considered to be present at the site. It is understood that this ASSSMP is required in order to allow for proper management and off-site disposal of Acid Sulfate Soil affected material from the site.

1.2 Proposed Development

Based on the proposed development plans (Ref. Mosca Pserras Architects, Project No. 14028, 11-17 Columbia Lane, Homebush), the site has been designated for the removal of all existing concrete flooring and the construction of two high rise residential towers over a common four-level basement car park. The four-level basement is proposed to have a finished floor level of RL-6 m Australia Height Datum (AHD).

The proposed development will also involve the construction of street extension to the east of the site, which will be constructed within the basement footprint; and 1,012.40 m^2 of public open space covering the majority of the area outside the basement footprint to the east of the site. A 352.90 m^2 deep soil landscaping area is also proposed for the area along the western boundary of the site, which will also serve as a transmission line easement.

Copies of selected development plans are provided in **Appendix C**.

1.3 Project Objectives

The objective of this ASSMP is to provide the framework for the on-going management and monitoring of the impacts of PASSs, throughout the construction and operation phases of the project, in accordance with the *Acid Sulfate Soils Manual* 1998 (ASSMAC, 1998).

1.4 Scope of Works

To achieve the above objectives, the scopes of works are as follows:

- A description of the soil attributes of the site;
- A schedule of the construction activities that involve the excavation or movement of ASS;
- A description of the potential impacts caused by the proposed construction activities;

- A description of the measures and procedures to be undertaken in the ASS area which when implemented will prevent, control or minimise the generation or escape of acid leachate into the surrounding environment;
- A focussed monitoring program covering soils, surface waters and groundwater;
- A description of the contingency procedures to be implemented in the case of failure of management procedures; and
- A record of consultation with co-ordinating authorities.

2. DESKTOP REVIEW

2.1 Property Identification, Location and Physical Setting

The site identification details and associated information are presented in **Table 2-1**, while the site locality is shown in **Figure A.1** at the end of this report.

Table 2-1 Site Identification, Location and Zoning

Attribute	Description
Street Address	11-17 Columbia Lane, Homebush NSW
Location Description	Approx. 13 km west of Sydney CBD, bound by: ▪ North: Nipper Street and mixed used commercial/residential buildings. ▪ East: Industrial/warehouses followed by railway corridor. ▪ South: Powells Creek followed by Strathfield STS substation and railway corridor. ▪ West: Powells Creek followed by land used for commercial storage purposes and medium-high density residential buildings.
Site coordinates using GDA94-MGA56 coordinate system:	North-east corner of site: Easting: 323268.015, Northing: 6251035.35 (Source: https://maps.six.nsw.gov.au/)
Site Area	Approximately 6,570 m^2
Site Owner	JQZ Pty Ltd
Lot and Deposited Plan (DP)	Lot 4 and 5 DP 261926
State Survey Marks	Eleven State Survey Marks (SSM) were situated in close proximity (<150m) to the site. The SSM located within 50m of the site have been listed below: ▪ SS114415: 85m to the north of the site at the corner of Columbia Lane and Parramatta Road; and ▪ PM14420: 100m to the north of the site at the corner of Parramatta Road and George Street. (Source: https://maps.six.nsw.gov.au/)
Local Government Authority	Strathfield Municipal Council
Parish	Concord
County	Cumberland
Current Zoning	R4 – High Density Residential (Strathfield Local Environment Plan, 2012)
Recent Land Uses	History review indicates the site has been primarily used for commercial and manufacturing purposes since at least 1936. The structures at the site are noted to have been demolished between 2014 and 2018 (EI, 2019).

2.2 Surrounding Land Use

The site is situated within an area of mixed land uses. As outlined in **Section 2.1**, the most sensitive land use down and cross gradient from the site includes residential buildings to the north and west, and Powells Creek to the west of the site.

2.3 Regional Setting

Regional topography, geology, soil landscape and hydrogeological information are summarised in **Table 2-2**.

Table 2-2 Regional Setting Information

Attribute	Description
Topography	The local topography was gently sloping towards the west. The regional topography can be described via two landscape regions. *Disturbed Terrain (xx)* Described as level plains to hummocky terrain, extensively disturbed by human activity including complete disturbance, removal or burial of soil. Local relief <10 m slopes <30%. Landfill includes soil, rock, building and waste materials. Original vegetation completely cleared, replaced with turf or grassland (Ref: Chapman and Murphy, 1989). *Blacktown (bt)* Gently undulating rises on Wianamatta Group Shales and Hawkesbury shale. Local relief up to 30m, slopes are usually <5%. Broad rounded crests and ridges with gently inclined slopes (Ref: Chapman and Murphy, 1989). Development has likely modified the landscape (see Soil Landscapes below).
Site Drainage	Site drainage is likely to be consistent with the general slope of the site (west). Stormwater is likely to be collected by pit and pipe drainage, and drain either to the municipal stormwater system or Powells Creek.
Regional Geology	With reference to 1:100 000 scale Geological Series Sheet 9130 (Sydney) 1983; the site is likely to be predominantly underlain by black to dark-grey Ashfield shales and laminites, comprised from the Wianamatta Group (Rwa).
Soil Landscapes	The Soil Conservation Service of NSW Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy, 1989) indicates that the site overlies two terrains types: *Disturbed Terrain (xx)*. Soils are typically turfed fill areas, commonly capped with up to 40 cm of sandy loam or up to 60 cm of compacted clay over fill or waste materials. *Blacktown (bt).* Soils are typically shallow to moderately deep (<100 cm) *Red and Brown Podzolic Soils* on crests, upper slopes and well drained areas; deep (150-300 cm) *Yellow Podzolic Soils* and *Soloths* on lower slopes and in areas of poor drainage.
Site Filling	Based on observations during previous investigations carried out by STS (2019), the average fill depth across the site varied. Fill soils appeared generally deeper across the northern and central portions of the site (approx. 0.5 – 2.7 mBGL), becoming shallower towards the south (approx. 0.3 – 1.2 mBGL). General fill soil descriptions are summarised below.

Attribute	Description
Typical Soil Profile	**Concrete slab–** thickness of approximately 0.2m; **Fill –** Gravelly clayey sand, fine grained, light grey, with gravel, dry, no odours (varying thickness 0.2 – 2.7 m); **Fill –** Silty sandy clay, brown, medium to high plasticity, with traces of gravel, moist, no odours (varying thickness 0.3 – 0.8 m); **Natural –** Silty clay, medium plasticity, light grey with yellow brown and occasional red brown (some grey/dark grey clays identified), moist, no odours (varying thickness); **Bedrock–** Shale, dark grey with some light grey, clay seams, wet, no odour.
Depth to Groundwater	Based on the previous investigation (STS, 2019), groundwater was encountered between 0.8 – 4.5 mBGL during drilling. With the limited information presented in the DSI (STS, 2019), it is difficult to determine the depth of groundwater in mAHD during the groundwater monitoring event. However, it is anticipated that groundwater is located between 2.76 – 5.5 mBGL.
Nearest Surface Water Feature	Powells Creek, located adjacent to the south and west of the site. The creek connects to the Parramatta River, approximately 3 km to the north-west of the site.
Groundwater Flow Direction	Groundwater has been inferred to flow north-west towards Powells Creek.

2.4 Acid Sulfate Soil Risk Mapping

Review of the Prospect Parramatta Acid Sulfate Soil Risk Map 1:25,000 scale (Murphy, 1997), in conjunction with the Guidelines for the Use of Acid Sulfate Soil Risk Maps (Naylor et al., 1998), indicated that the site lies within an area *No Known Occurrence*. In such cases, land management activities are not likely to be affected by acid sulfate soil materials.

With reference to the Strathfield Municipal Council Local Environmental Plan 2012 Acid Sulfate Soils Map (ASS_004), the site fell within a category classified as class 5 ASS. Acid sulfate soils are not typically found within Class 5 areas. Areas classified as class 5 are located within 500 m of adjacent class 1, 2, 3 or 4 land. Works in a class 5 areas that are likely to lower the water table below 1 mAHD on adjacent class 1, 2, 3 or 4 land will trigger the require for assessment and may require management.

Based on the above reviews, it would appear that it is unlikely for acid sulfate soils to be located on the subject site. However, as noted in the previous investigation (STS, 2019), such risk maps are generally indicative and not intended to be confirmation of the presence (or absence) of acid sulfate soils on a particular site.

2.5 Geomorphic and Site Characteristics

Observations compiled during the site inspection, and via aerial photography interpretation, were compared against various geomorphic and site characteristics outlined in ASSMAC (1998) indicating likely ASS occurrence. A comparison of site specific and geomorphic features with those indicative of potential ASS presence are presented in **Table 2-3**.

Table 2-3 Summary of Geomorphic and Site Features

Geomorphic Features	Presence on Site
Holocene Sediments	Unknown
Soil horizons less than 5 mAHD	Present
Marine / estuarine sediments or tidal lakes	Not present
Coastal wetland; backwater swamps; waterlogged or scaled areas; inter-dune swales or coastal sand dunes.	Not present
Dominant vegetation is mangroves, reeds, rushes and other swamp or marine tolerant species	Not present
Geologies containing sulphide bearing material	Unknown
Deep older (Pleistocene) estuarine sediments	Unknown

One of the seven geomorphic characteristics listed are noted to be present onsite.

3. PREVIOUS ASSESSMENTS

3.1 Available Documents

This investigation follows on from previous assessments completed at the site, including:

- STS (2019) Detailed Site Investigation,11-17 Columbia Lane, Homebush NSW. Ref 19/1315, 21024/1934D-E, dated June 2019.

Due to the proximity of the site to Powells Creek, an ASS investigation was incorporated into the assessment, to determine the likelihood and potential impact of ASS within the soil.

The previous assessment included soil profiling and sampling at six test boreholes (BH21, BH22, BH23, BH24, BH24A and BH25). The maximum sampling depth was 5.5 mBGL (metres below ground level). The geological information obtained during the investigation is summarised in **Table 3-1**.

Based on observations during previous investigations carried out by STS (2019), the average fill depth across the site varied. Fill soils appeared generally deeper across the northern and central portions of the site (approx. 0.5 – 2.7 mBGL), becoming shallower towards the south (approx. 0.3 – 1.2 mBGL). The typical soil profile across the site is exemplified in **Table 2-2**.

With reference to **Table 4.4** of the ASSMAC Guidelines, the analytical results were interpreted with respect to greater than 1,000 tonnes of soil to be disturbed, as exemplified in **Table 3-2**.

Table 3-1 Action Criteria for ASS Management

Type of Material		Net Acidity	
Texture Range (NCST 2009)[1]	Approx. Clay Content (%<0.02mm)	>1,000 t material disturbed	
		% S equivalent (oven dried basis)	Mol H^+/tonne (oven dried basis)
Medium: Light medium to heavy clays	>40	>0.03	>18

Note 1 NCST: National Committee on Soil and Terrain

Analytical results of laboratory tested samples within the ASS assessment (STS, 2019) are summarised in **Table 3-4**, with a more detailed tabulation presented in **Table B.1** at the end of this report. Key findings of the ASS assessment are:

- Screening of forty-seven samples for PASS did not record any pH_f values of less than pH 5, indicating that the site soils were not affected by sulfuric soils (ASS). Field oxidation analysis indicated that samples ranged from pH 2.9 – pH 10. The recorded difference in pH_f to pH_{ox} ranged between 0.4 – 3.8 pH units, with reactions ranging from slight to vigorous. Based on the initial analysis, a number of samples showed signs for the presence of PASS.
- Following field screening, twelve representative samples were selected for laboratory chromium suite analysis (S_{CR}) to ascertain the potential for acid sulfate soils. Nine samples returned positive results, with seven samples noted to exceed the adopted action criteria. Exceedance locations and their corresponding approximate depths are noted in **Table 3-3** and **Figure A.2**.

- The risk of acid generation from unoxidised sulfur compounds was considered to be present. This result indicated the presence of potential ASS from depths of 0.5 mBGL within silty clay soils present at the site.
- Based on the results, the laboratory calculated the appropriate liming rate (based on a liming product with 100% neutralising value) and indicated a safety factor of 1.5. The liming rate ranged from 1.6 – 8.3 kg of lime product per tonne of untreated PASS.

Table 3-2 Exceedance Locations and Depths

Borehole	Site Location	Depth (mBGL)
BH22	North-East	0.5 – 1.5
BH23	Central	1.5 – 3.0
BH25	North-Central	1.5

As noted by STS (2019), based on the locations of boreholes returning exceedances, PASS are anticipated to be encountered within the historic tributary creek alignment, which is located along the western and southern portions of the site (**Figure A.3**). Whilst analyses from these boreholes were the only ones which exhibited PASS, confirmation testing should be conducted during bulk excavation works.

Table 3-3 Summary of Results – Tested Samples

Borehole	Depth (mBGL)	pH_f [4]	pH_{ox} [5]	Reaction Strength [3]	S_{CR} [6] (%)	Net Acidity (%S)	Net Acidity (Mol H+/t)	Net Acidity Excluding ANC (Mol H+/t)
BH21	3.5	8.4	6.5	XXX	<0.005	<0.01	<5	<5
	5.0	8.4	6.6	XXX	<0.005	<0.01	<5	<5
BH22	0.5	7.1	3.3	XXX	0.014	0.03	21	21
	1.0	5.7	2.9	XXX	0.063	0.16	99	99
	1.5	5.7	3.1	XXX	0.022	0.08	51	51
	2.0	5.4	3.9	XX	<0.005	0.01	9	9
BH23	1.0	7.8	6.4	XX	<0.005	<0.01	<5	<5
	1.5	6.7	3.8	XXX	0.014	0.04	26	26
	2.0	5.7	3.5	XXX	0.006	0.05	29	29
	3.0	5.5	4.1	XX	<0.005	0.04	25	25
BH25	1.5	5.1	3.5	XX	<0.005	0.18	110	110
	2.0	5.2	4.1	XX	<0.005	0.02	12	12

Field ASS Indicator	**<4**	**<3.5**	**XXX**	**NR**	**NR**	**NR**	**NR**
ASSMAC	**NR**	**NR**	**NR**	**0.03**	**NR**	**18**	**18**
	Result exceeds ASSMAC Action Criteria [1,2] – Coarse Textures						
	Result exhibits possible field indication of PASS/ASS						

Note 1 Action criteria provided in **Table 4.4** of the ASSMAC Guidelines, August, 2018.
Note 2 Criteria for sites where more than 1,000 t of soil is to be disturbed.
Note 3 Reaction Indicators – X: slight, XX: moderate, XXX: strong/high, XXXX: extreme/vigorous
Note 4 pH_f = Field pH
Note 5 pH_{ox}= Peroxide oxidised pH
Note 6 S_{CR} = Chromium reducible sulfur

3.2 Limitations of STS (2019) Report

Review of the report prepared by STS was found to have been conducted in general accordance with the ASSMAC Guidelines, with soil samples analysed by a NATA-accredited laboratory (SGS, Alexandria).

However, certain limitations within the report are noted with regard to the following:

- There are no analytical laboratory reports within the appendices which include ASS analysis;
- Section 15.3 of the report states that ASS is anticipated to be encountered within the historic tributary creek alignment, which according to the historical records presented in Appendix E was formerly located along the western and southern boundaries of the site. No boreholes were analysed for ASS within these portions of the site, despite some natural grey and dark grey silty clays noted within the soil log descriptions;
- There is no sampling rationale or justification with regard to the selection of boreholes BH21, BH22, BH23 and BH25 for ASS screening and analysis; and
- The criteria for chromium suite analysis was incorrectly assessed against the total net acidity (%S) of samples, where it should be compared to chromium reducible sulfur (S_{CR}) (%).

Based on the detailed report (STS, 2019), EI are not satisfied that ASS are present on-site, however, the data presented cannot be discounted. In EI's opinion, additional field screening will need to be undertaken on natural soils within the former tributary creek alignment, along the western and southern boundaries of the site. ASSs identified within BH22 (0.5 – 1.5 mBGL), BH23 (1.5 – 3.0 mBGL) and BH25 (1.5 mBGL) will need to be assessed with regard to pH in the field during excavation.

4. ACID SULFATE SOILS MANAGEMENT PLAN

4.1 Overview

Based on the findings of STS (2019), site soils present a risk from unoxidised sulfur compounds (i.e. from potential ASSs), which are expected to generate acidic sulfate compounds upon oxidation. The extent of any associated adverse impacts will depend on the following factors:

- Volume of excavated soil identified as being ASS;
- Physical characteristics of the ASSs, such as grain size and natural buffering capacity;
- Time that ASSs are exposed to air; and
- Rate of oxidation and transport of the oxidation products.

The length of time that ASS (both the excavated and remaining surface materials) will be exposed to air is likely to be of short duration (days to weeks). The shortest possible time of air exposure will be permitted, to minimise the extent of oxidation and transport of reaction products. Ideally, any stockpiled ASSs will be treated on the same day that they are excavated.

EI understand that JQZ Pty Ltd shall be responsible for the implementation and actioning of this ASSMP.

EI's review and interpretation of ASS information provided by STS (2019) considers that natural materials encountered from below the depth of filling soil may potentially contain oxidisable sulfur compounds that have the ability to generate acidic leachate. However, as noted in **Section 3.2**, a number of limitations were identified. To rectify this, a phase of additional investigation is outlined in **Section 4.2** to assist with identifying the spatial distribution of ASS at the site. Further investigation will also allow selection of the most appropriate method for handling and management of ASS during soil disturbance works.

4.2 Additional Investigation

Additional field screening will need to be undertaken on natural soils within the former tributary creek alignment, along the western and southern boundaries of the site (**Figure A.3**). This can be conducted in conjunction with remedial works prescribed in the EI RAP (EI, 2019), where four test pits and three monitoring wells have been recommended (locations exemplified in **Figure A.4**).

Boreholes identified as PASS within the regions of BH22 (0.5 – 1.5 mBGL), BH23 (1.5 – 3.0 mBGL) and BH25 (1.5 mBGL) will need to be removed as PASS in accordance with the management procedures outlined below.

Remaining natural soils of the site are to be assessed as normal, with any obvious indicators of ASS to be assessed by an experienced and qualified environmental scientist/engineer. Such indicators may include some or all of the following:

- Dark blue/grey (sometimes black) clays/sands;
- Mottled or blotched yellow colouring within natural soils;
- Remnants of plants/grasses/shells within natural soils;
- A strong smell of rotten eggs may emit from the soils; and

- A field pH of <4.0.

Following collection and interpretation of the additional ASS information, handling and management measures described in the following sections should be reviewed and amended by the environmental consultant to ensure that most satisfactory methods are proposed for soil disturbance works.

4.3 Disposal of Potential Acid Sulfate Soils below the Water Table

In accordance with the EPA (2014) *Waste Classification Guidelines Part 4: Acid Sulfate Soils*, potential ASS may be disposed of in water below the permanent water table, provided:

- This occurs before they have had a chance to oxidise, i.e. within 24 hours of excavation;
- They meet the definition of 'virgin excavated natural material' (VENM) under the *Protection of the Environment Operations Act 1997*, even though they contain sulfidic ores or soils; and
- Landfills must be licensed by NSW EPA to dispose of potential ASS below the water table.

Potential ASS must be disposed of within 8 hours of their receipt at a landfill and kept wet at all times until their burial at least 2.0 metres below the lowest historical level of the water table at the disposal site. It is understood that PASS shall be disposed below the water table at the receiving landfill facility, as required.

4.3.1 Process for Excavation of PASS

Excavation shall proceed in stages, as follows:

- The site surface shall be stripped and prepared; any existing fill materials shall be excavated and removed or stored separately in covered stockpiles;
- Surface fill shall be stripped and removed and care must be taken to ensure that no surface fill material is mixed with PASS material below. The sides of the excavation shall also be stripped a further 200 mm laterally to ensure potential fill soils do not fall into the pit and cross contaminate PASS materials below;
- Once fill material is removed, the surface shall be inspected by a qualified environmental consultant and a representative of the receiving landfill facility, prior to excavation of PASS;
- When surface clearance is granted, PASS materials shall be excavated to the required depth and loaded directly onto waiting trucks. Each truckload shall be inspected and verification testing for pH shall be carried out to confirm soil pH does not fall below pH 5.5 prior to leaving the site; and
- Verification testing is required to demonstrate that materials with existing acidity are not being reburied. Should field pH fall below pH 5.5, the materials from that truck are to remain on-site and lime neutralisation techniques are to be implemented, as discussed in **Section 4.3**.

4.3.2 Transportation

Transport of PASS material to the receiving landfill facility shall take place immediately. If this is not possible, PASS soils shall be stockpiled and immediately covered. Stockpiled PASS materials must leave the site within 12 hours of excavation otherwise lime neutralisation techniques shall proceed as discussed in **Section 4.3**

4.3.3 Documentation

Documentation must be provided to the occupier of the landfill for each truckload of PASS received, indicating that the soil excavation, transport and handling have been in accordance with ASSMAC (1998), thus preventing the generation of acid.

The occupier of the disposal site must also test the pH of each load of soil received immediately prior to its placement under water using the test method(s) in ASSMAC (1998) (Methods 21A and/or 21AF). These details, together with the pH of the soil recorded at the time of its extraction, must be retained by the occupier of the landfill site.

Soil that has dried out, undergone any oxidation of its sulfidic minerals, or which has a pH of less than pH 5.5 must be treated by neutralisation and disposed of at a landfill that can lawfully accept it.

The pH of the water at the landfill into which the potential ASS is placed must not be less than pH 5.5 at any time. Landfill licence conditions require the occupiers of potential ASS disposal sites to regularly monitor the pH of ground and surface waters at their premises.

4.4 Disposal of Potential Acid Sulfate Soils Above the Water Table

The total volume of PASS to be excavated or disturbed during the development program shall be stockpiled separately within designated areas, and treated (limed) immediately. More specifically, the management procedures are:

- For treatment of large volumes of material by mechanical application of neutralisation materials, treatment should be carried out on a treatment pad, with adequate sediment erosion control measures in place;
- Excavated PASS shall be stockpiled upon the treatment pad area. The treatment pad should consist of a minimum 300 mm thickness of compacted crushed limestone, or other appropriate neutralisation material. The level of compaction used should produce an appropriately low permeability base to prevent infiltration of leachate. The treatment pad should be bunded with a minimum 150 mm high perimeter of compacted, crushed limestone to contain potential leachate runoff within the treatment pad area and prevent surface water runoff from entering the treatment pad area. Lime shall be spread evenly upon the excavated materials, and thoroughly mixed; and
- Following treatment, soils should be chemically assessed and waste classified for offsite disposal in accordance with the EPA (2014) *Waste Classification Guidelines*.

In addition, the following management strategies shall also be considered and implemented, as required, to manage risk:

- Installation of leachate collection and treatment systems;
- Construction of supplementary erosion and sediment control structures.

If lime treatment on freshly excavated PASS cannot be performed immediately, plastic sheeting shall be placed over the stockpile to reduce oxidation, and the following shall be adopted:

- For every day a stockpile remains on-site, representative samples will be monitored for pH; where pH falls below pH 5.5, lime will be applied for neutralisation purposes; and
- On-site neutralisation of acidic soils (<pH 5.5) will be carried out using powdered, agricultural lime.

Determination of Lime Requirement

The quantity of lime required to neutralise the theoretical maximum amount of acid that could be generated from complete oxidation of the ASS is approximately **8.3 kg $CaCO_3$ per tonne** of soil.

Method of Neutralisation

In order to facilitate mixing, the soils should be thinly spread (<0.5 m). Lime should be added by hand and/or excavator bucket, followed by mixing using light-weight rotators and/or shovels.

Field pH testing on representative samples should be performed to ensure that sufficient neutralisation has occurred (i.e. pH is >pH 5.5), prior to disposal.

4.5 Management of In-situ Acid Sulfate Soils

Potential ASS which becomes exposed (oxidised) on excavation surfaces may produce acid. This corresponds to natural soil below the depth of site fill at the subject site.

For every day that such an excavated surface is in an exposed state, pH values shall be monitored from representative samples. Where soil pH levels falls below pH 5.5, lime will be applied to the potential ASS horizon(s) following the methodology presented in **Section 4.3**. Plastic sheeting can be placed over the corresponding surface (where possible) to reduce the oxidation rate.

4.6 Groundwater Management and Disposal

4.6.1 Groundwater Management

The removal (pumping) of any groundwater from an excavation area may cause alterations to the existing groundwater table. Extracted groundwater should be pumped to a holding vessel for assessment of pH characteristics during the dewatering process. Extracted water should be treated with hydrated lime to display a pH level of pH 6-8, prior to off-site disposal. Powdered agricultural lime should be added to the water by hand and/or excavator bucket and mixed. Field pH testing on representative samples should be performed to ensure that sufficient neutralisation has occurred, prior to disposal.

In addition to the above, an appropriately designed truck wash area will be required to capture liquids and solids generated, prior to vehicles exiting the Site. Treatment and neutralisation of liquids and solids shall be in accordance with **Section 4.5.1** and **Section 4.3**, respectively.

4.6.2 Groundwater Disposal

It is anticipated that extracted groundwater from the dewatering process will be disposed to the municipal stormwater system. Any permits / licences from Council and Water NSW shall be obtained prior to discharging to the municipal stormwater system.

Water for disposal will be tested routinely (weekly intervals) for the duration of dewatering activities, to ensure that no change to the quality of water entering the stormwater system, with the results made available to Council or Water NSW on request. Should it be found that groundwater quality is not suitable for disposal to the stormwater system, groundwater treatment or a Sydney Water permit to dispose to sewer shall be required prior to disposal.

Water quality monitoring for disposal to the municipal stormwater system shall include the following:

- Daily monitoring of field parameters (pH, electrical conductivity, dissolved oxygen, temperature and turbidity) in the treated discharge water using data logging equipment;
- Weekly sampling and laboratory analysis of treated groundwater water for suspended solids, dissolved metals (aluminium, arsenic, cadmium, chromium, copper, iron, lead, nickel, zinc and mercury), TRHs, BTEX, VOCs, PAHs, total nitrogen and total phosphorus. Laboratory results should be compared to freshwater trigger values provided in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) for slightly - moderately disturbed systems to provide a 95% level of species protection.

Weekly sampling shall be performed by a suitably qualified Environmental Consultant and submitted to a NATA accredited laboratory for analysis of the above parameters, depending on the time frame required to complete the works.

4.7 Risk Management

This management plan has been based on the assumption that PASS is present in natural soils below the depth of filling soils, and will be disturbed and exposed during the proposed development. Should the actual amounts of ASS significantly differ from those in this document, management techniques may need to be revised.

During the proposed excavations, it is recommended that site inspections be conducted by a qualified environmental consultant/engineer, in order to supervise the works and check that the assumptions made in the report are consistent with field evidence. The qualified environmental consultant/engineer should ensure:

- Soils indicative of potential ASS materials are adequately managed; and
- Adequate testing of excavated / exposed PASS is performed to establish liming requirements.

All contractors must employ best practices in managing any off-site water and soil quality impacts during site redevelopment. All waste materials must be chemically assessed and waste classified under the EPA (2014) *Waste Classification Guidelines*, prior to off-site disposal to appropriate landfill facilities.

4.8 Contingency Planning

A contingency plan is detailed below in **Table 4-1**. The plan provides a list of potential events that may arise during bulk excavation and the actions to be undertaken if unexpected conditions occur.

Table 4-1 Contingency Plan

Unexpected Condition	Action
Potential ASS identified at unexpected depths	▪ Stop excavations; ▪ Have material assess by an environmental consultant for the presence of ASS; and ▪ Follow management procedures adopted in the ASSMP.
Neutralisation of ASS was not effective	▪ Re-assess liming rates and add additional lime to material; and ▪ Re-test material to check neutralisation.

Unexpected Condition	Action
Neutralisation of ASS indicates that too much lime has been added and soils are alkaline	▪ Remediate soils before use; ▪ Remediation comprises mixing additional ASS with the material, i.e. use excess lime to neutralise more ASS; and ▪ Re-test material to check neutralisation.
Bunded PASS treatment area is damaged	▪ Repair bund as soon as practicable; ▪ Clean-up any PASS that escaped the treatment area and place back into the treatment area; and ▪ Check surrounding area for impact form the PASS or leachate, and undertake remedial action as required.
Groundwater level falls below the top of areas defined as containing PASS	▪ Stop dewatering; ▪ Review PASS exposure by checking the ASS and Non-ASS interface in the affected area; ▪ Determine potential causes by reviewing construction practises, weather, baseline groundwater monitoring data, and performing additional groundwater monitoring as necessary on groundwater monitoring present at the site; ▪ Review and confirm mitigation measures to be implemented, including: ▪ Maintain PASS soil moisture levels through targeted groundwater recharge; ▪ Adjusting the construction activities or schedule; and ▪ Treatment of additional PASS in treatment area.

5. STATEMENT OF LIMITATIONS

The findings presented in this report are the result of discrete and specific sampling methodologies used in accordance with best industry practices and standards. Due to the site-specific nature of soil sampling from point locations, it is considered likely that all variations in subsurface conditions across a site cannot be fully defined, no matter how comprehensive the field investigation program.

While normal assessments of data reliability have been made, EI assumes no responsibility or liability for errors in any data obtained from previous assessments conducted on site, regulatory agencies (e.g. Council, EPA), statements from sources outside of EI, or developments resulting from situations outside the scope of works of this project.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to EI's investigations and assessment.

EI's assessment is necessarily based upon the result of the site investigation and the restricted program of surface and subsurface sampling, screening and chemical testing which was set out in the proposal. Neither EI, nor any other reputable consultant, can provide unqualified warranties nor does EI assume any liability for site conditions not observed or accessible during the time of the investigations.

This report was prepared for the above named client and no responsibility is accepted for use of any part of this report in any other context or for any other purpose or by other third parties. This report does not purport to provide legal advice.

This report and associated documents remain the property of EI subject to payment of all fees due for this assessment. The report shall not be reproduced except in full and with prior written permission by EI.

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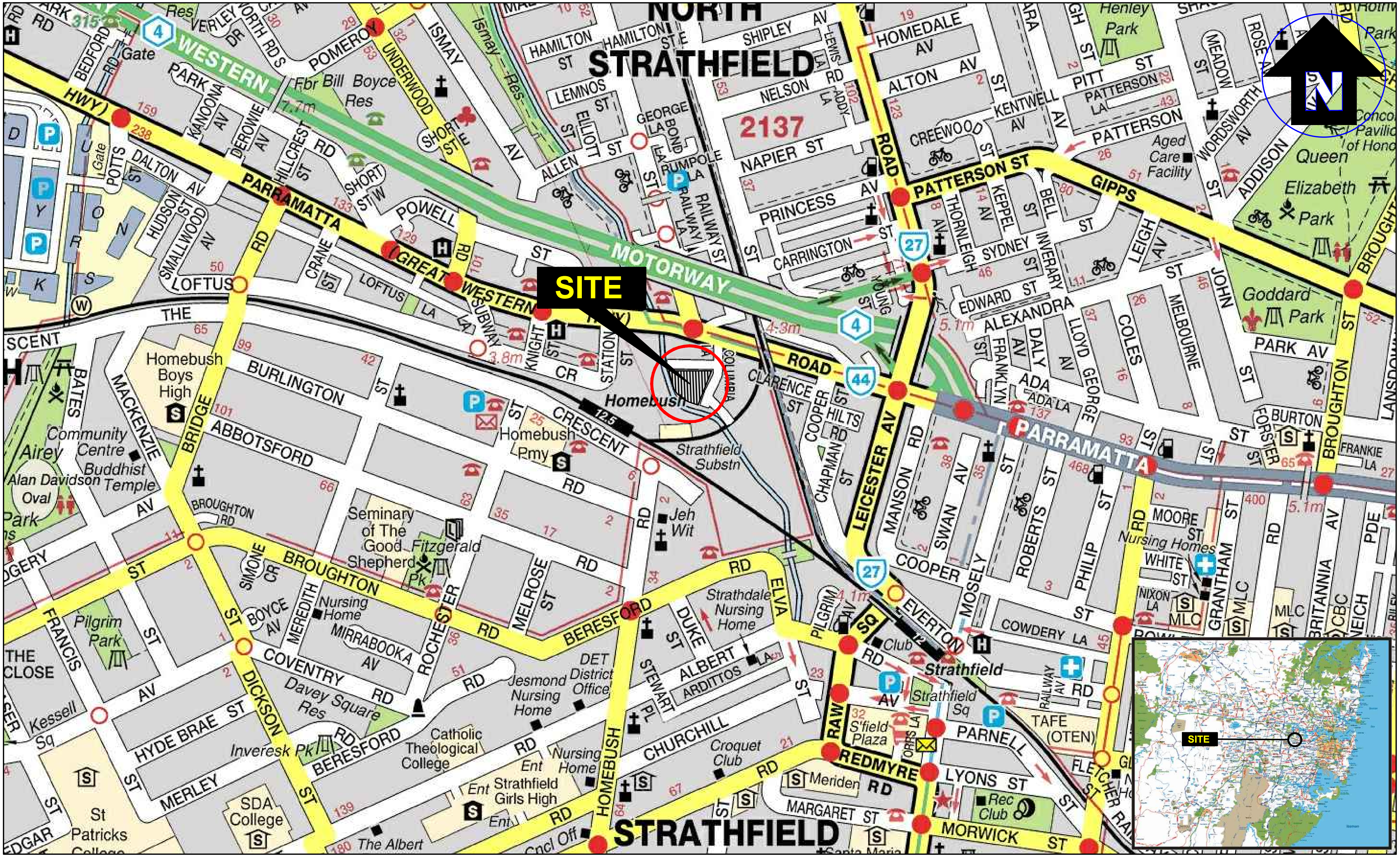
ABBREVIATIONS

AASS	Actual acid sulfate soils
AHD	Australian Height Datum
ASS	Acid sulfate soils
ASRIS	Australian Soil Resource Information System
ASSMAC	Acid Sulfate Soil Management Advisory Committee (ASSMAC)
BGL	Below Ground Level
BH	Borehole
COC	Chain of Custody
DA	Development Application
DP	Deposited Plan
EI	EI Australia
EPA	Environmental Protection Authority
km	Kilometres
m	Metres
mAHD	Metres relative to Australian Height Datum
mBGL	Metres below ground level
NATA	National Association of Testing Authorities, Australia
NSW	New South Wales
OEH	Office of Environment and Heritage, NSW (formerly DEC, DECC, DECCW)
PASS	Potential acid sulfate soils
pH	Measure of the acidity or basicity of an aqueous solution
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance / Quality Control
SRA	Sample receipt advice (document confirming laboratory receipt of samples)

Appendix A - Figures



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Approved:	J.H.
Date:	28-06-19
Scale:	Not To Scale

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Acid Sulfate Soil Management Plan
11-17 Columbia Lane, Homebush NSW

Site Locality Plan

Figure:
A.1

Project: E24275.E14

Map Source: Mosca Pserras Architects, Job No. 14028, Drawing No. AP05, Issue P22

LEGEND

- Approximate site boundary
- Approximate borehole location (STS - May 2019)
- Approximate underground storage tank location
- Approximate boundary of deep soil zone / transmission line easement
- Approximate basement boundary
- Approximate Nipper Street exit
- Approximate public open space

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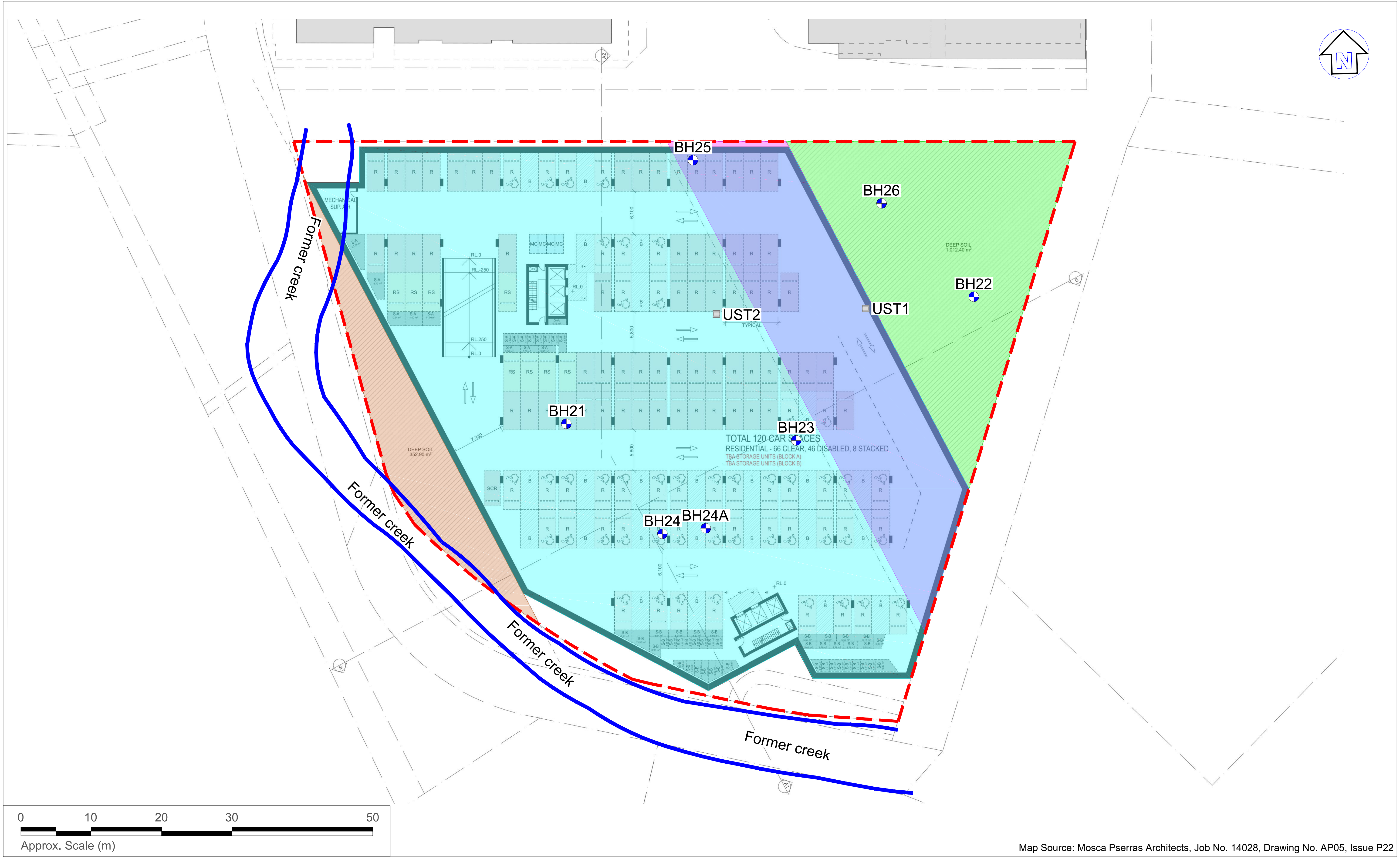
Sampling Location Plan - STS, 2019

Figure:
A.2

Project:
E24275.E14



Map Source: Mosca Pserras Architects, Job No. 14028, Drawing No. AP05, Issue P22

LEGEND

- Approximate site boundary
- Approximate borehole location (STS - May 2019)
- Approximate underground storage tank location
- Approximate boundary of deep soil zone / transmission line easement
- Approximate basement boundary
- Approximate Nipper Street exit
- Approximate public open space
- Approximate location of former tributary

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Acid Sulfate Soil Management Plan
11-17 Columbia Lane, Homebush NSW

Former Tributary Alignment

Figure: A.3

Project: E24275.E14

Map Source: Mosca Pserras Architects, Job No. 14028, Drawing No. AP05, Issue P22

LEGEND

- Approximate site boundary
- Approximate underground storage tank location
- Approximate location of proposed test pits
- Approximate location of proposed monitoring wells
- Approximate boundary of deep soil zone / transmission line easement
- Approximate basement boundary
- Approximate Nipper Street exit
- Approximate public open space

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Acid Sulfate Soil Management Plan
11-17 Columbia Lane, Homebush NSW

Proposed Sampling Locations

Figure: A.4

Project: E24275.E14

Appendix B - Tables

Table B.1 - Soil Analytcial Results: Acid Sulfate Soils (STS, 2019) **E24275.E14 - Homebush**

Sample ID	Site Location	Depth (mBGL)	Date Sampled	Material	Analysis									
					pH_F	pHox	Strength of Reaction	pH Difference (pH_f - pHox)	S_{CR} (%)	Net Acidity (%S)	Net Acidity (moles H+/tonne)	Net Acidity Excluding ANC (moles H+/tonne)	Liming Rate Inc. ANC (kg CaCO3/tonne)	Liming Rate Inc. Exc (kg CaCO3/tonne)
STS - Detailed Site Investigation (2019)														
ASS1	BH21	0.5	20/05/2019	FILL	10.6	10	XXXX	0.6	NA	NA	NA	NA	NA	NA
ASS2		1.0		FILL	11	10	XXXX	1	NA	NA	NA	NA	NA	NA
ASS3		1.5		Silty CLAY	9.4	7.1	XXX	2.3	NA	NA	NA	NA	NA	NA
ASS4		2.0		Silty CLAY	10.1	8.1	XXX	2	NA	NA	NA	NA	NA	NA
ASS5		2.5		Silty CLAY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASS6		3.0		Silty CLAY	9.5	7.3	XXX	2.2	NA	NA	NA	NA	NA	NA
ASS7		3.5		Silty CLAY	8.4	6.5	XXX	1.9	<0.005	<0.01	<5	<5	<0.1	<0.1
ASS8		4.0		Silty CLAY	8.4	7	XX	1.4	NA	NA	NA	NA	NA	NA
ASS9		4.5		Silty CLAY	8.8	7.1	XX	1.7	NA	NA	NA	NA	NA	NA
ASS10		5.0		Silty CLAY	8.4	6.6	XXX	1.8	<0.005	<0.01	<5	<5	<0.1	<0.1
ASS11		5.5		Silty CLAY	9.1	6.9	XXX	2.2	NA	NA	NA	NA	NA	NA
ASS12	BH22	0.5		Silty CLAY	7.1	3.3	XXX	3.8	0.014	0.03	21	21	1.6	1.6
ASS13		1.0		Silty CLAY	5.7	2.9	XXX	2.8	0.063	0.16	99	99	7.4	7.4
ASS14		1.5		Silty CLAY	5.7	3.1	XXX	2.6	0.022	0.08	51	51	3.8	3.8
ASS15		2.0		Silty CLAY	5.4	3.9	XX	1.5	<0.005	0.01	9	9	NA	NA
ASS16		2.5		Silty CLAY	6.1	5.6	XX	0.5	NA	NA	NA	NA	NA	NA
ASS17		3.0		Silty CLAY	6.4	5.5	XX	0.9	NA	NA	NA	NA	NA	NA
ASS18		3.5		Silty CLAY	6.5	6	XX	0.5	NA	NA	NA	NA	NA	NA
ASS19	BH23	0.5		FILL	7	5.3	XX	1.7	NA	NA	NA	NA	NA	NA
ASS20		1.0		FILL	7.8	6.4	XX	1.4	<0.005	<0.01	<5	<5	<0.1	<0.1
ASS21		1.5		Silty CLAY	6.7	3.8	XXX	2.9	0.014	0.04	26	26	2	2
ASS22		2.0		Silty CLAY	5.7	3.5	XXX	2.2	0.006	0.05	29	29	2.1	2.1
ASS23		2.5		Silty CLAY	8.2	6.2	XX	2	NA	NA	NA	NA	NA	NA
ASS24		3.0		Silty CLAY	5.5	4.1	XX	1.4	<0.005	0.04	25	25	1.9	1.9
ASS25		3.5		Silty CLAY	6.6	5.7	XX	0.9	NA	NA	NA	NA	NA	NA
ASS26		4.0		Silty CLAY	7.1	5.8	XX	1.3	NA	NA	NA	NA	NA	NA
ASS27		4.5		Silty CLAY	7.4	6	XX	1.4	NA	NA	NA	NA	NA	NA
ASS28		5.0		Silty CLAY	7.1	5.9	XX	1.2	NA	NA	NA	NA	NA	NA
ASS29		5.5		Silty CLAY	7.3	6	XX	1.3	NA	NA	NA	NA	NA	NA
ASS30	BH24	0.5		Silty CLAY	5.7	4.1	XX	1.6	NA	NA	NA	NA	NA	NA
ASS31		1.0		Silty CLAY	5	4	XX	1	NA	NA	NA	NA	NA	NA
ASS32		1.5		Silty CLAY	5.9	4.9	XX	1	NA	NA	NA	NA	NA	NA
ASS33		2.0		Silty CLAY	7.2	5.9	XX	1.3	NA	NA	NA	NA	NA	NA
ASS34		2.5		Silty CLAY	7.5	5.9	XX	1.6	NA	NA	NA	NA	NA	NA
ASS35		3.0		Silty CLAY	6.9	5.6	XX	1.3	NA	NA	NA	NA	NA	NA
ASS36		3.5		Silty CLAY	7.5	6.5	XXX	1	NA	NA	NA	NA	NA	NA
ASS37	BH25	0.5		FILL	7.1	4.7	XXX	2.4	NA	NA	NA	NA	NA	NA
ASS38		1.0		Silty CLAY	6.9	5	XX	1.9	NA	NA	NA	NA	NA	NA
ASS39		1.5		Silty CLAY	5.1	3.5	XX	1.6	<0.005	0.18	110	110	8.3	8.3
ASS40		2.0		Silty CLAY	5.2	4.1	XX	1.1	<0.005	0.02	12	12	NA	NA
ASS41		2.5		Silty CLAY	5.5	4.6	XX	0.9	NA	NA	NA	NA	NA	NA
ASS42		3.0		Silty CLAY	6.5	5.5	XX	1	NA	NA	NA	NA	NA	NA
ASS43		3.5		Silty CLAY	6.1	5.6	X	0.5	NA	NA	NA	NA	NA	NA
ASS44		4.0		Silty CLAY	6.7	6.7	XX	0	NA	NA	NA	NA	NA	NA
ASS45		4.5		Silty CLAY	6.7	6.7	X	0	NA	NA	NA	NA	NA	NA
ASS46		5.0		Silty CLAY	7.2	7.2	XX	0	NA	NA	NA	NA	NA	NA
ASS47	BH24A	4.0		Sandy CLAY	7.4	8	XXXX	-0.6	NA	NA	NA	NA	NA	NA
ASS48		4.5		Silty CLAY	7.5	8	XXXX	-0.5	NA	NA	NA	NA	NA	NA
SILs														
ASSMAC (1998) Screening Criteria[1]			**Field ASS Indicator**		<4.0	<3.5	XXX	>1	NR	NR	NR	NR	NR	NR
			Acid Sulfate Soil Action Criteria [2]		NR	NR	NR	NR	0.03	NR	18	18	NR	NR

Notes:

(blue)	Result exhibits possible field indication of PASS / AASS
(yellow)	Exceeding ASSMAC Action Criteria - Coarse Textures

1	Action criteria provided in **Table 4.4** of the Acid Sulfate Soils Assessment Guidelines, NSW Acid Sulfate Soils Management Advisory Committee, August, 1998.
2	Crtieria for sites where more than 1,000 t of material to be disturbed.
NR	No reference criteria available in current regulatory tools.
NA	Not analysed
S_{CR}	Chromium Reducible Sulfur
Reaction Indicators	X: slight reaction, XX: moderate reaction, XXX: strong/high reaction, XXXX: extreme/vigorous reaction