POWERHOUSE PARRAMATTA
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N
ACID SULFATE SOIL MANAGEMENT PLAN

JBS&G

NSW GOVERNMENT

Infrastructure NSW
Acid Sulfate Soil Management Plan

Powerhouse Parramatta
Phillip Street
Parramatta, NSW

3 April 2020
58352/128686 (Rev 0)
JBS&G Australia Pty Ltd

www.jbsg.com.au

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Abbreviations

Term	Definition
AASS	Actual Acid Sulfate Soil
AHD	Australian Height Datum
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soil Management Plan
BGS	Below Ground Surface
CC	Construction Certificate
DA	Development Application/Approval
DCP	Development Control Plan
EPA	NSW Environment Protection Authority
ha	Hectare
LEP	Local Environmental Plan
LOR	Limit of Reporting
NoW	NSW Office of Water
PASS	Potential Acid Sulfate Soil
SAC	Site Action Criteria
S_{Cr}%	Chromium Reducible Sulfur (%)
sPOCAS	Suspended Potential Oxidation Combined Acidity and Sulfur (test method)
S_{pos}%	Potential Oxidisable Sulfur
SWL	Standing Water Level
TAA	Total Actual Acidity
TPA	Total Potential Acidity
TSA	Total Sulfidic Acidity

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by Infrastructure NSW (the client) to conduct a Detailed Site Investigation (DSI) of potential contamination at the proposed future location of the Museum of Applied Arts and Sciences (also referred to as the future Powerhouse Parramatta) at Philip Street, Parramatta NSW (the site). The total site is legally identified as Lot 1 and Lot 2 in DP1247122 and Lot 1 in DP128476 and occupies an area of approximately 2.5 hectares (ha). The site location and layout are shown on **Figures 1** and **2**, respectively.

The DSI has been prepared and issued as *Detailed Site Investigation Infrastructure NSW Museum of Applied Arts and Sciences, Philip Street Parramatta NSW*, 27 Match 2020, JBS&G Australia Pty Ltd (JBS&G 2020). A potential for actual and/or potential acid sulphate soils (ASS and/or PASS) to occur at depth have been identified in JBS&G (2020). There is a likelihood that deep excavation works as anticipated with the proposed development, more than likely restricted to 'piling' activities, will encounter soils as classified as acid sulfate soils / potential acid sulfate soils (ASS or PASS).

This ASSMP has been prepared with consideration to the requirements of *Acid Sulfate Soil Manual* (ASSMAC, 1998) and the specific deep inground disturbance works anticipated for the site. Given the proposed works will include the generation of excess material, consideration has also been given to a future classification for off-site disposal of the natural material under the NSW EPA *Waste Classification Guidelines* (EPA 2014a[1] and 2014b[2]).

This report further supports a State Significant Development (SSD) Development Application (DA) for the development of the Powerhouse Parramatta at 34-54 & 30B Phillip Street and 338 Church Street, Parramatta. The Powerhouse Parramatta is a museum (information and education facility) that has a capital investment value in excess of $30 million and as such the DA is submitted to the Minister for Planning pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). Infrastructure NSW is the proponent of the DA.

The Department of Planning, Industry and Environment have issued Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development. This report has been prepared having regard to the SEARs as issued for the management of site contamination issues, interpreted as inclusive of ASS and/or PASS.

[1] *Waste Classification Guidelines Part 1: Classifying Waste*. NSW EPA 2014 (EPA 2014b)

[2] *Waste Classification Guidelines, Part 4: Acid Sulfate Soils*. NSW EPA (EPA 2014b)

1.2 Aims and Objectives

The aim of this assessment is to first assess the extent of potential ASS/PASS within the areas of proposed ground disturbance. In addition, it is a further objective to outline management techniques to mitigate the potential environmental impacts associated with the anticipated disturbance of ASS/PASS during the proposed site excavation works associated with deep piling as will potentially be undertaken to facilitate the proposed development of the site. Specifically, the objectives of this ASSMP are to document:

- The known site sub-surface characteristics that will be encountered during future excavation works to support design and implementation of future investigative and management activities;
- A monitoring and sampling strategy to be implemented prior to and during the proposed deep ground disturbance activities such that ASS/PASS may be appropriately identified and managed during the excavation works;
- Evaluation of potential ASS/PASS management opportunities and constraints resulting in the identification of a preferred management strategy;
- Procedures for the management and validation of ASS/PASS treatment during the future site excavation works so as to minimise the potential for adverse environmental impacts as a result of the ASS/PASS disturbance activities; and
- Outline the necessary off-site disposal requirements for potential ASS/PASS spoil generated from the proposed works.

The DPIE have issued SEARs to the applicant for the preparation of an EIS for the proposed development. This report has been prepared having regard to the SEARs below:

SEAR	Where addressed
15. Contamination and Remediation The EIS shall: - Identify geotechnical issues (including Acid Sulfate Soils) associated with the construction of the development. A Preliminary Site Investigation Study if needed, and/or further information as required by SEPP55 including an Acid Sulfate Soils Management Plan	Acid Sulfate Soil management has been addressed within this report.

1.3 Overview of Proposed Development

The Powerhouse was established in 1879, and Powerhouse Parramatta will radically return to its origins through the creation of seven presentation spaces of extraordinary scale that will enable the delivery of an ambitious, constantly changing program that provides new levels of access to Powerhouse Collection. The Powerhouse will set a new international benchmark in experiential learning through the creation of an immensely scaled 360-degree digital space, unique to Australia.

Powerhouse Parramatta will reflect the communities and cultures of one of Australia's fastest growing regions. It will hold First Nations culture at its core and set a new national benchmark in culturally diverse programming. The Powerhouse will be highly connected through multiple transport links, and integrate into the fine grain of the city.

Powerhouse Parramatta will be an active working precinct and include the Powerlab, which will enable researchers, scientists, artists and students from across regional NSW, Australia and around the world to collaborate and participate in Powerhouse programs. The Powerlab will feature digital studios to support music and screen industries alongside co-working spaces, life-long learning and community spaces. Integrated into the Powerlab will be a research kitchen and library that will support a NSW industry development program including archives and oral histories.

This application will deliver an iconic cultural institution for Parramatta in the heart of Sydney's Central City. The SSD DA seeks consent for the delivery of the Powerhouse Parramatta as a single stage, comprising:

- Site preparation works, including the termination or relocation of site services and infrastructure, tree removal and the erection of site protection hoardings and fencing;
- Demolition of existing buildings including the existing Riverbank Car Park, 'Willow Grove', 'St George's Terrace' and all other existing structures located on the site;
- Construction of the Powerhouse Parramatta, including:
    - Seven major public presentation spaces for the exhibition of Powerhouse Collection;
    - Front and back-of-house spaces;
    - Studio, co-working and collaboration spaces comprising the 'Powerlab', supported by 40 residences (serviced apartments) for scientists, researchers, students and artists artists, students, researchers and scientists, and 60 dormitory beds for school students;
    - Education and community spaces for staff, researchers and the Powerlab residents, the community, and education and commercial hirers;
    - Commercial kitchen comprising the 'Powerlab Kitchen' used for cultural food programs, research, education and events;
    - Film, photography, and postproduction studios that will connect communities with industry and content that will interpret the Powerhouse Collection;
    - Public facing research library and archive for community, industry, students and researchers to access materials; and
    - A mix of retail spaces including food and drink tenancies with outdoor dining.
- Operation and use of the Powerhouse Parramatta including use of the public domain provided on the site to support programs and functions;
- Maintenance of the existing vehicular access easement via Dirrabarri Lane, the removal of Oyster Lane and termination of George Khattar Lane, and the provision of a new vehicular access point to Wilde Avenue for loading;
- Public domain within the site including new public open space areas, landscaping and tree planting across the site; and
- Building identification signage.

The project does not seek consent for the carrying out of works outside of the site boundary, and in particular does not involve any alterations to the existing edge of the formed concrete edge of the Parramatta River or to the waterway itself.

1.4 Application

This document applies to the excavation of soils below a depth of 2 m. This is consistent with guidance in City of Parramatta Council records for the site, and the potential occurrence of ASS/PASS.

2. Site Conditions

2.1 Site Identification

The site location and the assessment area are shown in **Figures 1** and **Figure 2**, respectively. The site is located at the northern edge of the Parramatta CBD on the southern bank of the Parramatta River. It occupies an area of approximately 2.5 hectares and has extensive frontages to Phillip Street, Wilde Avenue and the Parramatta River. A small portion of the site extends along the foreshore of the Parramatta River to the west, close to the Lennox Street Bridge on Church Street. The site excludes the GE Office Building at 32 Phillip Street.

Assessment area details are summarised in **Table 2.1** and described in detail in the following sections.

Table 2.1: Summary of Assessment Area Details

Lot/DP	Lot 1 and Lot 2 DP1247122, Lot 1 DP128476
Address	Philip Street, Parramatta
Local Government Authority	City of Parramatta Council
Approximate Area size	2.5 ha
Current Zoning	B4 Mixed Use, RE1 Public Recreation
Current Land Use	Carpark, commercial properties including restaurants and open space
Previous Land Use	Carpark since 1960s
Proposed Land Use	Open Space / Recreational – Powerhouse Parramatta plus open space areas for public access

2.2 Site Description

A detailed inspection of the assessment area was conducted on 28 February 2020 by one of JBS&G's trained and experienced environmental scientists. Observations of the current site configuration and potential areas of concern are discussed below.

The site is currently occupied by a number of buildings and structures, including:

- Riverbank Car Park – a four-level public car park;
- Willow Grove – a two-storey villa of Victorian Italianate style constructed in the 1870s;
- St George's Terrace – a two-storey terrace of seven houses fronting Phillip Street constructed in the 1880s;
- 36 Phillip Street – a two-storey building comprising retail and business premises;
- 40 Phillip Street – a two-storey building comprising retail and business premises; and
- 42 Philip Street – a substation building set back from the street.

The immediate context of the site comprises a range of land uses including office premises, retail premises, hotel, serviced apartments and residential apartments. To the north is the Parramatta River and open space corridor, beyond which are predominately residential uses. The Riverside Theatre is located to the north-west across the Parramatta River.

Two ground-level asphalt carparks situated to the south of the Riverbank Car Park and were divided by an open-space, private parkland and Willow Grove and St George's Terrace. Small landscaped areas consisting of vegetation and patchy grass/exposed soils were also situated at various locations throughout both carparks. A number of private carparks were also situated at the rear of the commercial properties along Phillip Street, with surface compositions comprising patchy asphalt and gravelled exposed soils.

Directly to the north of the commercial properties, Oyster Lane and George Khattar Lane merge and slope downwards in a northerly direction towards Parramatta River and to the east of the Riverbank

Car Park. A landscaped area comprising large trees and grass also exists between George Khattar Lane and Riverbank Car Park.

2.3 Discussion of Geology and Acid Sulfate Soil Conditions

Review of the 1:100 000 scale Sydney Geological Sheet Series 9130 (NSW DMR 1983[3]) indicates that the site is located on the Wianamatta Group Shale, consisting mostly of shale, carbonaceous claystone, laminate, fine to medium grade lithic sandstone. Previous investigations (see **Section 3.8**) reported fill over natural soils as silty sand/silty clay overlying sandstone.

Review of the NSW Department of Environment and Heritage online resource eSPADE[4], indicated the site overlies the Birrong Soil Group which comprises deep (>250 cm) *Yellow Podzolic Soils* on older alluvial terraces, deep (>250 cm) Solodic Soils and Yellow Solonetz on the current floodplain. The soil landscape is prone to localised flooding and presents a high soil erosion hazard. Furthermore, the Birrong Soil Group can be characterised as saline subsoil with very low soil fertility and seasonal waterlogging.

Review of the Acid Sulfate Soil Risk Map (NSW DLWC)[5] indicates that the site is located within an area of Disturbed Terrain which includes areas historically impacted by reclamation of low-lying wetlands, dredging, mining or urban development. The nearby Parramatta River comprises an area of high probability of acid sulfate soil occurrence in bottom sediments. Acid Sulphate Soils are anticipated to be present underlying the site at depth.

Previous environmental assessments completed for the site have reported that ASS/PASS conditions are generally not present in fill materials / near surface soils, however may be present in deeper soils. On this basis, and in consideration of the proposed development, guidance in PCC records for the site, and the likely extent of minor excavations and deep excavations as may be required for piling, the provisions of the plan are intended to apply to any excavation proposed to a depth of 2 m below the existing ground surface.

2.3.1 Potential Acid Sulfate Soil Assessment Conclusions

Based on the proposed site plans and with consideration to the proposed development details, the following has been identified with regard to the requirements for management of ASS / PASS risks at the site:

- Disturbed natural soils below the water table that are disturbed or otherwise exposed to the atmosphere during any construction phase, or otherwise soils below a depth of 2 m (as consistent with shallowest depth of groundwater in areas of proposed development) may require treatment for ASS/PASS if kept on-site to prevent production of acid sulfate soils with the potential to impact on the surrounding environment;
- The proposed development works will include the disturbance of only minor volumes of natural alluvial soils currently present underlying fill materials and beneath the water table as likely to be restricted to spoils as generated by piling works;
- Where soils below this depth are proposed to be disturbed, then advance sampling will require to be undertaken to assess the soils for a sPOCAS analysis to determine an initial liming rate. Mixing of the ASS/PASS soils with lime (if present) will cause a neutralisation of the acidity as otherwise generated by the ASS/PASS on disturbance;

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3 *Sydney 1:100,000 Geological Sheet 1930, 1st Edition*. NSW Department of Mineral Resources 1983 (NSW DNR 1983)

4 *eSPADE* https://www.environment.nsw.gov.au/eSpade2WebApp# NSW Department of Environment and Heritage. Accessed 5 March 2020

5 *'Acid Sulphate Soil Risk Map – Prospect-Parramatta,* 1997 1:25 000 (NSW DLWC)

- Following successful completion of the neutralisation process, the treated soils will no longer be considered ASS/PASS materials and so may potentially be reused on site as engineered fill material;
- Any identified neutralised ASS/PASS in excess of site requirements will require classification by reference to EPA (2014) Waste Classification Guidelines prior to offsite disposal; and
- It is anticipated that the ASS/PASS management requirements, will be limited to the natural soils underlying fill materials across the site, as present at depth.

3. Acid Sulfate Soil General Information

3.1 Acid Sulfate Soil Background

Acid sulfate soils (ASS) is a common name given to naturally occurring sediments and soils containing iron sulfides (generally as iron sulfide or iron disulfide). These soil profiles are typically located in coastal, low-lying alluvial or estuarine areas such as mangroves, salt marshes, coastal rivers and creeks, estuaries, tidal lakes and coastal floodplains where historical iron rich sediment deposition in the presence of a sulfate source (commonly salt water), organic matter and microbial action over time has resulted in the formation of particular environmental conditions. Acid sulfate soils are predominantly encountered in areas with an elevation of less than 5 m AHD and may be found close to the ground level or at depth in the soil profile where continued deposition has resulted in raising of the ground levels.

Changes in environmental conditions which result in the exposure of these materials to air, via excavation or drainage of subsurface soils, can lead to the reaction of the iron sulfides with oxygen, causing the generation of sulfuric acid. This may result in significant environmental and infrastructure damage if the produced acid is spread by groundwater or surface water.

Acid Sulfate Soils (ASS) consist of two major categories:

- Actual Acid Sulfate Soils (AASS) are soils that have been exposed to oxygen which has caused the oxidation of iron sulfides to form sulfuric acid. Some of this acid is commonly neutralised by other soil particles in a process known as buffering, however the excess acid is spread by water movement through the soil; and
- Potential Acid Sulfate Soils (PASS) are soils which contain iron sulfides, but which have not been oxidised. These soils are generally kept from contact with air by permanent waterlogging or the density of the soil profile and so are relatively stable, or in equilibrium. In this state the soils are generally non-acidic and are considered harmless to the environment. However, oxidation of such soils through disturbance has the potential to generate acidic conditions.

Commonly, an acid sulfate soil profile will consist of a combination of both AASS and PASS material as a result of ongoing chemical reactions in response to environmental changes including groundwater fluctuations and seasonal soil moisture changes.

In NSW, development of land subject to ASS occurrence is managed at a planning level in accordance with the *Acid Sulfate Soil Manual* (1998) prepared by the Acid Sulfate Soil Management Advisory Committee (ASSMAC). Local Environmental Plans (LEP) provide a regulatory regime for the sustainable management of acid sulfate soils in the coastal zone. The ASS Manual provides guidance on the assessment of acid sulfate soil conditions and appropriate management strategies for development of ASS identified land.

3.2 Laboratory Assessment Guidelines

The assessment of site soil conditions with respect to ASS occurrence is completed in accordance with the guidance provided in ASSMAC (1998). The requirement to manage soils for ASS is evaluated by comparison of laboratory analysis results with Site Action Criteria developed based on three broad soil texture categories. The SAC are based on the percentage of oxidisable sulfur or equivalent acid trail (i.e. titratable actual acidity-TAA or titratable potential acidity-TPA) results. There are two categories based on the scale of the proposed disturbance, with the SAC for small scale (i.e. less than 1000 tonnes) works based upon the texture of the soil material and the SAC for large scale works adopting the most sensitive SAC being the SAC for coarse textured soils in small scale works.

Table 3.1 ASSMAC Site Action Criteria based on General Soil Texture Categories

Type of material		Action Criteria 1-1000 tonnes disturbed		Action Criteria if more than 1000 tonnes disturbed	
Texture Range. McDonald at al. (1990)	Approx. clay content (%<0.002 mm)	Sulfur trail % S oxidisable (oven-dry basis) e.g. S_{Cr} or S_{pos}	Acid trail Mol H^+ /tonne (oven-dry basis) e.g., TPA or TSA	Sulfur Trail % S oxidisable (oven-dry basis) e.g. S_{Cr} or S_{pos}	Acid trail Mol H^+ /tonne (oven-dry basis) e.g., TPA or TSA
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium texture Sandy loams to light clay	5-40	0.06	36	0.03	18
Fine texture Medium to Heavy clays and silty clays	≥40	0.1	62	0.03	18

Exceedance of the SAC attributable to ASS material generally triggers the need to prepare a management plan and is based on the percentage of oxidisable sulfur (or equivalent TPA, TAA) for broad categories of soil. However, it is noted that other soil properties and constituents may cause acidic conditions in soils that are not related to acid sulfate soil conditions. This may include sources of organic acidity where the soils have a pH of less than 5 and positive titratable actual acidity (TAA) or titratable potential acidity (TPA) but have no detectable sulfur source (i.e. no S%). In this case, exceedance of the Acid Trail SAC does not trigger treatment of these soils.

Given the nature of the works to be undertaken at the subject site (i.e. minimal volumes to be disturbed) and with consideration to the variability of the soils types noted in previous investigations, the SAC adopted for assessment and management of ASS at this site are:

- Sulfur Trail Criteria (S_{pos} or S_{Cr} %) > 0.03 %;
- Acid Trail Criteria (TSA, TPA) > 18 mol H^+ / tonne soil.

3.3 Other Regulatory Guidance

Section 105 of the *Contaminated Land Management Act 1997* (CLM Act) allows the Environment Protection Authority (EPA) to "make or approve" guidelines for any purpose related to the objects of the Act. In addition to ASSMAC (1998), this management plan has been prepared with reference to the following:

- *Waste Classification Guidelines Part 1: Classifying Waste* (EPA 2014a)
- *Waste Classification Guidelines Part 4: Acid Sulfate Soils* (EPA 2014b)
- *Contaminated Sites: Guidelines for NSW Site Auditor Scheme*, 3rd Edition, October 2017 (EPA 2017)
- *Protection of the Environment Operations Act* 1997 (POEO Act) and associated regulations.

4. Extent of ASS/PASS within Proposed Area of Disturbance

Previous investigations have identified a potential for ASS/PASS to be present in deep soils at the site. This is consistent with the proximity of the site to the Parramatta River and the potential for sulfidic material to be present in deep soils. It is likely that future deep excavation works comprising excavation for the undercroft, life cores and piling, will cause the disturbance of ASS/PASS soils.

At the outset of these works, an indication will be required of the potential depth that ASS/PASS materials are present (if present at all) and the levels of sulfidic materials present in the soils. At the stage of the ASSMP preparation, this information is not yet available for the site.

These works will be required to be undertaken where a plan of proposed deep excavations has been prepared, and the extent of deep excavations is known. This would likely occur with detailed geotechnical assessments prior to construction of buildings, and with detailed building designs.

At the time that these detailed plans are available, representative investigation locations shall be undertaken through the area of proposed deep excavation and samples of soils from below a depth of 2 m collected at regular intervals. These samples shall be assessed for a sPOCAS analysis and compared to criteria nominated in **Table 3.1**. The distribution of ASS/PASS shall be determined from these analysis results, and the appropriate provisions of this ASSMP applied to soils where appropriate.

Initial liming rates to achieve the neutralisation of the disturbed soils can further be determined form the analysis rates. These liming rates shall be use din the first instance to implement the neutralisation works as described in further detail in **Section 5**.

5. Management Procedures

The aim of the following management procedures is to identify ASS/PASS material and implement appropriate mitigation measures such that the potential environmental impacts associated with disturbance of ASS/PASS during the proposed site construction works may be appropriately managed. Specifically, the objectives are to provide:

- A methodology for the identification of materials requiring management;
- Protocols for the on-site treatment and management of ASS/PASS materials and associated leachate water (as required) during the proposed works;
- Excavation inspection and validation assessment protocols to be implemented during the proposed works such that the extent of ASS/PASS material may be delineated from non-PASS material to provide for off-site disposal of the balance of the natural soils as virgin excavated natural material (VENM);
- Water and soil quality targets for the excavation, treatment and removal of material encountered during the proposed works; and
- A contingency framework in the event that additional ASS/PASS conditions are encountered during the site works; monitoring indicates disturbance of off-site ASS/PASS materials; or the proposed treatment strategy fails.

5.1 Scope of Soil Disturbance Activities

Of relevance to the scope of the ASSMP, as being restricted to soils below a depth of 2 m across the extent of the site, potential soil disturbance activities that will disturb deep soils will most likely be restricted to excavation for the installation of an undercroft level and piling to support the construction of future structures on the site. Sub-surface structures are not proposed with the development, and with the exception of the undercroft across a portion of the site, no basements have been included in the site building.

The extent of excavation and piling for submission with the EIS is presented on the Architectural Plans provided for the development works and will require investigation for ASS/PASS once the specific locations and depths are determined following consent approvals.

5.2 Evaluation of Potential Management Strategies

Where the presence of ASS/PASS has been identified, evaluation of options to minimise the level of disturbance and to mitigate the potential impact of disturbance (if necessary) of the materials is required. As per ASSMP (1998), potential mitigation approaches have been identified:

- Avoid ASS/PASS materials being encountered during works by not undertaking bulk excavation works into natural alluvial soils, i.e. removing excavation and/or dewatering requirements;
- Where encountering ASS/PASS during works cannot be avoided, manage the potential for acid generation by neutralising disturbed materials, preventing movement of acid impacted water, and the use of suitable construction materials;
- If PASS materials have previously been disturbed, undertake works to mitigate the existing conditions, minimise the production of further acid during the proposed works and rehabilitate impacted areas;
- Treat soil by allowing full oxidation of the sulfide component under controlled conditions followed by flushing the acid from the soil with water and neutralisation of the subsequent leachate;

- Avoid using untreated ASS/PASS materials as fill material in non-ASS areas by either leaving material on-site, or managing the potential for acid generation prior to material being transported from the site of origin; and/or
- Reburial of ASS materials beneath the permanent water table or beneath a dense soil profile which excludes oxygen exposure such as an engineered clay cap. This may be undertaken on-site if there are low lying areas where reburial and consequential flooding of the soil profile or construction of a suitable capping layer can be undertaken as part of development works, or at an alternative off-site location provided that sufficient stabilisation of material is undertaken to minimise acid generation during transportation and handling.

The potential suitability of the various options is further discussed in the following sections.

5.2.1 Avoidance Strategies

Avoidance of ASS/PASS disturbance is generally considered to be the preferred means of ASS/PASS risk management where such actions can be achieved.

Given the proposed works to be excavations and piling boreholes of likely significant depths and into horizons where ASS/PASS are present, and will most likely generate excess spoil due to the installation of the pier within the created boreholes, avoiding ASS/PASS disturbance is not considered a viable option.

5.2.2 Management by Neutralisation

Neutralisation techniques can be used to treat ASS/PASS by the addition of chemicals that react with the produced acid to ensure that acid is not released from the treated material. The neutralisation activities should result in the pH of the disturbed materials (water and/or soil) being between 5.5 to 7.5 and requires that ASS/PASS material disturbed during site activities be treated with the preferred neutralising agent.

Laboratory analysis is used to assess the levels of existing and/or actual acidity and indicates the level of neutralising capacity required to react with all potential acidity that may be generated during/following disturbance of the ASS/PASS material. Due to the small volumes of ASS/PASS potentially being generated however, laboratory confirmation of treated materials will only be required where material is to be disposed of offsite or used at the ground surface. Field testing is considered adequate to validate materials to be placed back within the excavations at depth within a short timeframe.

The potential uncertainty associated with the quantity of neutralising capacity to be added is commonly managed by the use of a factor of safety of 1.2 or 2 depending upon the level of uncertainty.

Sufficient capacity in terms of a suitable treatment area, machinery, budget to purchase the neutralising agent and time is necessary to successfully implement ASS/PASS neutralisation. Implementation of environmental controls is also necessary to ensure that all potentially acidic leachate produced during the treatment process is captured and appropriately managed. This can be done with sand bags or silt fencing placed around the excavated materials to ensure water can be treated and neutralised prior to either evaporation, use as dust suppression or placement back into the excavation.

For the purposes of this plan, the neutralising chemical is assumed to be high quality agricultural lime (aglime). The aglime should be fine ground (<1mm) calcium carbonate ($CaCO_3$) or calcite (limestone or marble powder). In the event that neutralising products other than high quality aglime are selected for use in this project, there are several issues that should be considered:

- Is there any potential environmental risk associated with use of the compounds (i.e. other components that may contaminate water, result in a much higher pH value (i.e. hydrated lime), stain treatment areas, etc); and/or
- Will the neutralising agent be of comparable effectiveness or will properties including: neutralising value, effective neutralising capacity, solubility, pH, chemical components, moisture content, impurities and particle size; require the quantity of agent addition to be varied by a consistent factor.

During works which are known to disturb materials from below the fill material or beneath the water table, a sufficient supply of agricultural lime (aglime), being the volume required to address the total project requirement, should be acquired prior to commencement of excavation works.

The quantity is based on requirements for the treatment of acid sulfate soils to be neutralised within the treatment area. Receipts, dockets and other field records showing the storage locations of all chemicals and location of all applications of neutralising agents must be kept.

ASS/PASS management by neutralisation is considered to be a suitable option for management of the identified ASS/PASS soils generated during the proposed deep excavations works as:

- Excavation of small volumes of natural material are required to be completed for drilling of boreholes to install piles;
- There is sufficient space that can be made available within the site (directly adjacent the piling area) to set aside a treatment area(s) close to the identified ASS/PASS disturbance which can be hydraulically isolated from the remainder of the site;
- Appropriate machinery to mix the soil and neutralisation chemicals can be supplied by the civil works contractors completing works on site; and
- Following successful completion of the neutralisation process, the treated soils are no longer considered to be ASS materials, and so may either be reused on site as engineered fill material, or alternatively, may be removed off-site as waste.

5.2.3 Full Oxidation and Leachate Collection

Although not a preferred option, in the event that the acid production potential is relatively low, or there is a relatively low quantity of material to be treated, consideration may be given to the excavation and exposure of the soils to promote full oxidation. This option requires the implementation of environmental controls to ensure that all acid produced is flushed from the soil as leachate. Similar to management by neutralisation, a suitable treatment area is necessary where material can be spread and reworked to allow oxygen to react with the sulfides in the soil and where all leachate produced can be captured and treated by neutralisation.

This method is considered not to be a viable option for the proposed works as the process of soil oxidation may take extended periods (weeks to months) to reach completion. There is also a significant level of uncertainty in the volumes of leachate that would require neutralisation and disposal due to climatic variation, including rainfall events. Given the low anticipated volume of material requiring treatment and the requirement to maintain environmental controls for a long period, this option is considered undesirable when compared to the relatively low cost of neutralisation chemicals as discussed in **Section 5.2.2** above.

5.2.4 Reburial of PASS Material

Strategic reburial or interment techniques can be used to manage PASS material by prevention of oxidation through permanent storage in an anoxic environment. These techniques are often adopted where areas are available for reburial and cost savings can be achieved by avoiding soil handling labour and neutralisation chemical costs. As the concrete and steel construction of the pile will be placed within the excavations, the placement of ASS/PASS materials back into the excavations are not considered a viable option and therefore this technique would not be recommended.

An alternative method of achieving reburial is over excavation of non-acid sulfate soil materials in an area that would not be anticipated to be disturbed in the future followed by reinstatement of the excavation with potential PASS material. Potential reburial sites must have a permanent groundwater table level above the proposed top of the reburial cell or alternatively measures to minimise oxygen exposure to ensure that the material is returned to an anoxic environment. These areas may be applicable in the northern portion of the site, which is present at a lower elevation to the remainder of the site.

Reburial may occur within the Site or alternatively, where appropriate licences are obtained, at a site lawfully able to accept this material in accordance with the requirements of EPA (2014).

Excavation of PASS and creation of re-interment voids must be staged to ensure that adequate space is available for all PASS materials to be adequately reburied below a permanent water table and that the PASS will not be buried in conditions that may cause the formation of acidic conditions. A maximum period of time between the commencement of disturbance and completion of interment works of approximately 48 hours should be adopted in all instances. If the material is to remain exposed for longer the 24 hours the pH levels should be monitored every 12 hours to ensure acid conditions are not developing.

On this site, given the required depth of excavation to expose the PASS material and the proposed development works consisting of mainly above-ground works, strategic reburial of PASS without neutralisation is considered unlikely to be a practicable management option.

5.2.5 Separation Techniques

Separation techniques are increasingly being implemented to reduce the quantity of ASS/PASS material requiring treatment in areas where works include the disturbance of large quantities of PASS. These activities include the removal of fine ASS particles including pyrite and monosulfides from coarser grained soil particles. This results in two material streams, concentrated ‘ASS fines’ and non-ASS material which can be removed from the management process. Management of ASS fines would then involve implementation of other ASS/PASS management techniques such as reburial, neutralisation, etc.

Separation is typically implemented by creating a soil slurry where fine particles can be suspended in solution away from heavier soil particles using methods such as sluicing or cycloning. Typically, such methods require suitably grained soils such as sand or non-consolidated sediments and a significant water source to implement the separation.

Environmental controls are required during the separation processes to ensure that the ASS fines do not undergo oxidation prior to the implementation of other management measures and validation of the non-ASS stream would then be necessary to confirm that the ASS fines have been adequately removed.

On this site, separation techniques are considered not to be a viable management option as these techniques cannot be used as a standalone management option and as such the ASS fines once separated would still require further treatment. Further, as there is only a small quantity of material requiring treatment, the establishment of infrastructure required is not economical.

5.2.6 Selection of Preferred Management Strategies

Evaluation of potential management strategies has identified that the use of neutralisation techniques where disturbance cannot be avoided is considered the most appropriate technique for this site. As the excavations will not allow for generated soil spoil to be used as backfill material due to the installation of piers within the piled boreholes, reburial of PASS/ASS materials within the excavation is not an option.

Management measures for identified ASS/PASS material will include the application of neutralisation chemicals to excavated ASS/PASS material, neutralisation of exposed excavation faces during works and neutralisation of any groundwater seepage and drainage leachate produced during the excavation and treatment works. Following validation to confirm the acid generation potential of the material has been appropriately neutralised, the material will either be set aside for use as engineered fill material within the development site, or alternatively, will require off-site disposal as per the requirements of EPA (2014).

5.3 General Site Management Strategy

The site management strategy to be implemented during works which may disturb ASS/PASS materials will ensure the following:

- Adequate treatment of ASS/PASS material such that there is sufficient acid neutralizing capacity and no net acidity following stabilization (as measured through appropriate field testing);
- Water discharged from the treatment areas (including run-off, water from dewatering and leachate) is neutral and discharged to stormwater once it has been shown to meet with the criteria specified in this plan or alternatively, shall be reused on site for dust suppression, or tankered off site as liquid waste; and
- Implementation of additional assessment procedures during earthworks operations for the effective treatment and management of any drained, disturbed or excavated acid sulfate soils.

5.3.1 Pre-disturbance Works

Subsequent to the additional investigation activities as identified in **Section 4**, and prior to the commencement of excavation works which may disturb ASS/PASS materials at the site, including activities with the potential to generate spoil, the following preparations should be considered:

- The sequencing of proposed deep excavation/ deep piling works and other associated activities should be planned in detail taking into account the time and space necessary to complete the ASS/PASS management activities outlined in this document. The planning should provide a contingency for treatment of additional quantities of materials in the event that the proposed works require additional excavation extents to those currently identified and/or the quantity of ASS/PASS material generated is greater than anticipated during implementation of the site works, or heavy rainfall events result in significant additional quantities of collected impacted water; and
- The actual areas of ASS/PASS occurrence where disturbance/excavation will occur during the proposed works as part of the site activities should be identified and suitable location(s) for treatment areas and/or storage of treatment bins close to the areas of disturbance identified (e.g. adjacent the excavation). Based on the proposed works, it is anticipated that there is sufficient space to complete the required excavation / piling works for each location in a single stage. To minimise the potential volume of water requiring management/ treatment, installation of appropriate bunding should occur around proposed areas of ground disturbance (i.e. around the piling rig) and the

treatment area. These measures should prevent the release of acidic water across the site and also the mixing of surface/stormwater with ASS/PASS material exposed within the excavated and/or undergoing treatment.

5.3.2 Neutralisation Chemicals

For the purposes of this plan, the neutralising chemical is assumed to be high quality agricultural lime (aglime). The aglime should be fine ground (<1 mm) calcium carbonate ($CaCO_3$) or calcite (limestone or marble powder). In the event that neutralising products other than high quality aglime are selected for use in this project, there are several issues that should be considered:

- Is there any potential environmental risk associated with use of the compounds (i.e. other components that may contaminate water, result in a much higher pH value (i.e. hydrated lime), stain treatment areas, etc); and
- Will the neutralising agent be of comparable effectiveness or will properties including: neutralising value, effective neutralising capacity, solubility, pH, chemical components, moisture content, impurities and particle size; require the quantity of agent addition to be varied by a consistent factor.

5.3.3 Treatment Area Design

As noted above, the treatment area should be situated in an appropriate location(s) with respect to site disturbance activities. In addition, consideration should also be given to the ease with which environmental controls can be implemented and potential requirement for off-site disposal of the material once stabilised and validated.

As the proposed works are expected to be small scale disturbance activities, it is anticipated that a large lined skip bin or suitable structure could be used as a 'treatment cell' to minimise the potential for release of acidic leachate or partially treated soil. This will enable the effective containment of excavated material prior to, during and following treatment of the material.

As a stormwater management contingency measure in addition to the general works stormwater/sediment erosion plans for the works, a temporary bund may be constructed surrounding the storage bin location for the duration of the on-site storage/treatment of ASS material. The bund surrounding each treatment pad may be constructed of concrete, compacted non-ASS clay, sand and lime filled sandbags or other suitable materials that are relatively impervious and can be coated with a guard layer of lime to neutralise acidic leachate that may contact the bund.

Alternatively, placement of the material adjacent the excavation area on a limed pad with appropriate bunding as described below would also be appropriate.

Should quantities of material disturbed during excavation works exceed that able to be managed adjacent to the excavation or in a large skip bin, a treatment area should be established with consideration of the following:

- The treatment area should be established separate to the area of disturbance but able to be accessed from the area of disturbance by plant/vehicles transporting the material to be treated and material to be removed from the treatment area at the completion of stabilisation activities. Adjacent to the excavation would be appropriate as long as enough space to contain any water leaching from the material was maintained;
- The treatment areas should be established on a solid ground surface with a thin layer of lime spread across the area prior to placement of the ASS/PASS materials. The area must include water/ sediment collection and treatment measures, and a nearby lime storage area;

- The treatment pad should be of a size that would allow treatment of material by a single machine over a reasonable timeframe to minimise the oxidation of material during spreading and treatment;
- The bund surrounding each treatment pad may be constructed as outlined above;
- Once well mixed with a suitable quantity of neutralisation agent field validation testing will be completed and the material will remain until validation of the material by an Environmental Consultant is given. The material will then be cleared for beneficial reuse within the site, or alternatively for off-site disposal to landfill;
- Surface water flows will be diverted around the treatment area where possible. Water falling within the various portions of the treatment area will be contained and neutralised with lime if required prior to either evaporation or use as dust suppression across the site. Water discharges from the site must not have a significant impact on pH, buffering capacity, colour or ionic composition of the receiving water body (stormwater, groundwater, sewer, etc);
- A sufficient supply of aglime should be kept on site at all times for the treatment of ASS/PASS to be neutralised within the treatment area; and for wet weather events where existing applications will require replacement and/or treatment of acidic water is necessary. Receipts, dockets and other field records showing the storage locations of all chemicals and location of all applications of neutralising agents must be kept; and
- The supply shall be stored in a covered and bunded area to prevent accidental exposure to water and deterioration of the inherent neutralizing capacity. ASS/PASS treatment materials should be stored in a manner that minimise the exposure of the materials to wet or humid conditions. Such conditions may result in the clumping or surface crusting of particulate lime which can reduce the level of effectiveness in neutralising water or soil.

5.3.4 General Site Management

All natural soils within the deep excavation zones must be treated as ASS/PASS material until such a time as the material is demonstrated to be non-PASS material or treatment effectively reduces the risk associated with the material and validation results meet the relevant specifications.

ASS/PASS materials that have been disturbed or excavated should be placed separately to non ASS/PASS fill materials and immediately treated as soon as practicable to minimise the quantity of soil, sediment and/or groundwater requiring treatment and the risk of environmental harm to the site and/or down-gradient receptors. It is expected that ASS/PASS material will be placed directly into bins, whilst the non-PASS fill material may be stockpiled on the ground surface, beyond the excavation / piling area bund.

Bunding, diversion drains, contaminated water treatment/containment etc may be used to contain surface water run-off from ASS/PASS disturbance zones and subsequent storage and treatment areas. However, ASS/PASS materials must not be used in the construction of bunds and other diversion devices.

Equipment used in the treatment of ASS/PASS shall be washed with an alkaline solution at the completion of each work period to minimize corrosion of equipment.

5.3.5 Treatment of Excavated ASS/PASS Material

Treatment of ASS/PASS soils will comprise the addition of sufficient quantities of finely ground neutralising agent to treat all oxidisable S% and actual acidity and provide a factor of safety to compensate for potential impurities in the neutralising agent, non-homogenous mixing and limitations to the solubility of the neutralising agent.

The excavated ASS/PASS material should be treated as soon as practicable and within one day of excavation.

If stockpiled, the material should be formed into a conical stockpile to minimise the exposure of the material to air. In the event of significant wet weather periods, the stockpiles should be covered with builder's plastic or similar to limit the infiltration of rainfall into the stockpiles.

Although not anticipated, if site conditions require the stockpiling of material for longer than 24 hours, the stockpiles should be treated with a guard layer of aglime of 5 kg lime/ m^2 per vertical metre of soil in the stockpile. The stockpile should then be covered with an impervious surface (i.e. builder's plastic) that covers the top and sides of the stockpile to minimise drying by wind and sun and to prevent rainfall entering the stockpile.

Irrespective of whether the material is placed within a skip bin or a treatment pad it used, mixing of the lime and soil mixture may be undertaken by harrowing, rotary hoeing, using an excavator shaker bucket to blend the material, the use of a pug mill or similar equipment. Care shall be taken to ensure that mixing occurs throughout the depth of the layer/throughout the binned material. The soil must be managed to achieve a consistency that will allow for thorough mixing of the soil and neutralising agent to ensure that the effective neutralisation occurs.

This may require mechanical turning of material and breaking up of soil to provide for adequate mixing of soil particles and lime. In some instances, drying of the disturbed material (with associated management of any acidic leachate and other resulting contaminants) may be required for the material to be workable. Drying should not be undertaken during foreseeable wet weather events due to the increased risk of runoff flushing acid from the material and into uncontrolled areas. It is noted that given the material does not comprise marine clay soils and dewatering will be required during excavation, additional drying of the material is not expected to be necessary during the works.

On completion of mixing the soil and lime, field testing can be undertaken immediately and if neutralisation has occurred and been confirmed, soil can be approved for re-use within the site if proposed within a deep excavation placed for this purpose.

Otherwise if soils are proposed to be removed off-site as waste or used at the ground surface, confirmation laboratory results will be required prior to approval.

5.3.6 Water Management During Treatment

Surface drainage and groundwater that comes into contact with ASS/PASS materials has the potential to become acidic and contaminated with heavy metals leached from the acidified soil. Sources of water may include ground surface drainage associated with rainfall, dewatering product produced during the excavation works, leachate produced during treatment of excavated soils, and groundwater inflow into open excavations.

Water from within the treatment area will be required to be collected, assessed and if necessary treated prior to discharge from the site. Once pH and contaminant concentrations are considered suitable for discharge from the site, the water may be used for dust suppression at the site and/or released to the site stormwater system.

Water will be neutralised, where required, by the addition of lime within either the bunded area, a dedicated treatment tank or lined detention basin. Lime shall be added incrementally and thoroughly mixed. Approximate lime application rates based on initial pH are provided in **Table 5.1** below.

Table 5.1 Treatment of Acidic Dewater

Water pH	Agricultural Lime / 1000L Water
0.5	11.7kg
1.0	3.7kg
1.5	1.2kg
2.0	0.37kg
2.5	0.12kg
3.0	37g
3.5	12g
4.0	4g
4.5	1.2g
5.0	0.37g
5.5	0.12g

Lime addition and mixing shall continue until the pH of the water is within the range of 6.5 – 8.5.

In the event water volumes greater than the capacity of the water treatment holding capacity are produced during the acid sulfate soil management activities, consideration should be given to off-site disposal of water via a licensed contractor or treatment of water using neutralisation chemical dosing within holding tanks prior to re-irrigation of open excavations once the pH of the water has been demonstrated to be suitable.

5.3.7 Validation of Treated ASS/PASS Material

Following the application and mixing of lime to the ASS/PASS, the material can be immediately sampled for field testing. The soil would be assessed to establish post neutralisation conditions and establish whether the following performance criteria have been achieved:

- Post neutralisation, the soil pH is greater than pH 5.5 (and preferably less than 9);
- The neutralising capacity of the treated soil must exceed the sum of the TAA and TPA of the soil, i.e. there is no net acidity in the soil as measured by sPOCAS / SCr < 0.03%S; and
- Excess neutralising potential should remain in the soil as all acid generation reactions may not be complete and so the soil may still have further capacity to generate acidity.

Validation testing using field tests to measure the soil/water pH shall be undertaken at a rate of ten samples per treatment batch (to a maximum quantity of 100 m^3, or a rate of 1 sample per 20 m^3). Field testing will include pH_f and post treatment peroxide pH_{fox}, with both required to meet the post neutralisation criteria noted above for all samples per treatment batch.

Confirmatory laboratory analysis (pH and sPOCAS / SCr) will be undertaken on materials to establish that the field test data generated is reliable and accurate. Additionally, laboratory confirmation data will also be required if material is to be removed offsite as waste or placed at the ground surface. If required, laboratory samples will be submitted at a rate of two samples per treatment batch (or a rate of 1 sample per 50 m^3). The samples obtained for laboratory analysis may be obtained by compositing three subsamples obtained from the treatment material to provide a broader indication of net acidity levels.

Following receipt and logging of the successful laboratory validation results, the stockpile may then be released for beneficial reuse of material at the site, or alternatively, for off-site disposal. In the event that the laboratory results indicate that the stockpile requires further treatment, the material should be returned to the treatment pad as a unique treatment batch and treated as required prior to re-sampling.

In the presence of positive field validation tests, laboratory analysis of validation samples may be employed to determine the level of net acidity and confirm that the treatment has been successful, or provide an indication of the quantity of further aglime application necessary to neutralise the soil.

If negative field tests occur but the confirmatory laboratory analysis results indicate that there is still net acidity, a further application of aglime will be mixed with material to ensure additional neutralisation capacity, prior to further confirmatory analysis.

Following receipt and logging of the successful laboratory validation results, the material may then be released for beneficial reuse of material at the site, or alternatively, for off-site disposal. In the event that the laboratory results indicate that the stockpile requires further treatment, the material should be treated as required prior to re-sampling.

5.3.8 Site Condition Monitoring

It is anticipated that monitoring of conditions will be undertaken by both the site contractors and an appropriately qualified consultant to ensure that the appropriate environmental controls are in place and the treatment strategy is minimising the environmental risk associated with the ASS materials.

The following inspection/monitoring regime will be implemented during the site works period and documented as appropriate to demonstrate compliance with this ASSMP:

- Stockpiles of material will be inspected daily by the site contractors with pH measurements of any retained leachate taken and recorded where required. In the event that leachate is significantly acidic (pH < 5.0), the stockpiled material may require further treatment; and
- Although not anticipated, all treated excavation faces to be retained for more than three days will be inspected on the third morning and lime reapplied as necessary each following morning.

Regular inspection of all excavation and treatment areas will be undertaken to identify potential indications of PASS oxidation. These inspections should note:

- Unexplained scalding, corrosion or degradation of onsite steel equipment and concrete paved surfaces;
- Formation of the mineral jarosite or other acidic salts in exposed or excavated soils;
- Areas of surface water blue-green, blue-white in colour or extremely clarified indicating high concentrations of aluminium; and
- Rust coloured deposits on excavation faces, in drainage paths, on bunds, channels, etc indicating iron precipitates.
- Such inspections should also identify the presence of unusual odours, including strong organic or sulfurous smells (i.e. rotten egg gas).

5.3.9 Removal of Neutralised ASS/PASS from the Site

Only material confirmed to be below the criteria listed in **Table 3.1** will be considered as stabilised ASS material for potential reuse within or removal from site. A final round of field pH testing should be undertaken prior to loading of the trucks to ensure that pH levels remain above 6. Material to be removed from the site will be classified in accordance with current EPA (2014) requirements and disposed of to a licensed facility permitted to accept the material.

6. Responsibilities

The selection of samples for environmental analysis shall be undertaken by a suitably qualified and experienced environmental or geotechnical consultant. Results of analysis shall be assessed and evaluated by a suitably qualified and experienced consultant.

Implementation of the physical treatment, material management and environmental controls portions of this ASSMP will be the responsibility of the site contractor engaged to complete civil works within the site, inclusive of deep excavation works. The monitoring of conditions, unless otherwise specified in the monitoring sections will be the responsibility of a suitable qualified environmental consultant who will regularly inspect the site, the treatment area and treatment activities and implement the validation assessments to document compliance with this ASSMP.

The contractor should appoint a foreman or other responsible employee to undertake the appropriate monitoring activities as designated in this ASSMP. This person should be appropriately trained by the environmental consultant in all actions to be completed by the contractor. Where doubt arises concerning the results of the inspections or of field test validity, the environmental consultant should be contacted for verification of appropriate actions.

The contractor is not authorised to make any changes to this ASSMP or implement unapproved variations to the treatment and/or monitoring protocols outlined in this document unless explicit written approval is obtained from the environmental consultant prior to implementation of the changes.

Where ambiguity or conflicts in procedures arise, it is the contractor's responsibility to seek clarification on appropriate actions from the environmental consultant.

ASS/PASS mitigation measures should be documented as they apply to all individual works activities to be undertaken at the site. All persons responsible for the works activities should be made aware of their responsibilities in writing and suitable ASS management training should be provided to those persons to ensure that the responsibilities can be achieved.

Where contingency actions are necessary, or in the event that non-compliance with the ASSMP is identified by the contractor, the environmental consultant should be immediately informed in writing. The environmental consultant will then be obliged to provide a timely response documenting the necessary corrective actions.

7. Contingencies

In the event of unexpected events, including the identification of additional ASS/PASS zones at the site, or the failure of management measures as described in this ASSMP, the associated environmental risk will be managed by the evaluation and implementation of the contingency procedures and mitigation strategies.

7.1.1 Additional Acid Sulfate Soil Identification

In the event that site excavation works encounter the potential for additional acid sulfate soil areas at the site, identified by visual cues, field testing or laboratory analysis, the additional areas will be treated as per the ASS/PASS material treatment protocols. If the material is to be excavated as part of the development works, the excavation will be undertaken in stages with suitable volumes to allow for the completion of the neutralisation treatment process prior to excavation of the next stage.

If the proposed works do not require excavation of the identified material, exposed surfaces will be treated with a guard layer of lime upon exposure. Groundwater seepage will be monitored and neutralising agents added as necessary to manage the potentially acidic leachate produced.

7.1.2 Failure of Initial Acid Neutralisation Treatment

As described in **Section 5.3.7** following the treatment of materials within the treatment area, validation sampling will be completed to assess the success of the neutralisation process prior to removal of the material from the holding area. In the event that the validation testing indicates that neutralisation of the material is incomplete (i.e. pH<6), a further application of lime and repeat of the treatment procedure will be undertaken prior to further validation assessment. If the proposed techniques fail, further consideration may be given to alternative management strategies as outlined in **Section 5.2**.

8. Conclusions

Site characterisation assessment data available for subsurface conditions across the site has identified the occurrence of potential ASS/PASS material at depth, primarily situated within natural alluvial soils, present beneath the water table. It has been adopted in the application of this ASSMP that ASS/PASS is potentially present below a depth of 2m on the site, and requires considerations for all potential excavations below 2.0 m. Given the depth of potential occurrence, there is currently limited available data as to the lateral extent of occurrence.

Where existing and future assessment data identifies the presence of ASS/PASS materials within or areas these materials may be disturbed, the measures as identified in this Acid Sulfate Soil Management Plan (ASSMP) provide appropriate procedures to manage the risks associated with the proposed activities. If successfully implemented, these measures will minimise the environmental risks associated with disturbance of the ASS/PASS materials.

9. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

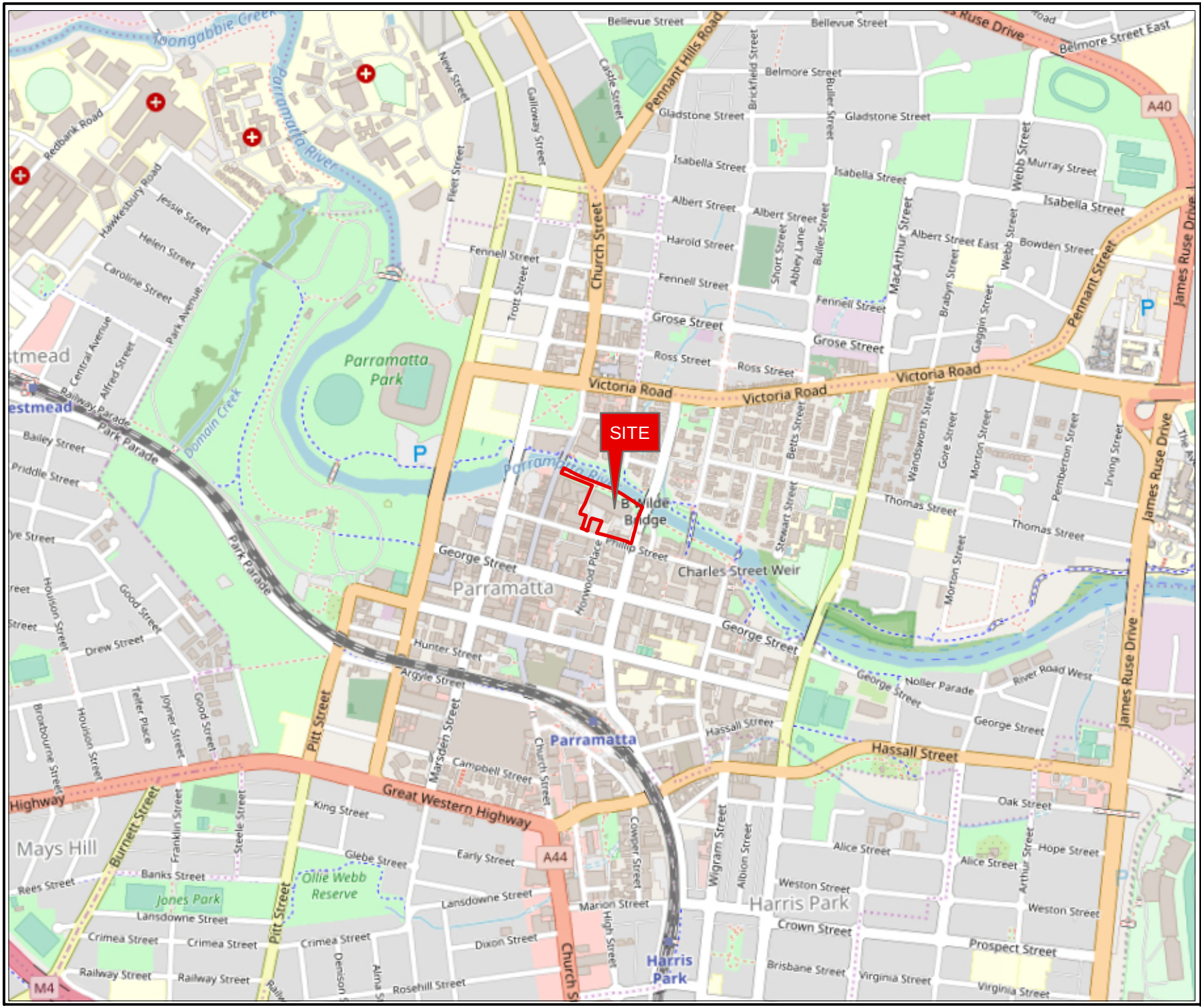
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Appendix A Figures



Legend:

Approximate Site Boundary

JBS&G

Job No: 58352	
Client: Infrastructure NSW	
Version: R03 Rev 0	Date 26/03/2020
Drawn By: AS/RF	Checked By: MP
Scale 1:15,000	

0 200 400
metres

Coord. Sys. GDA 1994 MGA Zone 56

Phillip Street, Parramatta, NSW

SITE LOCATION

FIGURE 1

File Name: N:\Projects\Infrastructure NSW\58352 - Parramatta Powerhouse\GIS\Maps\R02 Rev A\58352_01_SiteLocation.mxd

Legend:

- Approximate Site Boundary
- Cadastre (NSW DCS, 2020)

JBS&G

Job No: 58352	
Client: Infrastructure NSW	
Version: R03 Rev 0	Date 26/03/2020
Drawn By: AS/RF	Checked By: MP
Scale 1:1,250	

0 10 20
metres

Coord. Sys. GDA 1994 MGA Zone 56

**Phillip Street,
Parramatta, NSW**

CURRENT SITE LAYOUT

FIGURE 2

File Name: N:\Projects\Infrastructure NSW\58352 - Parramatta Powerhouse\GIS\Maps\R02 Rev A\58352_02_CurrrentSiteLayout.mxd
Reference: www.nearmap.com - Imagery 22-01-2020

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