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ACID SULPHATE SOILS MANAGEMENT PLAN

2 Factory Street, Granville NSW

Prepared for

MDM Pty Ltd

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ES4962-2

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EXECUTIVE SUMMARY

Aargus Pty Ltd was commissioned by MDM Pty Ltd to conduct an Acid Sulphate Soils Management Plan (ASSMP) on the property located at 2 Factory Street, Granville NSW ("the site"). The site is located within the City of Parramatta Council.

The Acid Sulphate Soil Investigation for the site was undertaken to determine the Potential for Acid Sulphate Soils (PASS) and Actual Acid Sulphate Soils (AASS) and therefore determine any management requirements for the excavation and disposal of the soil.

As part of the proposed development, the northern portion of the site is proposed to be developed into a multi-storey commuter car park under a voluntary planning agreement. The southern portion of the site is proposed to be rezoned to R4 high density residential under the Parramatta LEP 2011 as to permit residential flat buildings.

Following field tests, ten (10) soil samples were submitted to MGT LabMark Laboratories for the SPOCAS tests. The soil was assessed against the guidelines set out in Acid Sulphate Soils Management Advisory Committee (ASSMAC) (1998) *Acid Sulphate Soils Assessment Guidelines*.

The results of the laboratory analysis show there are signs of Potential Acid Sulphate Soils (PASS) in samples BH1 (2.4m), BH2 (2.5m) & BH3 (2.5m).

In general, the borehole logs indicate that PASS were detected in a layer of natural Silty Clay, medium plasticity, grey mottled, sitting on top of the shale bedrock beneath the site. The soil profile was present between 2.0m and 3.0m BGL.

Based on the proposed depth of excavation, the observed soil profile and the results of the laboratory analysis, potential acid sulphate materials exist within the site as follows:

- The Silty Clay, medium plasticity, grey mottled natural soils (sitting on top of the shale bedrock) from 2.0m to 3.0m BGL.

Therefore, these locations are considered to be PASS will require treatment prior to disposal.

All other natural soils, with the exception of those listed above, are considered to be VENM.

In regards to the on-site investigation, proposed development features and laboratory analysis the potential for the generation of acid sulphate soils is expected and therefore the site is to be considered **suitable** for development upon following the recommended management strategies that are provided for the effective management of any acid sulphate soils that may be generated on site.

On this basis, an Acid Sulphate Management Strategy has been included within this report.

1.0 INTRODUCTION

Aargus Pty Ltd was commissioned by MDM Pty Ltd to conduct an Acid Sulphate Soils Management Plan (ASSMP) on the property located at 2 Factory Street, Granville NSW ("the site"). The site is located within the City of Parramatta Council.

The need to assess for the presence or absence of Acid Sulphate Soils (ASS) has been warranted since the site has been identified through fieldwork as having Potential Acid Sulphate Soil (PASS). In such cases, it is essential to assess for the presence of PASS to ensure the appropriate disposal and management of the soil as the disturbance of PASS can result in the formation of acid products, which can damage ecological systems and certain infrastructure.

As part of the proposed development, the northern portion of the site is proposed to be developed into a multi-storey commuter car park under a voluntary planning agreement. The southern portion of the site is proposed to be rezoned to R4 high density residential under the Parramatta LEP 2011 as to permit residential flat buildings.

Fieldwork was undertaken on the 28th June 2012 and following field tests, ten (10) soil samples from three boreholes was submitted to MGT LabMark Laboratories for the SPOCAS tests. The soil was assessed against the guidelines set out in Acid Sulphate Soils Management Advisory Committee (ASSMAC) (1998) *Acid Sulphate Soils Assessment Guidelines*.

It is to be noted that those who excavate soils from the subject site should take care to note changes in the soil profile. The presence of grey to greenish blue clays is a common indicator of ASS. It is recommended excavation be halted and that a suitably qualified environmental scientist be contacted should these clays be discovered.

1.1 What Are Acid Sulphate Soils?

Acid Sulphate soil is the common name given to a range of soil types containing iron sulphides and/or their oxidation products.

As the sea level rose and inundated land, sulphate in the sea water mixed with land sediments containing iron oxides and organic matter. The resulting chemical reaction produced large quantities of iron sulphides in the waterlogged sediments. When exposed to air, these sulphides oxides to produce sulphuric acid, hence the name acid sulphate soils.

Acid sulphate soils are generally found in:

- Coastal lowlands, embayments and estuarine floodplains;
- Areas where the level of land is below 5m Australian Height Datum (AHD);
- Holocene Sediments (~10,000 years old or younger).

The sulphuric acid produced by oxidation of iron sulphides affects soil and water and can severely damage the environment. As sulphuric acid moves through the soil, it mobilises iron, aluminium, manganese and other heavy metals from mineral sources. Acidic and metal-rich waters can be highly detrimental to flora and fauna.

Aquatic life, such as fish and crustaceans are extremely sensitive to acid drainage. In some situations brought about by a combination of weather and hydrology, fish and crustaceans are not able to avoid the effluent and large kills over entire estuaries may result.

Acid waters can also corrode engineering works and infrastructure such as culverts, bridges and weirs, which are in contact with these waters. The precipitation of iron hydroxide/oxide flocs from acidic, iron-rich waters can cause the blocking of drains, wells and the reduction of aquifer recharge.

1.2 Previous Reports

Two (2) previous environmental investigations were conducted on the site as shown below:

- Environmental Resources Management Pty Ltd (2001) - "*Preliminary Environmental Site Assessment, 2 Factory Street, Granville NSW*". (Report no. 101135RP1, dated May 2001).
- Aargus Pty Ltd (2001) - "*Environmental Site Assessment, 2 Factory Street, Granville NSW*". (Report no. ES4962, dated May 2012).

Some of the information provided within these reports was utilised within this current assessment.

2.0 OBJECTIVES OF THE ACID SULPHATE MANAGEMENT PLAN (ASSMP)

The objective of this ASSMP is to consider both the existing and potential future environmental impacts relating to PASS material in and around the project site and to detail mitigation measures to minimise the potential impacts within the surrounding areas.

The control measures in this ASSMP to mitigate the environmental impacts of the proposed excavations to acceptable levels have been developed to achieve the following objectives:

- Control and, where possible, minimisation of disturbance of acid sulphate soils;
- Confirmation of the success of impact control measures by the means of validation monitoring;
- Compliance with statutory requirements, and
- Preservation of water quality on an ongoing basis.

Each environmental protection measure is based upon a proven and Industry Best Practice methodology.

The ASSMP is designed for the excavation phase of the development. It is based on tabulated checklists for management measures, maintenance, reporting, failure identification and corrective action for each identified issue.

The control measures proposed in this ASSMP are for:

- Assessment Procedures for PASS utilising a sampling protocol, set criteria to measure and agreed standards for those criteria to evaluate acid potential;
- Treatment of water accumulating within the site to an acceptable water quality for discharge (if required);
- Ongoing Monitoring Programme, if required; and
- Treatment of potential acid sulphate soils if encountered and control structures to prevent leachate discharge off-site without meeting specified target water quality criteria.

3.0 SCOPE OF WORKS

The scope of works for the assessment involved:

- Site Inspection to identify likelihood of soil types (Desktop Study);
- Targeted Soil Sampling;
- Field testing;
- Interpretation of SPOCAS Test Analysis and Findings; and
- Report generation in accordance with corresponding Assessment Guidelines and governing criteria.

4.0 DESKTOP STUDY

To determine whether there is a potential for acid sulphate soils to be present within a site, reference was made to the NSW Department of Land & Water Conservation (DLWC) *Acid Sulphate Soil Risk Maps* (Edition Two, December 1997, Scale 1:250,000), in particular "Parramatta-Prospect". A review of the aforementioned map indicated that there is "No Known Occurrence" of acid sulfate soil materials within the soil profile.

The decision to classify certain areas as Acid Sulphate Soils (ASS) is based on a number of geomorphic conditions and site criteria. The following points are used to determine if ASS are likely to exist (extracted from ASSMAC (1998) Acid Sulphate Soils Assessment Guidelines):

- Sediments of recent geological age (Holocene) ~ 10 000 y.o.
- Soil horizons less than 5m AHD (Australian Height Datum).
- Marine or estuarine sediments and tidal lakes.
- In coastal wetlands or back swamp areas; waterlogged or scalded areas; interdune swales or coastal sand dunes.
- In areas where the dominant vegetation is mangroves, reeds, rushes and other swamp tolerant and marine vegetation.
- In areas identified in geological descriptions or in maps bearing sulphide minerals, coal deposits or former marine shales/sediments.
- Deeper older estuarine sediments >10m below the ground surface, Holocene or Pleistocene age.

4.1 Site Walk Over

The initial investigation of the subject site was focused on understanding the context of the site in its surrounding environment while identifying visual and olfactory ASS cues.

4.2 Site Description

The site is located at 2 Factory Street, Granville NSW, in the City of Parramatta Council (see Appendix A – Site Location) and is approximately 11,000m^2 in area.

Surrounding land use was identified as follows:

To the North	⇒ Clyde Railway Station and rail lines
To the South	⇒ Australia Post International Mail Centre
To the East	⇒ Australia Post International Mail Centre
To the West	⇒ Factory Street, then commercial & residential properties

The surrounding land uses are commercial, residential and vacant in nature.

4.3 Proposed Development

The northern portion of the site is proposed to be developed into a multi-storey commuter car park under a voluntary planning agreement. The southern portion of the site is proposed to be rezoned to R4 high density residential under the Parramatta LEP 2011 as to permit residential flat buildings.

Reference may be made to Appendix G – Proposed Development Drawings.

4.4 Local geology, hydrogeology, surface waters

The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates the residual soils within the site to be underlain by 'Ashfield Shale'. The Ashfield shale group are generally underlain by Hawkesbury Sandstone which consists of medium to coarse grained quartz sandstone with minor shale and laminate lenses.

Fieldwork observations indicated that underlying the sealed surfaces, the subsurface lithology of the site comprises of fill materials then natural clay.

A groundwater bore search from the Department of Land and Water Conservation database revealed one registered bore within a 2km radius of the site. The bore GW024667 is located approximately 2km north of the site. The final depth of the bore is 4.57m with a standing water level of 2.4m. The bore is listed as being authorised and intended for general use.

The site is generally flat and is approximately 5m AHD. The regional topography comprises a gentle slope towards the east.

The closest water body is Duck River, located approximately 90m east of the site and flows in a north easterly direction into Parramatta River. All building roofs and concrete surfaces have storm water drainage in place. Stormwater from the local and surrounding areas are expected to flow towards Duck River in a north easterly direction. On and off site migration from surface areas are not considered to be of environmental concern.

4.5 Groundwater

The area surrounding the subject property is generally flat and near level with a gentle slope of about 2-3 degree to the east. Site stormwater runoff is expected to flow via stormwater drains located to the eastern & northern boundaries of the site.

Due to the proximity of Alexandra Canal and presence of shallow groundwater on the site, off site migration from surface areas of the site is considered to be an environmental concern. Also, based on the surrounding commercial/industrial nature of the area, on-site migration is also considered a cause for concern.

Groundwater seepage was generally encountered at the natural clay/shale material interface, ranging in depths between 2.0m and 2.5m below ground level (BGL).

5.0 SOIL BORING AND SAMPLING

A soil sampling and analysis program was used to consolidate the nature and degree of Acid Sulphate Soils present in the surface and subsurface geology. Samples were collected from three boreholes excavated within the site area of proposed development. The boreholes were excavated to a maximum depth of 7.0 m below ground level (the borehole locations are presented in Appendix A – Site plan). Samples were collected at various intervals within the profile.

Field analysis was performed on the collected samples for pH_f and pH_{fox} in accordance with the required sampling techniques of the *ASSMAC (1998) Assessment Guidelines* (see Appendix F – ASSMAC (1998) Field pH and peroxide test protocol).

5.1 Health & Safety

Standard Health and Safety procedures were observed. Latex gloves were worn to prevent contamination of samples. Breathing apparatus and PPE suits were supplied but not worn.

5.2 Quality Assurance/Quality Control (QA/QC)

Standard QA/QC procedures were followed. The decontamination of sampling equipment was achieved by washing the trowel with phosphate-free detergent and tap water, followed by final rinsing with distilled water. This was conducted after the collection of samples. Standard sampling and analysing procedures are in accordance with and set out in *NSW ASSMAC Acid Sulfate Soils Assessment Guidelines* (1998).

6.0 FIELD RESULTS

6.1 Soil observations

Based on information from all boreholes, the surface and sub-surface profile across the site is generalised as follows:

- Bitumen / Gravel and/or Concrete
- FILL; Sand Clay; medium grained to fine, dark brown to black with inclusions of rocks, gravel and blue metal;
- NATURAL, Silty Clay, orange brown, medium plasticity;
- NATURAL, Silty Clay, grey mottled, medium plasticity;
- NATURAL; Shale dark grey; and
- NATURAL; Shale light grey.

Groundwater seepage was generally encountered at the natural clay/shale material interface, ranging in depths between 2.0m and 2.5m below ground level (BGL).

6.2 Field pH results

The results of field pH tests are presented in Table 1 below.

Table 1: Summary of field analysis results

Sample	Depth (m)	pH		pH		Change in pH
		H_2O	pH_f	H_2O_2	pH_{fox}	($pH_f - pH_{fox}$)
BH1	1.5	7.3	8.58	5.2	5.4	3.18
BH1	2.5	7.3	5.84	5.2	4.32	1.52
BH1	4.0	6.8	6.62	5.2	5.13	1.49
BH1	7.0	6.8	6.9	5.0	6.41	0.49
BH2	0.5	7.3	8.1	5.0	5.2	2.9
BH2	2.5	7.3	6.3	5.0	4.42	1.88
BH2	4.0	7.3	7.11	5.0	5.82	1.29
BH2	7.0	7.3	8.2	5.0	6.85	1.35
BH3	0.5	7.3	8.0	5.0	5.1	2.9
BH3	2.5	7.3	5.78	5.0	4.57	1.21
BH3	4.0	7.3	6.9	5.0	5.71	1.19
BH3	7.0	7.3	8.2	5.0	6.95	1.25

Notes:
- pH_f refers to pH field (soil and distilled H_2O).
- pH_{fox} refers to pH field oxidised (soil and peroxide).
- Change in pH refers to pH field minus pH field oxidised.
- - refers to a more acidic change in pH
- + refers to a more alkali change in pH

To investigate the pH of the soils (pH_{fox}) distilled water was added to the soil samples. The pH_f of the investigated samples was well above 4. This indicates the soils from which the samples were collected did not contain Actual Acid Sulphate Soil (ASS). Further testing was required in order to determine the extent of acid sulphate soils.

To investigate the presence of PASS (potential acid sulphate soils), 30% peroxide (H_2O_2) was added to soil samples and the resulting pH of the mixture was measured (field test protocols are presented in Appendix D – ASSMAC (1998) Field pH and peroxide test protocol). The pH of the soil peroxide solution (pH_{fox}) did not decrease

below 3 pH units in any of the samples which would indicate if PASS was present. The values for pH_{fox} of greater than 5 indicate no net acid generating ability, and the soils are hence not considered to contain Potential Acid Sulphate Soils. The values of pH_{fox} of less than 5 show net acid generating ability, and the soils are hence considered to contain Potential Acid Sulphate Soils.

The addition of peroxide to the soil did change colour from grey to brown and did release sulphurous odours for samples at depths 2.5m, 4.0m and 7.0m BGL for all borehole locations BH1, BH2 and BH3.

Because of this result the site has been designated as possibly containing Potential Acid Sulphate Soils (PASS) at depths ranging from 2.0m to 7.0m BGL.

Following the field tests, a total of ten (10) samples were submitted for SPOCAS analysis to MGT LabMark Laboratories.

7.0 LABORATORY ANALYSIS RESULTS

Following the field tests, ten soil samples were submitted to the laboratory (MGT LabMark Laboratories) for the recommended suspension peroxide oxidation combined acidity and sulphate (SPOCAS) testing suite. A summary of the results are shown below in Table 2.

Table 2: Laboratory SPOCAS analysis results

Sample	Soil Texture	S-POS (%) (sulphur trail)	TAA (mol H^+/ tonne)	TPA (mol H^+/ tonne) (acid trail)	TSA (mol H^+/tonne) (acid trail)	Liming Rate
BH1 2.4m	*Medium*	0.02	34	**49**	15	**3.5**
BH1 4.0m	*Medium*	<0.02	11	14	3	1.3
BH1 7.0m	*Medium*	<0.02	<2	3.7	<2	<1
BH2 2.5m	*Medium*	0.02	34	**36**	<2	**3.5**
BH2 4.0m	*Medium*	<0.02	6	10	4	<1
BH2 7.0m	*Medium*	<0.02	<2	<2	<2	<1
BH3 2.5m	*Medium*	0.02	29	**31**	<2	**3.1**
BH3 4.0m	*Medium*	<0.02	3.7	5	<2	<1
BH3 7.0m	*Medium*	<0.02	<2	<2	<2	<1
ASSMAC Guidelines	**Coarse Texture**	**0.03**	**-**	**18**	**18**	
	Medium Texture	**0.03**	**-**	**18**	**18**	

Notes for Table 1:
- Guidelines follow the ASSMAC "Acid Sulfate Soils Assessment Guidelines 1998".
- Criteria based upon clay content of >5%
- Criteria based upon more than 1000 tonnes disturbed
- Bold values exceed ASSMAC guidelines

It is considered that soils most closely resemble a combination of the *"Medium Texture" & "Coarse Texture"* described in Table 4.4, Assessment Guidelines of the NSW Acid Sulphate Soil Management Advisory Committee (ASSMAC) *"Acid Sulphate Soil Manual"* (August 1998).

When comparing the results summarised above in Table 1 to Table 4.4 (ASSMAC) for Medium and Coarse Texture soils it can be determined that some of the samples exceeded the action criteria for percentage of peroxide oxidisable sulphur (SPOS) or acidity trail (TPA or TSA) (whichever was greater) indicating that these soils have acid sulphate generating potential.

Sulphur trail (*S-POS*) results indicate that potential acid sulphate soils (i.e. soil with unoxidised pyrite) are present in the underlying soils but with results below the action criteria. The results for the acid trail (TAA, TPA and TSA) were reported above the action criteria of 18 moles H^+/t, indicating that the soil has limited "in situ acid buffering (neutralising)capacity" (e.g. the soil may contain limited alkaline components/inclusions such as shell fragments).

In general, the borehole logs indicate that PASS were detected in a layer of natural Silty Clay, medium plasticity, grey mottled, sitting on top of the shale bedrock beneath the site. The soil profile was present between 2.0m and 3.0m BGL.

Based on the proposed depth of excavation, the observed soil profile and the results of the laboratory analysis, potential acid sulphate materials exist within the site as follows:

- The Silty Clay, medium plasticity, grey mottled natural soils (sitting on top of the shale bedrock) from 2.0m to 3.0m BGL.

Therefore, these locations are considered to be PASS will require treatment prior to disposal.

All other natural soils, with the exception of those listed above, are considered to be VENM.

Based on the proposed depth of excavation, the observed soil profile and the results of the laboratory analysis, potential acid sulphate materials exist within the site, therefore, will require treatment prior to disposal.

8.0 CONCLUSIONS AND RECOMMENDATIONS

During the ASS/PASS investigation the analytical results of the SPOCAS method indicated that the Medium Texture soils samples did not exceed the action criteria for percentage of peroxide oxidisable sulphur (SPOS) but exceeded acidity trail (TPA or TSA) (whichever was greater) showing that these soils have acid sulphate generating potential.

The results of the laboratory analysis show there are signs of Potential/Actual Acid Sulphate Soils (PASS) in samples BH1 (2.4m), BH2 (2.5m) & BH3 (2.5m).

In regards to the on-site investigation, proposed development features and laboratory analysis the potential for the generation of acid sulphate soils is expected and therefore the site is to be considered **suitable** for development upon following the recommended management strategies that are provided for the effective management of any acid sulphate soils that may be generated on site.

On this basis, an Acid Sulphate Management Strategy is included within this report.

9.0 PROPOSED ACID SULPHATE MANAGEMENT STRATEGY

As acidity is transported by water, excavations should be conducted during dry periods as far as possible as this will minimise the risk associated with sudden or heavy rain, allows better control of treated waters for discharge, and provides some safety margin for unattended weekend or holiday periods. The following provides the proposed acid sulphate management methodology.

9.1 Areas of PASS

As field observations, acid sulphate risk map and testing has indicated that material at depths at 2.5m BGL is likely to contain potential acid sulfate soils.

Management and disposal of PASS soils is to be undertaken in accordance with section 9.6 within this report. However should soils be found not to be acceptable within this soil profile then the following management strategies will need to be undertaken.

Neutralisation of PASS is considered likely to comprise mixing of excavated material with lime, with quantities to be calculated on the basis of SPOCAS testing, and guidelines provided in ASSMAC Management Guidelines (1998), as described in Table 4.5 & 4.6 of the ASMACC Guidelines.

Application of these procedures indicates that a dosing rate of lime per tonne of soil, based on a worst case scenario from the S-POCAS testing, is 3.5kg / tonne. Therefore, for every tonne of actual ASS to be treated, 3.5kg of lime is required. The lime used should have a neutralising value of at least 95% (aglime is recommended for this purpose).

9.2 Acid Sulphate Soil Treatment

On-site Treatment – In general, if on-site treatment neutralisation of the AASS/PASS material were to be adopted and that material is to remain stockpiled for over one week, material containing AASS/PASS should ideally be stockpiled separately on a liming pad/stockpiling site and mixed with lime at the above dosage rate. Appropriate monitoring and leachate control is to be adopted.

Once AASS/PASS material has been placed in the treatment areas, it should be dosed with aglime in accordance with the calculated dosing rate, that being 5.3kg / tonne. This will be followed by thorough mixing of the soil/aglime mixture with site machinery to treat the soil. Additional quantities of aglime above the calculated dosing rate may be required to allow for difficulties in mixing. The effectiveness of the adopted dosing rate should be confirmed by the regular screening of the treated material using pH and peroxide pH field tests.

It should be noted that as a precautionary measure, treatment works involving aglime should not be conducted during windy conditions, unless the material can be appropriately conditioned to prevent dust generation.

Off-site Treatment - No off-site treatment is envisaged.

9.3 Treatment Pad Design Features

For treatment of large volumes of material, neutralisation should be carried out on a treatment or liming pad. The following issues should be considered in the treatment pad design.

A guard layer of neutralising agent should be spread onto the soil surface of the treatment pad area prior to the placement of soils. Alternatively a layer of high density plastic sheeting may be used. These methods will reduce risk by neutralising acidic leachate generated in the treatment pile and not neutralised during the treatment process. This is especially relevant to the first layer of PASS that is placed for treatment prior to application of the neutralising agent. The guard layer will also assist in protecting groundwater quality.

To further reduce risk, a layer of compacted non-ASS clayey material (0.3–0.5 m thick) might be placed on the surface of the treatment pad and below the guard layer to restrict infiltration from the material being treated. In fully contained situations a physical barrier may be used as an alternative to a guard layer of neutralising agent as a means of protecting groundwater quality and preventing infiltration of acidic water; e.g. a bunded concrete slab, paved area or layer of bitumen may be placed under a temporary treatment pad.

Treatment areas should be located to the west of the site near the driveway, as far away from the watercourse as possible (See Appendix A- Treatment areas). Appropriate sediment controls should be used in order to prevent the escape of any potential acid sulfate soils from the treatment area.

9.4 Leachate Control

Any leachate generated during the treatment operations must be directed to collection ponds and properly treated. In addition, a truck wash down area comprising a hardstand of base coarse with drainage should be constructed adjacent to a leachate

pond so that truck wash down water can be collected for treatment. It is recommended that leachate collection ponds be constructed to accommodate the leachate/water that would be generated by rainfall over a three day period. This is to account for rainfall/surface water runoff which may occur during a standard non-work period (i.e. weekend).

Should leachates be intended for reuse on-site, water quality should be regularly monitored and assessed against discharge criteria (ASSMAC).

PASS/AASS materials should be monitored for pH during dewatering. Materials should be lightly conditioned/moistened to prevent oxidation if lowered pH is observed and treated with a calcium hydroxide solution (e.g. quicklime; refer to Section 3.3) if required (i.e. pH <5.5). Disposal of leachate requires approval of the appropriate consent authorities (e.g. Parramatta City Council, Sydney Water). An appropriate water quality management plan should be implemented to maintain water quality to a standard appropriate for disposal into the stormwater system (with appropriate consent/approvals). Regular monitoring should be conducted to ensure water quality meets guideline criteria. If leachate does not meet the consent conditions for disposal into the stormwater system, then arrangements may need to be made for treatment or discharge into the sewerage system (including consent of the appropriate authorities).

9.5 Monitoring

Monitoring of Acid Sulfate potential and effectiveness of neutralisation may be undertaken as prescribed in Table 3 below.

Table 3: Suggested monitoring frequencies and target levels

Material	Test	Frequency	Target Level
Ponded leachate Water (both leachate and groundwater) ponded in the excavation	pH	Daily, following rain events and non work periods	- pH 6.5 - 8.5, but not less than 5.5
Discharged leachate (irrigation into subsoil)	pH*	Daily checks of pH during discharge period.	- pH 6.5 - 8.5
	TSS	- Daily visual checks, (with measurements taken if turbidity is observed) - weekly monitoring	- TSS <50 NTU
Soils to be disposed of	Field pH Peroxide pH	During and after treatment (prior to disposal).	- pH 6.0 - 12.0 - No change in colour - No effervescence - No release of sulphurous odour - No depression in pH below field H

DO and TSS also required if discharged to stormwater. The DO and TSS should be confirmed by weekly sampling and analysis during the discharge period

It is considered that, given the treatment method to be adopted, field pH and peroxide pH testing should be conducted on treated materials prior to disposal. If material fails the pH and peroxide pH testing, further dosing with aglime should be conducted prior to disposal of the material until it meets the pH testing criteria.

9.6 PASS Disposal

The NSW DECC *Waste Classification Guidelines:* Part 4: *Acid Sulfate Soils (2009)* provides two options for disposal of PASS soils to landfill, those being above or below the water table.

PASS must be kept wet at all times during excavation and subsequent handling, transport and storage until they can be disposed of safely. They must be received at the proposed disposal point within 16 hours of being dug up.

9.6.1 Disposal *below* the Water Table

PASS must 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 may contain sulfidic ores or soils.

Landfills must be licensed by EPA to dispose of potential ASS below the water table.

Documentation must be kept by the occupier of the landfill for each truckload of potential ASS received, indicating that the soil's excavation, transport and handling have been in accordance with the *Acid Sulphate Soil Manual*, thus preventing the generation of acid.

9.6.2 Disposal *above* the Water Table

Where PASS cannot be classified as VENM or a suitable underwater disposal site at a landfill is not available, the soil must be treated in accordance with the neutralising techniques in the *Acid Sulfate Soil Manual*. After treatment the soil should be chemically assessed in accordance with Step 5 in Part 1 of the W*aste Classification Guidelines*. Reference should be made to Section – 9.7.

The treatment process to be implemented for the PASS material within the site is per Section 9.6.1 – *Disposal below the water table*.

9.7 Actual Acid Sulphate Soils (AASS) Disposal

AASS must be treated by the generator of the waste before they can be considered for disposal. Treatment should be in accordance with the neutralising techniques in the *Acid Sulfate Soil Manual*.

The following is a summary of the procedures to be followed for the excavation, treatment, classification and disposal of AASS materials.

- All AASS material will be excavated and re-located to the relevant treatment pad area (refer to Treatment Pad plan), and then treated with the correct lime dosage.
- The correct lime dosage rate, based on a worst case scenario from the S-POCAS testing, is 5.3kg / tonne. Therefore, for every tonne of actual ASS to be treated, 27kg of lime is required.
- Field pH tests will then be carried out to determine if the treatment process has been successful.
- If treatment was unsuccessful, then further treatment would be required.
- If treatment was successful, the generator of the waste must chemically assess the soil in accordance with Step 5 in Part 1 of the W*aste Classification Guidelines*.
- The soils will be then be classified and disposed of to the relevant landfill licensed to accept such materials.

Landfills must be licensed by EPA to accept this waste and must be informed that the AASS has been treated in accordance with the neutralising techniques in the *Acid Sulphate Soil Manual* and that the waste has also been classified in accordance with Part 1 of the W*aste Classification Guidelines*.

9.8 Validation of Acid Sulphate Soil Management Procedures

In order to understand if the management plan has been successfully implemented the following validation measures should be undertaken:

- All testing is to be undertaken in compliance with the relevant guidelines.
- Due to the scale of the development and the potential for Acid Sulphate Soils it is recommended that on site supervision of excavation be undertaken.
- Field testing and/or SPOCAS Testing will be undertaken in order to provide confidence that all acid sulphate material will be treated and removed successfully. In the event of a failure further treatment will be undertaken and then further field testing will be undertaken.
- Should any of the monitoring not conform with criteria outlined in section 9.5 then corrective action will be undertaken and further testing will be undertaken.
- All non-conformances will be documented and provided to the contractor to rectify prior to further excavation being undertaken.

10.0 RESPONSIBILITIES OF THE SUB-CONTRACTOR

The sub-contractor should be responsible for the correct implementation of the ASS management protocols presented in this Acid Sulphate Soils Management Plan (ASSMP). The sub-contractor is not empowered to vary any specific management protocols or procedures, unless explicit written approval has been given by the project manager.

Where ambiguity or conflict exists as to the procedure to be followed, it is the sub-contractor's responsibility to seek clarification from the project manager, in writing if necessary.

As AASS has been identified, the main contractor should appoint a representative to undertake appropriate monitoring, who should be appropriately trained by an environmental consultant. As a minimum, daily monitoring requirements may be undertaken by the main contractor, or his nominated representative, with weekly verification checks by the environmental consultant. Daily logs of such monitoring should be kept by the sub-contractor, and signed copies should be forwarded to the project manager weekly, or as requested.

It is the sub-contractor's responsibility to inform the project manager immediately on discovery of non-compliances of the ASSMP or exceedances of monitoring trigger levels, and with the latter's approval, implement immediate remedial measures. A report of such incidents should be prepared for retention by the Project Manager.

It is anticipated that the independent environmental consultant will inspect and monitor the site(s) on both a regular and random basis, and carry out such sampling and/or in-situ measurements as are necessary to check compliance with the ASSMP. The sub-contractor must offer appropriate assistance/co-operation to the consultant.

The requirements of ASS management are in addition to, but do not override any other standard procedures such as safety considerations. Where conflict results, or may result from the implementation of ASSMP as against other performance criteria, it is the sub-contractor's responsibility to obtain specific directives from the project manager.

In Summary

The results of the laboratory analysis show there are signs of Potential/Actual Acid Sulphate Soils (PASS) in samples BH1 (2.4m), BH2 (2.5m) & BH3 (2.5m).

In regards to the on-site investigation, proposed development features and laboratory analysis the potential for the generation of acid sulphate soils is expected and therefore the site is to be considered **suitable** for development upon following the

recommended management strategies that are provided for the effective management of any acid sulphate soils that may be generated on site.

On this basis, an Acid Sulphate Management Strategy has been included within this report.

Please do not hesitate to contact us on the contact details provided if you have any questions.

For and on behalf of

Aargus Pty Ltd

Con Kariotoglou

WHS Consultant and Project Manager

Reviewed By:

Mark Kelly

Environmental Manager

Although the information provided by a Preliminary Assessment can reduce exposure to risks, no assessment, however diligently carried out, can eliminate them. It must be noted that these findings are professional findings and have limitations. Even a rigorous professional assessment may fail to detect all ASS and/or PASS on a site. Sulphates may be present in areas that were not surveyed or sampled.

APPENDIX A

LOCALITY MAP & SITE PLAN

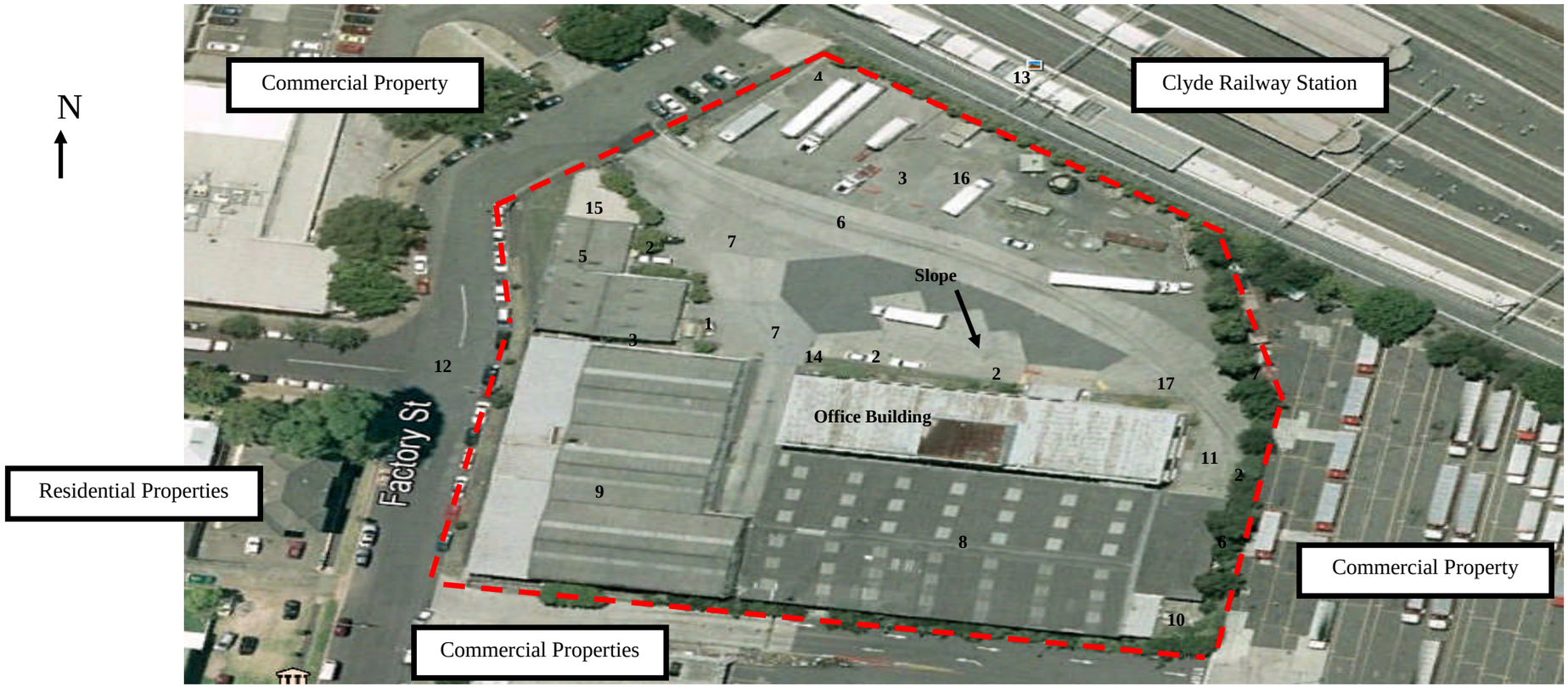
LOCALITY MAP

Reference: Google (2012)

ABN 46 063 579 313 Aargus Pty Limited Environment – Chemicals – Business Development

Drawn	CK	**Acid Sulphate Soils Management Plan MDM Pty Ltd 2 Factory Street, Granville NSW**	Aargus AUSTRALIA	Figure 1
Approved	MK			
Date	04/06/12			
Scale	N/A			Job No: ES4962/2

SITE PLAN



NUMBER	SITE FEATURES	NUMBER	SITE FEATURES
1	Transformer	11	Former UST's area
2	Car Parking	12	Factory Street
3	Asphalt	13	Clyde Railway Station
4	Product Storage	14	Skip Bin
5	Former gate house	15	Retail Shop - Kitchens
6	Railway Lines	16	Parked Truck
7	Concrete surfaces	17	Scrap metal
8	Warehouse 1 - Used for metal fencing storage		
9	Warehouse 2 - Grocery Goods		
10	Bunded area (former above ground storage tank)		

Source: Google 2012

Drawn	CK
Approved	MK
Date	04.06.2012
Approx Scale	N/A

Acid Sulphate Soils Management Plan
MDM Pty Ltd
2 Factory Street, Granville NSW

Aargus AUSTRALIA

Fig 2

ES4962/2

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL REPORT

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by Aargus (Australia) Pty Ltd and its associated companies using guidelines prepared by ASFE (The Association) of Engineering Firms Practising in the Geo-sciences. They are offered to help you in the interpretation of your Environmental Site Assessment (ESA) reports.

REASONS FOR CONDUCTING AN ESA

ESA's are typically, though not exclusively, carried out in the following circumstances:

- as pre-acquisition assessments, on behalf of either purchaser or vender, when a property is to be sold;
- as pre-development assessments, when a property or area of land is to be redeveloped or have its use changed for example, from a factory to a residential subdivision;
- as pre-development assessments of greenfield sites, to establish "baseline" conditions and assess environmental, geological and hydrological constraints to the development of, for example, a landfill; and
- as audits of the environmental effects of an ongoing operation.

Each of these circumstances requires a specific approach to the assessment of soil and groundwater contamination. In all cases however, the objective is to identify and if possible quantify the risks that unrecognised **c**ontamination poses to the proposed activity. Such risks may be both financial, for example, cleanup costs or limitations on site use, and physical, for example, health risks to site users or the public.

THE LIMITATIONS OF AN ESA

Although the information provided by an ESA could reduce exposure to such risks, no ESA, however, diligently carried out can eliminate them. Even a rigorous professional assessment may fail to detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled.

AN ESA REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental report should not be used:

- when the nature of the proposed development is changed, for example, if a residential development is proposed instead of a commercial one;
- when the size or configuration of the proposed development is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership
- or for application to an adjacent site.

To help avoid costly problems, refer to your consultant to determine how any factors, which have changed subsequent to the date of the report, may affect its recommendations.

ESA "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to help minimise its impact. For this reason owners should retain the services of their consultants

through the development stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Natural processes and the activity of man change subsurface conditions. As an ESA report is based on conditions, which existed at the time of subsurface exploration, decisions should not be based on an ESA report whose adequacy may have been affected by time. Speak with the consultant to learn if additional tests are advisable.

ESA SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Every study and ESA report is prepared in response to a specific brief to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Other persons should not use a report for any purpose, or by the client for a different purpose. No individual other than the client should apply a report even apparently for its intended purpose without first conferring with the consultant. No person should apply a report for any purpose other than that originally contemplated without first conferring with the consultant.

AN ESA REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when design professionals develop their plans based on misinterpretations of an ESA. To help avoid these problems, the environmental consultant should be retained to work with appropriate design professionals to explain relevant findings and to review the adequacy of their plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final borehole or test pit logs are developed by environmental scientists, engineers or geologists based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final logs customarily included in our reports. These logs should not under any circumstances be redrawn for inclusion in site remediation or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimise the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To reduce the likelihood of boring log misinterpretation, the complete report must be available to persons or organisations involved in the project, such as contractors, for their use. Those who o not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing all the available information to persons and organisations such as contractors helps prevent costly construction problems and the adversarial attitudes that may aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because an ESA is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in transmittals. These are not exculpatory clauses designed to foist liabilities onto some other party. Rather, they are definitive clauses that identify where your consultant's responsibilities begin and end. Their use helps all parties involved recognise their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your ESA report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

APPENDIX C

CLIENT TEAM

C O N K A R I O T O G L O U

DATE OF BIRTH	10th December 1962
EDUCATIONAL	Bachelor of Science Sydney University, Sydney Australia
	Diploma of Occupational Health & Safety TAFE (ongoing)
	Advanced Certificate, Graphic Design Billy Blue School of Graphic Arts
ADDITIONAL COURSES	Certificate, Building Business Management Certificate, Desktop Publishing
MEMBERSHIPS	Australian Institute of Occupational Hygienists Environment Institute of Australia and New Zealand
FIELDS OF SPECIAL COMPETENCY	Occupational Health & Safety and Health Monitoring Asbestos and Hazardous Materials Assessments, Asbestos Risk Assessments and Management Plans, Soil Classifications, Preliminary Site Assessments, Detailed Site Assessments, Remedial Action Plans, Remediation and Validations.

EXPERIENCE:

2011-present	**WHS Consultant & Project Manager**, *Aargus Pty Ltd*
2007-2011	**Project Manager**, *Aargus Pty Ltd*
2002-2007	**Creative Director**, *Howling Media*
1990-2002	**OH&S Officer & Project Manager**, *EnviroSciences*
1988-1990	**Technical Officer**, *Sydney Diagnostic Services*
1986-1988	**Technical Officer**, *Douglas Laboratories*

PROJECT EXPERTISE

Air Quality Monitoring – Levels of volatile gases were monitored to determine Occupational Health and Safety (OH&S) compliance within an enclosed work environment.

Acid Sulphate Soil Assessment – Development areas within potential Acid Sulphate Soil regions were assessed to determine the presence, absence or extent of Acid Sulphate Soils. Duties included site surveys, soil sampling, chemical testing of soils, preparation of borehole logs, liaising with clients and regulatory authorities and report generation.

Asbestos Monitoring – Dust emissions from the demolition of a building and excavation of soil with known asbestos contamination were monitored in order to measure effects on the neighbouring properties. Duties included the use of technical equipment, liaising with site personnel, analysis of data and report generation.

Asbestos Removal – Work involved monitoring the removal and delineating the extent of contamination of bonded asbestos waste from an excavation site.

Classification of Excavation Material, NSW – Involvement in classifying excavated material from development sites for removal to an appropriate landfill or assessing suitability for use within a proposed development. Duties included liaising with site personnel / contractors, soil sampling and descriptions, QA/QC and report generation.

Dust Monitoring – Dust emissions from construction sites were collected over a period of time in order to assess the specific amount of particulate matter escaping the construction area onto neighbouring properties.

Environmental Management Plans – Preparation of how the earthworks program are to be undertaken during the development works, the environmental procedures to be followed during operation and includes an Occupation Health & Safety (OH&S) plan.

Ground Water Well Monitoring – Work involved instructing contractors on where to drill monitoring wells, construction and interpretation of survey data of the wells, measurements of groundwater levels, measurement of the rate of groundwater infiltration, sampling of groundwater, QA/QC, determining groundwater flow direction and report generation

Hazardous Materials Assessment – Structures proposed for demolition were surveyed for hazardous material such as asbestos, lead and other substances known to be harmful to human health and the environment. Duties included liaising with contractors and regulatory authorities, identification of hazardous materials, sampling of potential hazardous materials and report generation.

Lead Assessment – Buildings were surveyed for lead paint, dust and soils and assessed to determine if they were harmful to human health and the environment. Duties included liaising with government, regulatory authorities, identification of lead based materials, sampling of these materials and report generation.

Phase 1 Environmental Site Assessments (desktop) – Duties included historical searches, analysing aerial photographs, liaising with authorities (WorkCover, Council's, EPA etc), identification of potential contaminants and report generation.

Phase 2 Environmental Site Assessments – Duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

Remedial Action Plans – Options for the remediation of known contaminated sites were prepared in order to determine the most efficient methods of remediation. Duties included reviewing of previous environmental assessments, data analysis, design and costing of potential remedial options.

Site Based Management Plans – includes detailed management practices, and procedures for all identified environmental issues for every environmentally relevant activity (ERA) within the site. The plans provide the environmental procedures to be followed during operation and are to safeguard the way in which waste is managed.

Soil Vapour Survey – Soil vapours originating from beneath an apartment block development containing known contamination were monitored to assess the affects on human health. Duties included operation of technical equipment, sampling of soil vapours, QA/QC, analysis of data and report generation.

Targeted Environmental Site Assessments – Duties included historical searches, analysing aerial photographs, liaising with authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

Underground Storage Tank Removal – Removal of underground storage tanks in order to satisfy regulatory requirements for the redevelopment of sites. Duties included historical searches, liaising with contractors and regulatory authorities, sampling and analysis design, soil and groundwater sampling, decontamination, QA/QC, data analysis and report generation.

M A R K K E L L Y

DATE OF BIRTH	25th October 1975
EDUCATIONAL QUALIFICATIONS	BAppSc (Geology) (Hons) University of New South Wales, Sydney, Australia Majoring in Soil and Groundwater Resources and Remediation
ADDITIONAL COURSES	Groundwater Hydrology Hydrogeochemistry Analysis and Interpretation of Hydrogeochemical Data Physical Aspects of Contaminated Groundwater Interpretation of Aeromagnetics Structural Interpretation and Analysis
PROFESSIONAL MEMBERSHIP	Geological Society of Australia (GSA)
PROFESSIONAL LICENCES	Senior First Aid Certificate (2006) X-ray Fluorescence (XRF) Metal Detector Operation License (EPA License No 24430) Energy Australia Passport (Service No. 7728)
PROFESSIONAL TRAINING	Asbestos Removal Course (TAFE NSW) XRF Training Course Energy Australia inductions, electrical safety rules, environmental training, safety training, first aid training, CPR training, low voltage release and rescue training and courses, substation entry & safely working near live power cables in EA network courses
FIELDS OF SPECIAL COMPETENCY	**Contaminated Land Assessment and Site Remediation –** management, technical advice, planning, data evaluation, coordinating and supervision of environmental/contaminated site assessments including preliminary and detailed assessments, contaminated site remediation and validation with particular reference to soil, water and groundwater. Acid sulphate soils, salinity and hazardous materials assessments.

EXPERIENCE:

2007 – Present	Senior Environmental Geologist – Aargus Pty Ltd
2006 - 2007	Senior Environmental Geologist – Geotechnique Pty Ltd
1999 – 2006	Environmental Geologist – Geotechnique Pty Ltd

PRACTICAL EXPERIENCE (Office)

- Project management, scheduling laboratory chemical analysis, data evaluation and reporting on environmental/contaminated site investigations including preliminary, detailed assessments, remediation and validation
- Preparation of waste classification, including biosolids from sewage treatment plants
- Salinity Assessments
- Preparation of proposals
- Occupational Health & Safety Issues
- Environmental Management Plans
- Coordinating and corresponding with Principal/Senior Environmental Engineers, Environmental Engineers, field staff, management, clients and contractors
- Liaising and negotiating with relevant government departments, statutory authorities
- Basic Turbocad skills

PRACTICAL EXPERIENCE (Field)

- Site inspections
- Soil and water sampling
- Installation of groundwater monitoring wells
- Assessing the contamination status of land/water
- Site remediation and validation
- Site management including remediation, asbestos removal
- PID calibration and use
- Hazardous material assessment
- Salinity indicators
- Service station works including underground storage tank removal
- Gas monitoring

SITES

Investigations have been carried out on a number of sites across the Sydney Metropolitan area, the greater Sydney area, rural NSW and interstate. The types of sites assessed include:

- Rural residential properties including active and former agricultural (market gardens, orchards, nursery, poultry) lands, farming lands, vacant lands etc
- Residential Properties including residential, townhouse and units
- Commercial / Industrial including activities such as tanneries, printing, tyre storage and manufacture, paint storage and manufacture, metal works, foundries, wheat processing and storage, scrap metal yards, metal recyclers etc

- Service Station Sites including small scale operations to larger sites operated by BP, Caltex etc.
- Schools including pre-development, re-development, refurbishing, hazardous materials assessment.
- Childcare Facilities
- Energy Australia facilities including active sites and decommissioning of sites.
- Sewage Treatment Plants including the assessment of biosolids, installation works and initialization of site management plans and inspections.

PROJECT EXPERTISE

Air Quality Monitoring – Levels of volatile gases were monitored to determine Occupational Health and Safety (OH&S) compliance within an enclosed work environment.

Acid Sulphate Soil Assessment – Development areas within potential Acid Sulphate Soil regions were assessed to determine the presence, absence or extent of Acid Sulphate Soils. Duties included site surveys, soil sampling, chemical testing of soils, preparation of borehole logs, liaising with clients and regulatory authorities and report generation.

Asbestos Monitoring – Dust emissions from the demolition of a building and excavation of soil with known asbestos contamination were monitored in order to measure effects on the neighbouring properties. Duties included the use of technical equipment, liaising with site personnel, analysis of data and report generation.

Asbestos Removal – Work involved monitoring the removal and delineating the extent of contamination of bonded asbestos waste from an excavation site.

Buried Chicken Carcass Removal – Work involved monitoring the removal and delineating the extent of buried of chicken carcasses within an existing poultry farm.

Classification of Excavation Material, NSW – Involvement in classifying excavated material from development sites for removal to an appropriate landfill or assessing suitability for use within a proposed development. Duties included liaising with site personnel / contractors, soil sampling and descriptions, QA/QC and report generation.

Dilapidation Assessment –The assessment entailed a site visit and a written and photographic documentation of all structural cracks on walls, ceilings, pavements, grates and road surfaces in the vicinity of the site. The purpose is to establish the pre-existing condition of the buildings so that any claim made for defects that occur during or after construction can be validated. Duties included liaising with site personnel / contractors, site inspection and report generation.

Due Diligence Reports – Carried out in relation to property acquisition and due diligence. Duties varied from report reviews, comments, costing, desktop studies, sampling and assessment, and reporting.

Dust Monitoring – Dust emissions from construction sites were collected over a period of time in order to assess the specific amount of particulate matter escaping the construction area onto neighbouring properties.

Effluent Disposal – Work was undertaken to assess the suitability of soil material for the construction of an effluent treatment and disposal system. Duties included soil sampling, preparation of borehole logs, calculation of permeability and flow rates and report generation.

Environmental Management Plans – Preparation of how the earthworks program are to be undertaken during the development works, the environmental procedures to be followed during operation and includes an Occupation Health & Safety (OH&S) plan.

Ground Water Well Monitoring – Work involved instructing contractors on where to drill monitoring wells, construction and interpretation of survey data of the wells, measurements of groundwater levels, measurement of the rate of groundwater infiltration, sampling of groundwater, QA/QC, determining groundwater flow direction and report generation

Hazardous Materials Assessment – Structures proposed for demolition were surveyed for hazardous material such as asbestos, lead and other substances known to be harmful to human health and the environment. Duties included liaising with contractors and regulatory authorities, identification of hazardous materials, sampling of potential hazardous materials and report generation.

Lead Assessment – Buildings were surveyed for lead paint, dust and soils and assessed to determine if they were harmful to human health and the environment. Duties included liaising with government, regulatory authorities, identification of lead based materials, sampling of these materials and report generation.

Phase 1 Environmental Site Assessments (desktop) – Duties included historical searches, analysing aerial photographs, liaising with authorities (WorkCover, Council's, EPA etc), identification of potential contaminants and report generation.

Phase 2 Environmental Site Assessments – Duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

Remedial Action Plans – Options for the remediation of known contaminated sites were prepared in order to determine the most efficient methods of remediation. Duties included reviewing of previous environmental assessments, data analysis, design and costing of potential remedial options.

Remediation Validation – The collection of data to assess the efficacy of remediation works in decontaminating sites. Duties included liaising with clients, contractors and regulatory authorities, field sampling, QA/QC, data analysis and report generation.

Salinity Assessments – Duties included historical searches, analysing aerial photographs, liaising with authorities, identification of potential contaminants, sampling and analysis design, soil sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

Sampling and Testing Plans – Preparation of sampling location, sampling density and testing program for ESA's and RemVal's that are sent to the Site Auditor for approval.

Site Audit Responses – replying to comments made by NSW Site Auditors on selected jobs to meet final requirements for a full clearance of a site after remedial works have taken place.

Site Based Management Plans – includes detailed management practices, and procedures for all identified environmental issues for every environmentally relevant activity (ERA) within the site. The plans provide the environmental procedures to be followed during operation and are to safeguard the way in which waste is managed.

Soil Vapour Survey – Soil vapours originating from beneath an apartment block development containing known contamination were monitored to assess the affects on human health. Duties included operation of technical equipment, sampling of soil vapours, QA/QC, analysis of data and report generation.

Targeted Environmental Site Assessments – Duties included historical searches, analysing aerial photographs, liaising with authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

Underground Storage Tank Removal – Removal of underground storage tanks in order to satisfy regulatory requirements for the redevelopment of sites. Duties included historical searches, liaising with contractors and regulatory authorities, sampling and analysis design, soil and groundwater sampling, decontamination, QA/QC, data analysis and report generation.

MAJOR PROJECTS

- Auburn Hospital - Various soil classifications and leachate management for an EPA inert and solid licensed landfill.

- Australian Defence Industries site, St Marys – Former defence force lands. An extensive sampling program was managed and the results of soil analysis were reviewed with respect to human heath risk and potential ecological impact. Reports endorsed by accredited site auditor.

- Auburn Catholic Club - Sampling and soil classification of soils, followed by onsite management of the disposal of the soils to licensed landfills.

- Barter & Sons - Former poultry farm, scheduled for industrial / commercial development. Responsible for cost estimating, project management and co-

ordination of site investigation works. Included a review of available site history, and contamination assessment of soils, targeting heavy metals, pesticides and asbestos. Remediation recommended landfill disposal (industrial and solid waste category).

- Brown Consulting (NSW) Group - Newbury Estate, Stanhope Gardens - Former market garden and grazing site developed for low density residential purposes. Responsible for cost estimating, project management and co-ordination of site investigation works, remediation and validation. Included review of site history information, contamination assessment of soils waters and sediment. Remediation recommendations included Landfill disposal and land farming. Reported on site investigations, remediation options (Remediation Action Plan), and validation. Reports endorsed by accredited site auditor.

- Columban Mission Institute, North Turramurra - Duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

- Cronulla Sewage Treatment Plant – Classification of biosolids for disposal off site to other land uses or to landfills.

- Deicorp Pty Ltd – Coulson Street, Erskineville – Former clothing factory and workshops with a UST to be redeveloped into a number of multi-storey residential apartment blocks. The collection of data to assess the efficacy of remediation works in decontaminating the site. Duties included liaising with clients, contractors and regulatory authorities, field sampling, QA/QC, data analysis and report generation. Reports endorsed by accredited site auditor.

- Department of Commerce – Assessment of a number of Department of Housing sites for potential hazardous materials within active housing commission units.

- Department of Housing – Lilyfield - Development of a residential area. Duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

- Department of Lands – Redfern - Development of a major residential area. Duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

- Duffy Kennedy Constructions – Cronulla – A former service station site. Sampling and soil classification of soils, followed by onsite management of the disposal of the soils to licensed landfills.

- EG Property Group / Funds Management –Port Adelaide, SA, Summer Hill and Five Dock, NSW –Active transport company, wheat production plant and silos, former bowling greens, former railway lines, land filling activities, land reclamation. Reports for due diligence and full environmental site assessments, duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil and groundwater sampling, preparation of borehole logs, decontamination, QA/QC and report generation.

- Energy Australia Substations - Various soil classifications and leachate management for an EPA inert and solid licensed landfill.

- Event Project Management - Bundaleer Street, Belrose – An active nursery to be redeveloped as part of extension works to the Covenant Christian School. A Phase 1 and Phase 2 contaminated land investigation with recommendations for remediation techniques and costs.

- Exceland Property Group (NSW) Pty Ltd – The Castellorizian Club at Kingsford. Duties included historical searches, analysing aerial photographs, liaising with authorities (WorkCover, Council's, EPA etc), identification of potential contaminants and report generation.

- Glasson Family Group – Wolli Creek – A large development site comprising a number of industrial properties including factories, warehouses, car yards etc. Conducting sampling and reporting on ASS/PASS and potential management techniques during future development.

- Glenbrook Sewer Installation - Environmental Representative for sewer installation contracts in Glenbrook. Responsible for the preparation of Environmental Management Plans (EMP) and work method statements. Monitored the works undertaken by the contractor, ensuring adequate environmental safeguards are in place and maintained. Prepared inspection reports and EMP status reports for Sydney Water.

- Granville Boys High School – assessment of soils and supervision of remedial works within an existing playing field. Remedial works included removal of soils contaminated with asbestos to an EPA licensed landfill.

- Group Development Services – Carrying out full assessments, from Stage 1 to Stage 4, on numerous rural residential sites in north western Sydney.

- International Speedway, Granville – Assessment of an existing spectator mound for asbestos and other soils analytes and recommendations for capping on-site.

- IWD Pty Ltd - Lyons Road, Drummoyne – A former service station with numerous UST's. The assessment included tank and line tests, gross pollution review, soil

sampling, groundwater sampling, historical review and final data interpretation. Remediation of contaminated soils after the tanks were removed, soil classification and final validating of site surfaces. Reports endorsed by accredited site auditor.

- JK Williams Contracting Pty Ltd - Various soil classifications and leachate management for an EPA inert and solid licensed landfill.

- John Morony Correctional Complex, Berkshire Park – assessment of soils and preparation of remedial costs prior to extension works to the existing prison.

- Landcom - Archbold Road, Eastern Creek and McIver Avenue, Middleton Grange – Former farming lands purchased by Landcom for residential subdivision, school developments, parklands and town centre (shopping facilities etc). Responsible for cost estimating, project management and co-ordination of site investigation works. Preparation of a preliminary RAP and recommendations in remediation techniques and costs.

- Liverpool City Council – Former park lands. Duties included historical searches, analysing aerial photographs, liaising with authorities (WorkCover, Council's, EPA etc), identification of potential contaminants and report generation.

- Mann Group - Various soil classifications and leachate management for an EPA inert and solid licensed landfill.

- Manson Group – Kogarah – Former glass factory with an UST. Preparation of a Remedial Action Plan (RAP), followed by remediation and validation of the site including project management, liaising with contractors and clients, sampling, soil classification and assessment, and final report generation.

- Narwee Boys High School – Preparation of a hazardous materials (HAZMAT) assessment. Analysis involved identifying asbestos materials from lagging, roofing guttering, floor tiles, electricity backing boards, mercury switches, mercury/cadmium lamps, synthetic mineral fibres, lead paint etc.

- Parramatta City Council - Sampling and soil classification of soils, followed by onsite management of the disposal of the soils to licensed landfills.

- Paynter Dixon Constructions Pty Ltd – Homebush – Teachers Credit Union site. Duties included historical searches, analysing aerial photographs, liaising with authorities (WorkCover, Council's, EPA etc), identification of potential contaminants and report generation.

- Penrith City Council - Claremont Meadows Stage 2 – South Western Precinct – Masterplan. Full environmental and salinity assessments were carried out to address the Claremont Meadows Stage 2 DCP - Performance Standards for which is currently under consideration by the Council for the Stage 1 Subdivision Plan of the properties provides for creation of residential allotments, dedication of a Public

Reserve, construction and dedication of new roads and creation of residue lots for future development.

- Proust & Gardner Consulting - Carrying out full assessments, from Stage 1 to Stage 4, on numerous rural residential and residential sites in both the local Sydney and Central Coast regions. Sites included vacant lands, farming lands, market gardens, poultry farms, residential properties and schools.

- Reefway Waste Services – Alexandria and Auburn – Active waste receivers and recyclers. Management of soil quality by analysing soils for reuse. Discussion with DECC on providing a 'gateway' mechanism for removing bona fide resource recovery from the waste regulatory framework.

- Richard Crookes Constructions Pty Ltd – Various soil classifications and leachate management for an EPA inert and solid licensed landfill.

- Robert Moore & Asscoiates - Carrying out full assessments, from Stage 1 to Stage 4, on numerous rural residential and residential sites across Sydney. Sites included vacant lands, farming lands, market gardens and residential properties.

- Royal Botanical Gardens, Sydney – Former works depot. Managing removal of UST's and associated pipelines, sampling and soil classification of soils to an EPA inert and solid waste licensed landfill.

- Sam the Paving Man - Sampling and soil classification of soils, followed by onsite management of the disposal of the soils to licensed landfills.

- Stocklands Mall, Merrylands - Former carpark area. Sampling and soil classification of soils, followed by onsite management of the disposal of the soils to licensed landfills.

- SPAD Pty Ltd – Former chemical factory. Report for full environmental site assessment, duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil sampling, preparation of borehole logs, decontamination, QA/QC and report generation. Preparation of a RAP, managing remedial works and issuing final validation report.

- Sydney Airport Corporation – Soil classification and leachate management for an EPA solid licensed landfill.

- Telstra Depot, Rooty Hill - Report for full environmental site assessment, duties included desktop study, liaising with clients, contractors and regulatory authorities, identification of potential contaminants, sampling and analysis design, soil sampling, preparation of borehole logs, decontamination, QA/QC and report

generation. Preparation of a RAP, managing remedial works and issuing final validation report.

- THG Resource – Kingston, QLD –Active scraps metal and car recycler. Duties included detailing management practices, outlining procedures for all identified environmental issues and providing a plan during operation to safeguard the way in which waste is managed.

- University of Sydney - Various soil classifications and leachate management for an EPA inert and solid licensed landfill.

APPENDIX D

PROPOSED DEVELOPMENT PLANS

Aargus

VOLUNTARY PLANNING AGREEMENT (VPA)

14. An indicative VPA offer has been made by the landowners for 2 Factory Street, Granville being the dedication of the northern portion of land abutting Clyde Railway Station of approximately 1,535sqm in size to Council for the purposes of a multi-storey commuter car park. The applicant has also shown interest in constructing the commuter carpark.

15. Council's endorsement is sought to commence formal negotiations of the VPA, including the assessment of the suitability of the land to be dedicated for a multi –storey commuter carpark, details relating to the size, construction and funding of the commuter carpark, the public benefit value of this dedication, the potential for additional/alternate contributions for example the dedication of unit(s) to Council for affordable housing purposes and the timing of the contribution(s).

16. The public benefit of this contribution would provide for a much needed commuter carpark in the Granville/Clyde area.

17. Initial investigations have revealed that a commuter carpark at this location may be feasible given that it is adjacent to Clyde Railway station yet on the periphery of the Granville Town Centre, being 600 metres (approximately) to the Granville Railway Station. This would give commuters a choice of accessing rail services from Clyde station or Granville station. Many commuters who access Granville town centre already currently park a similar walking distance away from Granville compared to the distance between the Clyde and Granville Railway Stations.

18. Transport for NSW is currently reviewing the Commuter Car Park and Interchange Program to address the needs of the local communities to ensure appropriate prioritisation of work and to establish the program of work and associated funding. Initial investigations of this indicative VPA offer with Transport for NSW have revealed that although Clyde Railway Station is mid-ranked on the commuter prioritisation list, Transport for NSW is willing to review the prioritisation list and explore this proposal in greater detail in conjunction with Council given the offer of land dedication and construction of the carpark by the applicant (landowner).

19. There are potential planning and public benefits in the indicative offer that should be further explored. Accordingly, this report recommends that, as required by Council's VPA policy, a formal resolution be made to proceed with negotiations and an appropriate officer be given delegated authority to negotiate the VPA on Council's behalf. The draft VPA will also need to be reviewed by Council's legal representative. It is recommended that delegation be given to the CEO of Council to negotiate the VPA.

NEXT STEPS

20. Should Council be willing to explore a planning proposal to rezone land at 2 Factory Street, Granville for high density residential uses the applicant would be invited to submit a planning proposal that addresses the matters in this report together with the required studies for further assessment.

21. The planning proposal must be prepared in accordance with Section 55 of the *Environmental Planning and Assessment Act 1979* and the Department of Planning and Infrastructure's *'A guide to preparing a planning proposal'* and *'A guide to preparing local environmental plans'*. The planning proposal must be accompanied with the following studies:

    (a) Urban Design Structure Plan
    (b) Land Use Planning Report
    (c) Traffic Impact Assessment
    (d) Social Impact Assessment
    (e) Acid Sulfate Soil Assessment
    (f) Land Contamination Report

22. Additional studies may be required following an assessment of the planning proposal.

23. A report will be put to Council following the assessment of the planning proposal and VPA. At this point, should Council proceed to support the planning proposal it will be submitted to the Department of Planning and Infrastructure for Gateway Determination.

CONCLUSION

24. The preliminary rezoning concept seeks to rezone the southern portion of the subject site to R4 High Density Residential under the Parramatta LEP 2011 so as to permit residential flat buildings. The proposal seeks a predominant building height of 15.8m (4 storeys) with a maximum building height of 18.8m (5 storeys). The northern portion of the site is proposed to be rezoned to SP2 Infrastructure under Parramatta LEP 2011 to facilitate a 148 space multi-storey commuter carpark. The applicant has made a VPA offer to Council for the dedication of this portion of land to Council for the purposes of a commuter carpark. The applicant has also shown interest in constructing the commuter carpark.

25. The industrial uses on the land are reaching, or have reached the end of their economic life. The site is well located in proximity of the Granville Town Centre and would rejuvenate the locality. The loss of employment land can be justified.

26. More detailed technical studies and investigations are required to justify different aspects of a future planning proposal including traffic, amenity, building height and floor space ratio.

27. Council's endorsement is required to further explore the concept presented by way of a planning proposal with the necessary studies submitted by the applicant that addresses the matters raised in this report.

Joel Carson
Project Officer Land Use Planning

Jennifer Concato
A/Manager Land Use Planning

ATTACHMENTS:

1	Assessment of the preliminary rezoning concept for land at 2 Factory Street, Granville	12 Pages
2	Preliminary rezoning concept submitted by applicant .	9 Pages

REFERENCE MATERIAL

ATTACHMENT 1 – Assessment of the preliminary rezoning concept for land at 2 Factory Street, Granville

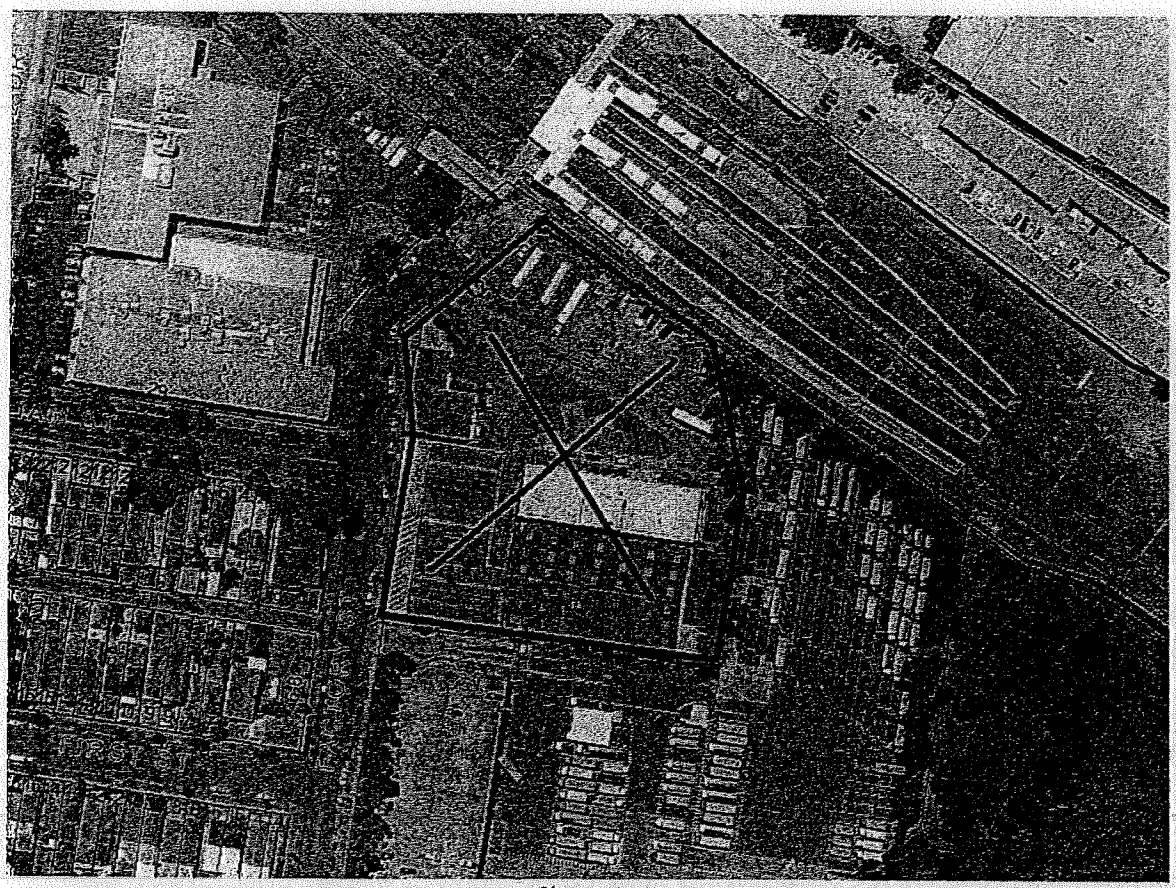
This assessment of the preliminary rezoning concept includes comments made by the following Council teams; Land Use Planning, Urban Design, Economic Development, Transport Planning, Traffic Services and Catchment Management.

THE SITE

The subject site adjoins the south side of Clyde Railway Station at 2 Factory Street, Granville (Refer to **Attachment 1**). The site is 10,700sqm in size. The site is currently zoned for industrial purposes and is occupied by a group of industrial buildings, generally of brick construction, 2 to 3 stories in height. Large vehicle parking areas are also located on the site.

The site is adjoined at the northern boundary by the Clyde Railway Station, and at the southern and eastern boundaries by the Australia Post International Mail Centre. To the north-west of the site across Factory Street is located an industrial building occupied by a Tabcorp call centre. To the south-west of the site across Factory Street are located low density residential dwellings.

Context map



Site map

BACKGROUND

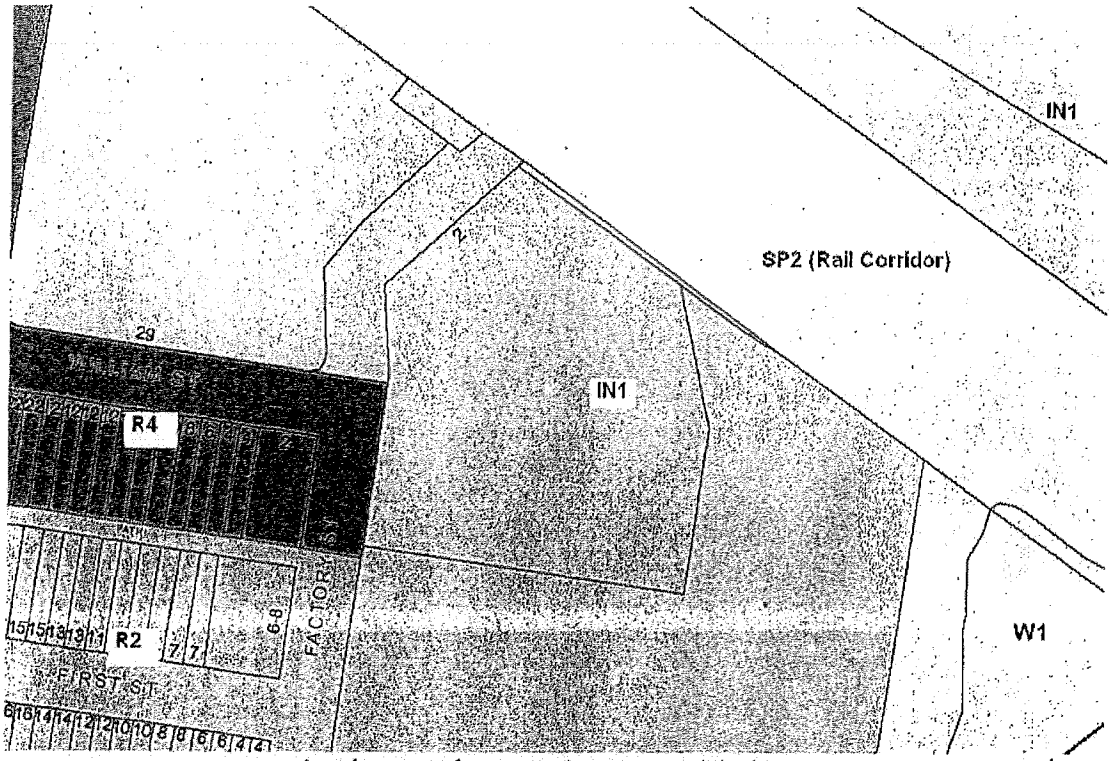
In November 2011, Council received a preliminary rezoning concept (located at **Attachment 2**) from Lockrey Planning & Development Solutions Pty Ltd, acting on behalf of the landowners MDM Pty Ltd. The proposal relates to the site known as 2 Factory Street, Granville, located adjacent to the south side of Clyde Railway Station.

The submission of a preliminary rezoning concept is to seek Council's initial feedback and to determine if the proposed concept has merit for further investigation. Should Council be willing to explore the concept presented, the applicant would be invited to submit a planning proposal together with the requested studies for further assessment by Council, that addresses the issues and makes the amendments recommended.

PLANNING CONTROLS

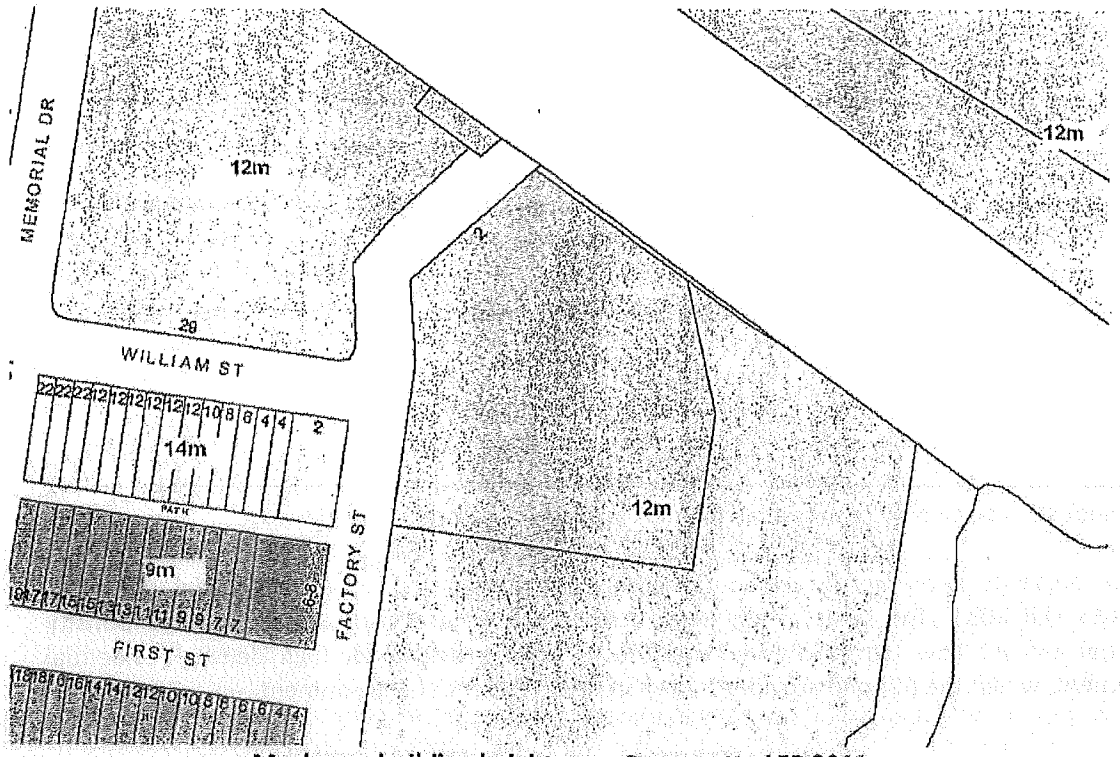
The subject site is currently zoned IN1 General Industrial under the Parramatta LEP 2011. The IN1 General Industrial zone provides for a range of industrial and warehouse land uses.

The lands adjacent to the northwest, south and east are also zoned General Industrial under the Parramatta LEP 2011. The lands to the west across Factory Street are zoned R4 High Density Residential and R2 Low Density Residential. The R4 zone provides for high density residential development, whilst the R2 zone provides for low density residential development.



Land use zoning map, Parramatta LEP 2011

The maximum building height permitted for the subject site under the Parramatta LEP 2011 is 12m. The industrial zoned lands to the northwest and south have a maximum building height of 12m. The R4 zoned lands to the west have a maximum building height of 14m, whilst the R2 zoned lands to the west have a maximum building height of 9m.



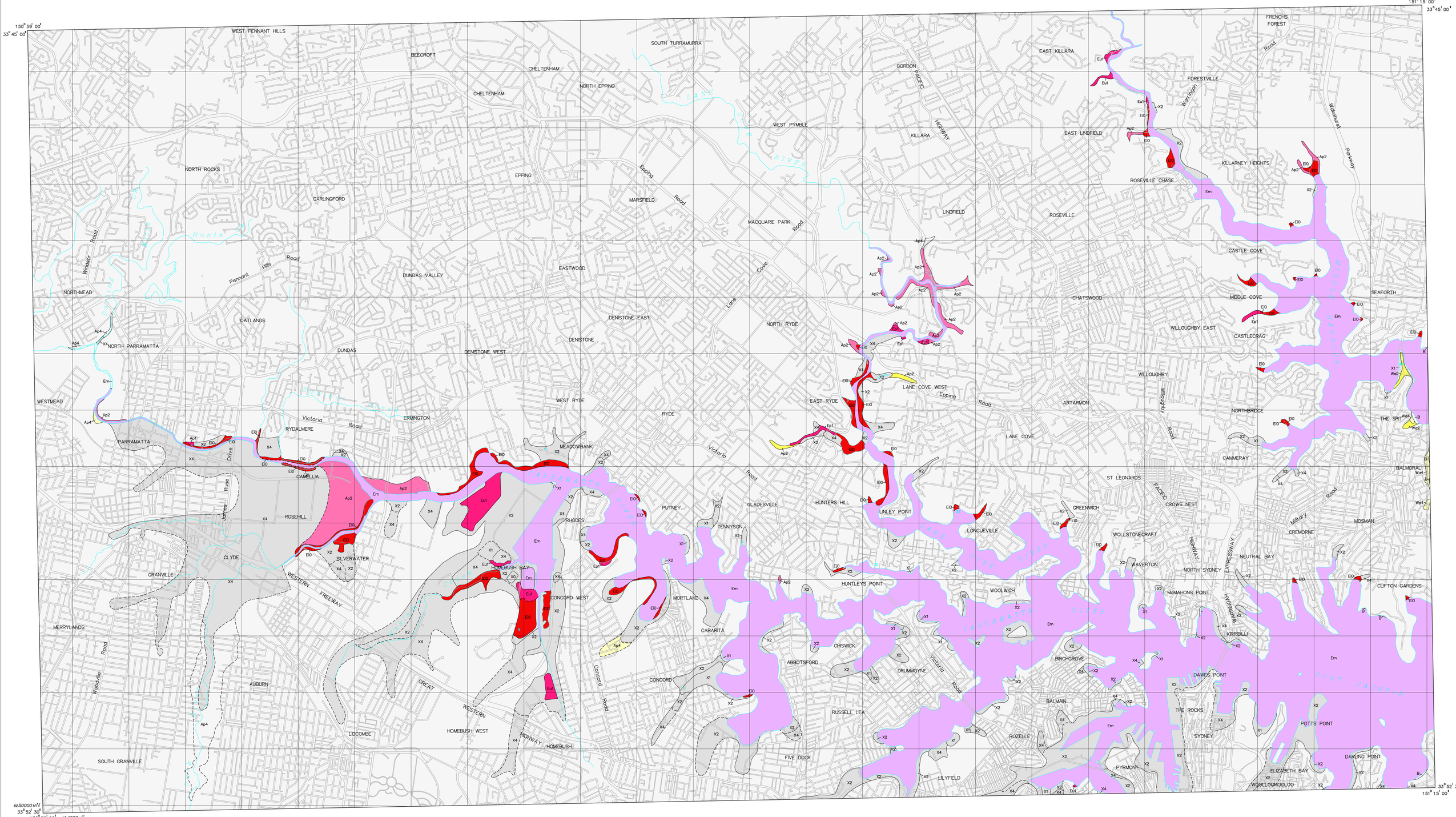
Maximum building height map, Parramatta LEP 2011

APPENDIX E

ACID SULPHATE SOILS RISK MAP

PROSPECT/PARRAMATTA RIVER

150° 59' 00" 33° 45' 00" — 151° 15' 00" 33° 45' 00"



6250000 mN 33° 52' 30" — 150° 59' 00" — 314000 mE — 151° 15' 00" — 33° 52' 30"

EDITION TWO
CROWN © DECEMBER 1997

KEY

Map Class Description	Depth to Acid Sulfate Soil Materials	Environmental Risk	Typical Landform Types
HIGH PROBABILITY High probability of occurrence of acid sulfate soil materials within the soil profile. The environment of deposition has been suitable for the formation of acid sulfate soil materials. Acid sulfate soil materials are widespread or sporadic and may be buried by alluvium or windblown sediments.	Below water level: Bottom sediments.	Severe environmental risk if bottom sediments are disturbed by activities such as dredging.	Bottom sediments of lakes, lagoons, tidal creeks, rivers and estuaries.
	At or near the ground surface.	Severe environmental risk if acid sulfate soil materials are disturbed by activities such as shallow drainage, excavation or clearing.	Estuarine swamps, intertidal flats and supratidal flats.
	Within 1 metre of the ground surface.	Severe environmental risk if acid sulfate soil materials are disturbed by activities such as shallow drainage, excavation or clearing.	Low alluvial plains, estuarine sandplains, estuarine swamps, backswamps and supratidal flats.
	Between 1 and 3 metres below the ground surface.	Environmental risk if acid sulfate soil materials are disturbed by activities such as deep excavation for pipelines, dams or deep drains.	Alluvial plains, alluvial swamps, alluvial levees and sandplains.
	Greater than 3 metres below the ground surface.*	Environmental risk if acid sulfate soil materials are disturbed by activities such as deep excavations, –e.g., large structure foundations or deep dams.	Elevated levees and sandplains, alluvial plains and alluvial swamps in estuarine reaches of catchments.
LOW PROBABILITY Low probability of occurrence of acid sulfate soil materials within the soil profile. The environment of deposition has generally not been suitable for the formation of acid sulfate soil materials. Soil materials are often Pleistocene in age. Acid sulfate soil materials, if present, are sporadic and may be buried by alluvium or windblown sediments.	Below water level: Bottom sediments.	The majority of these landforms are not expected to contain acid sulfate soil materials. Therefore, land management is generally not affected by acid sulfate soils. However, highly localised occurrences may be found, especially near boundaries with environments with a high probability of occurrence. Disturbance of these soil materials will result in an environmental risk that will vary with elevation and depth of disturbance.	Elevated alluvial plains and levees dominated by fluvial sediments. Plains and dunes dominated by aeolian soils. Pleistocene plains. Lacustrine and alluvial bottom sediments.
	At or near the ground surface.		
	Within 1 metre of the ground surface.		
	Between 1 and 3 metres below the ground surface.		
	Greater than 3 metres below the ground surface.*		
NO KNOWN OCCURRENCE Acid sulfate soils are not known or expected to occur in these environments.		No known occurrences of acid sulfate soil materials.	Land management activities not likely to be affected by acid sulfate soil materials.	Bedrock slopes, elevated Pleistocene and Holocene dunes, and elevated alluvial plains.
DISTURBED TERRAIN		Disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees. Soil investigations are required to assess these areas for acid sulfate potential.		

*Deep occurrences of acid sulfate soil materials not able to be confirmed by field inspection and sampling.

LAND & WATER CONSERVATION

Another quality product prepared by G.I.S. OPERATIONS

SCALE 1:25000

metres 500 0 2 kilometres

G N

TRANSVERSE MERCATOR PROJECTION
Numbered grid lines are 1000 metre intervals of the Australian Map Grid, Zone 56. Grid values are shown in full only at the south-west corner of the map.

Cadastral information based on the Digital Cadastral Data Base courtesy of the Surveyor Generals Department of N.S.W. Waterbody boundaries are dynamic and show slight differences between cadastral and topographic information.

LANDFORM CODES

Landform Process Class	Landform Element		Elevation#
W.....Aeolian	b.....Backplain	t.....Levee Toe	0.....0–1 m
A.....Alluvial	k.....Backswamp	o.....Ox-bow	1.....1–2 m
B.....Beach	m.....Bottom Sediments	p.....Plain	2.....2–4 m
E.....Estuarine	n.....Channel	a.....Sandplain	4.....>4 m
L.....Lacustrine	d.....Dune	s.....Swamp	
S.....Swamp	r.....Interbarrier Swamp	y.....Spkay	Additional Descriptive Codes
	i.....Intertidal Flat	u.....Supratidal Flat	(p).....Pleistocene
X.....Disturbed Terrain*	g.....Lagoon	w.....Swale	(s).....Acidic Scald
	l.....Levee	c.....Tidd Creek	

*Elevation levels given on the map refer to the elevation of the ground surface at the time of mapping. Depending on the nature of the disturbances, these elevation levels may or may not represent the original ground surface elevation.

#Approximate AHD

THIS MAP IS TO BE USED AS A GENERAL GUIDE FOR REGIONAL AND LOCAL SCALE LAND USE PLANNING AND LAND MANAGEMENT ONLY AND NOT FOR THE ASSESSMENT OF SPECIFIC SITES WHICH CAN ONLY BE ASSESSED BY A SITE SPECIFIC SOIL INVESTIGATION. THIS MAP IS BASED ON THE BASIS OF CURRENT INDICATORS WHICH MAY VARY AS THE PROCESS OF DETECTING THE OCCURRENCE OF ACID SULFATE SOILS IS FURTHER DEVELOPED. ACID SULFATE SOILS MAY OCCUR IN AREAS SPECIFICALLY IDENTIFIED ON THE MAP AS NO KNOWN OCCURRENCE.

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THIS MAP IS ONLY RELIABLE AT THE PUBLISHED SCALE OF 1:25000

MAP PREPARED BY C.L. MURPHY REVIEWED BY C.L. MURPHY

MAP COMPILED BY G.I.S. OPERATIONS FROM DIGITISED FIELD INFORMATION AND DATA HELD IN THE DEPARTMENT OF LAND AND WATER CONSERVATION'S GEOGRAPHIC INFORMATION SYSTEM.
THIS MAP SHOULD BE USED IN CONJUNCTION WITH THE GUIDELINES FOR THE USE OF ACID SULFATE SOIL RISK MAPS S.D. NAYLOR et.al. (1995) DEPARTMENT OF LAND AND WATER CONSERVATION

THIS MAP IS PART OF A SERIES OF ACID SULFATE SOIL RISK MAPS ALONG THE ENTIRE NEW SOUTH WALES COAST. THE MAPPING HAS BEEN UNDERTAKEN BY A TEAM OF EXPERIENCED AND QUALIFIED SOIL SURVEYORS. THE MAPPING IS BASED ON THE ASSESSMENT OF GEOMORPHIC PROCESSES AND ENVIRONMENTS. ASSESSMENT METHODS INCLUDE, INTERPRETATION OF AERIAL PHOTOGRAPHY AND SATELLITE IMAGERY, EXTENSIVE FIELD WORK AND LABORATORY SOIL TESTING.

LEGEND

LANDFORM BOUNDARY.....
APPROXIMATE LANDFORM BOUNDARY.....
SOIL PROFILE DESCRIPTION SITE.....27
RIVER or CREEK.....
CADASTRE .....

KEY TO ADJOINING MAPS IN THIS SERIES

	HORNSBY/ MONA VALE 91 30S1	
	PROSPECT/ PARRAMATTA RIVER 91 30N3	SYDNEY HEADS 91 30N2
LIVERPOOL 9030S2	BOTANY BAY 91 30S3	BONDI 91 30S2