

# RAINBOW BEACH

## GEOTECHNICAL REPORT



Luke & Company Pty Ltd  
**June, 2008**

# GEOTECHNICAL REPORT

**Prepared for:**

**Part 3A Concept Plan – Rainbow Beach (MP 06\_0085)  
Part 3A Project Application – Rainbow Beach (MP 07\_0001)**

**Part Lot 1232 DP 1142133, Lot 5 DP 25886 and  
Lots 1,2,3 & 4 DP 1150758  
Rainbow Beach, BONNY HILLS**

**Prepared by Luke & Company Pty Ltd  
On Behalf of St Vincent's Foundation Pty Ltd**

**JUNE 2010**

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## Appendices

- Appendix 1** Holmes and Holmes Pty Ltd - *Geotechnical Appraisal for Development Options at Lake Cathie – November 1993*
- Appendix 2** Holmes and Holmes Pty Ltd – *Preliminary Acid Sulphate Soil Investigation South of Lake Cathie – December 1998*
- Appendix 3** Holmes and Holmes Pty Ltd – *Acid Sulphate Soil Investigation - March 2003*
- Appendix 4** Holmes and Holmes Pty Ltd – *Acid Sulphate Soil Investigation - April 2003*
- Appendix 5** Chandler Geotechnical Pty Ltd – *Acid Sulphate Soil Investigation - April 2004*
- Appendix 6** Cardno Pty Ltd - *Water Engineering and Environment Report Appendix A: Acid Sulphate Soil Management Plan – April 2010*

# 1. Scope of Document

## 1.1 Scope of Document

This document is relevant to two applications pursuant to Part 3A of the Environmental Planning and Assessment Act 1979 as follows:

MP 06_0085	Rainbow Beach Concept Plan
MP 07_001	Open Space Corridor and Constructed Wetland, Rainbow Beach

## 1.2 Scope of Part 3A Applications

The Concept Plan application seeks consent for:

- The delineation of the limits of the residential subdivision;
- The location of the three adopted intersections with Ocean Drive;
- The location of an additional intersection with Ocean Drive currently under investigation by Council;
- The delineation of the future school sites;
- The delineation of the Greater Lake Cathie/Bonny Hills Village Centre;
- The delineation of the eco-tourist development site; and
- The delineation of the Open Space, Drainage and Wildlife Habitat Corridor.

The Project Application will seek consent for the following elements:

- Open space, drainage and wildlife habitat corridors;
- Earthworks required for constructed wetlands and to create filled reclaimed areas;
- Stormwater treatment and management; and
- District Sporting Fields.

Consent for the Project Application and the completion of the associated physical works therein, will advance the project to the point where:

- urban and residential development areas are reclaimed to inundation free levels and are appropriately protected and vegetated;
- the open space, habitat and drainage corridor areas of the site are rehabilitated with typical indigenous coastal habitats appropriate to the location and incorporating passive recreational facilities (eg pathways, cycleways, park seating, children's playgrounds and picnic areas);
- the District Sporting Fields are filled, vegetated and readied for transfer to Port Macquarie-Hastings Council.

Urban and residential development consistent with the Concept Plan will then be completed in a series of stages, each of which will be the subject of future applications.

### 1.3 DGRs addressed

The Director has issued Director General's Requirements (DGRs) for the Concept Plan (CP) Application and the Project Application (PA).

The following Concept Plan and Project Application DGRs are addressed in this report:

**CP 4.3**      *Identify the presence and extent of acid sulphate soils on the site and if necessary, appropriate mitigation measures."*

**PA 6.3**      *Identify the presence and extent of acid sulphate soils on the site and where relevant, appropriate mitigation measures."*

## 2. Introduction

The subject land is located at Rainbow Beach, approximately 18km south of Port

The subject land is located at Rainbow Beach, approximately 18km south of Port Macquarie and is identified as Part Lot 1232 DP 1142133, Lots 1, 2, 3 & 4 DP 1150758 and Lot 5 DP 25886. The subject land is situated between the coastal villages of Lake Cathie to the north and Bonny Hills to the south. The land is used primarily for agricultural activities such as cattle grazing and contains two dwellings and associated farm sheds.

Port Macquarie-Hastings Council adopted a Structure Plan in July 2004 to facilitate residential development in the Lake Cathie / Bonny Hills area to cater for the growing demand for urban land. The area is identified as Area 14 and includes land identified for future residential, commercial and light industrial development. The subject land is already zoned residential, however forms part of Area 14 and requires statutory certainty with respect to the adopted Area 14 Structure Plan.

The Structure Plan identified the location of the proposed residential precincts, village centre, community facilities, schools, playing fields and the major road network to service development within Area 14. The structure plan identified and adopted three intersections along Ocean Drive. The Concept Plan proposed by the applicant is in accordance with the Structure Plan.

Extensive site investigations for the proposed development have been undertaken over many years to determine the general soil types and depths, the waterable level, the availability of material suitable for filling of building areas and identification of the existence of potential acid sulphate soils.

The majority of the areas for excavation within the proposed development lie within an area classified as Class 4 in Hastings Local Environmental Plan 2001 – Acid Sulphate Soil Maps. Hastings Development Control Plan No. 34 – Acid Sulphate Soils determines that Class 4 areas require all excavation beyond 2 metres below the natural ground level, as in the case of the proposed constructed wetland, to be the subject of a Development Application, and requires the preparation of an Acid Sulphate Soils Management Plan.

Within this report the several geotechnical investigations undertaken are summarised and graphically presented where practicable.



The Acid Sulphate Soil Management Plan (ASSMP) for the proposed constructed wetland is contained in the Cardno Water Engineering and Environment Report and complies with statutory requirements in the NSW Acid Sulphate Soil Manual 1998 (ASSM 1998).

### 3. Summary of Geotechnical Investigations Undertaken

Due to the presence of acid sulphate conditions on the site, additional soil assessments, over and above the Acid Sulphate Management Plan requirements, were carried out by suitably qualified persons, as per Hastings Development Control Plan 34.

The geotechnical investigations undertaken to date are summarised in Table 1 below and the complete documents are attached as annexures to this report.

**Table 1: Schedule of Geotechnical Studies undertaken to date**

Date	Borehole ID	Type	Reference	Annexure
25-11-93	BH1 – BH26	Backhoe pits	Holmes & Holmes (1993)	1
25-11-93	BH27- BH40	Auger	Holmes & Holmes (1993)	1
15-12-98	101 -106	Auger	Holmes & Holmes (1998)	2
21-3-03	107 - 111	Auger	Holmes & Holmes (2003b)	3
3-4-03	29448 - 29498	Auger	Holmes & Holmes (2003c)	4
14-4-04	1 - 4	Auger	Chandler (2004)	5

The Cardno Water Engineering Report describes the subsurface stratigraphy based on these investigations, as follows:

- The material to be excavated from the constructed wetlands is a sandy alluvium suitable for use as filling on the areas of residential allotments, roads *et al* to be filled.
- Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS) occur throughout the area of the proposed constructed wetlands.

- There is a clear demarcation between the surface soils with “low” potential acidity (PASS) requiring little or no treatment and soils at deeper levels with “high” potential acidity requiring management and significant treatment.
- This demarcation boundary corresponds consistently with the occurrence of distinctive deeper grey clays of estuarine origin.

Sections 5 and 6 of this report provide a graphic representation of each of the boreholes including description of soils encountered and ASS potential.

## **5. Acid Sulphate Soils**

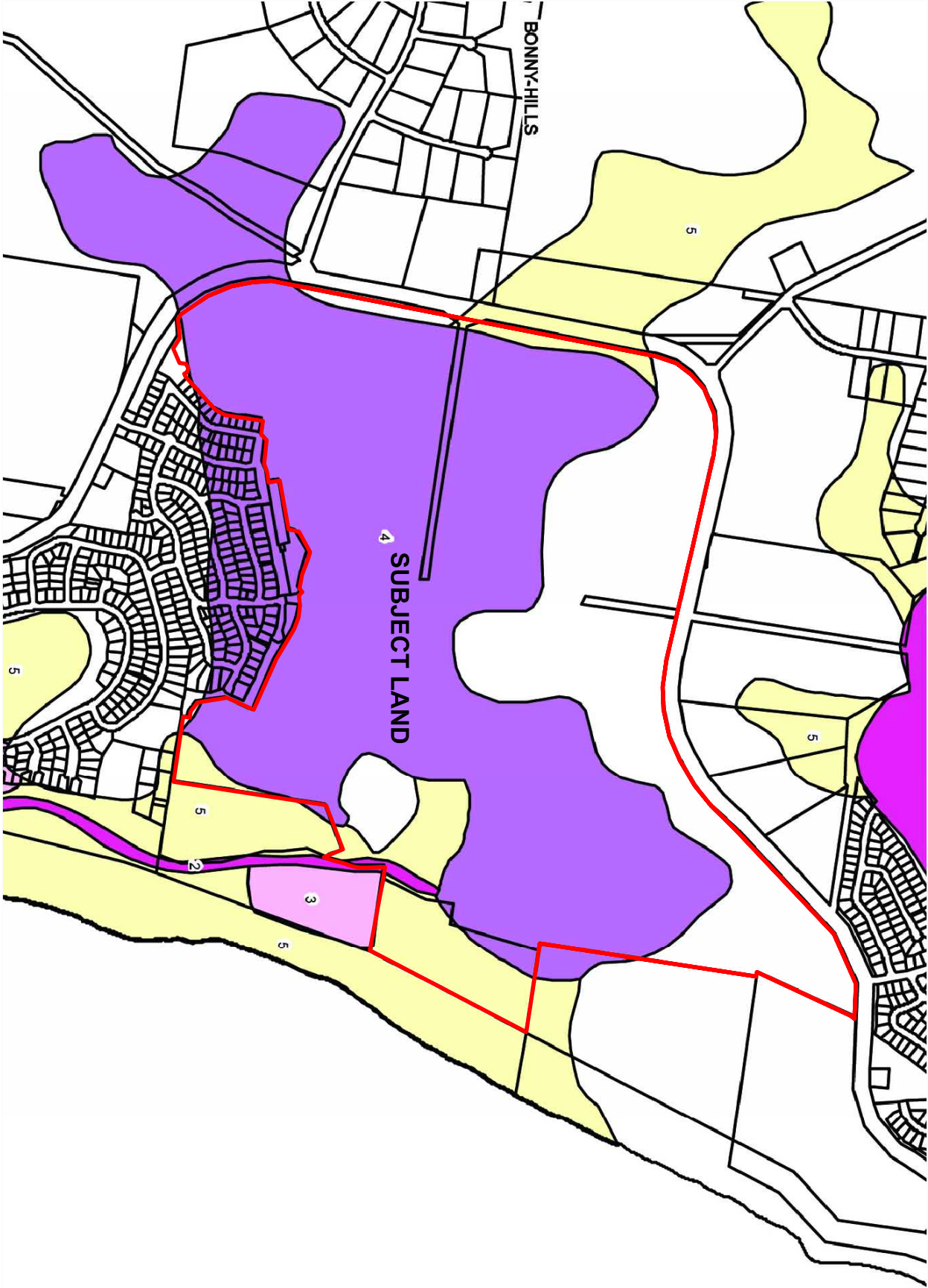
### **5.1 Classification of PASS Areas**






Hastings Local Environmental Plan 2001 – Acid Sulphate Soils map “Lake Cathie South To Bonny Hills” is shown in Figure 1. This map identifies the majority of the subject land as being within Class 4, although there are minor areas of Class 5 and Class 1.

The proposed excavation of the constructed wetland is within a designated Class 4 area. The constructed wetland will involve excavations beyond 2 metres below the natural ground surface.

FIGURE 1

EXTRACT FROM  
HASTINGS LOCAL  
ENVIRONMENTAL  
PLAN 2001. ACID  
SULPHATE SOILS  
MAPPING



Acid Sulfate Soils	
	1 Class 1
	2 Class 2
	3 Class 3
	4 Class 4
	5 Class 5



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Rainbow Beach Estate  
Concept Plan Application Set  
Job. No. 4509ND DWG: RM

SCALE:  
Not to Scale  
The stated scale of the drawing may be altered by copying.  
The scale should be verified prior to seeking measurements  
from the drawing



## 5.2 Acid Sulphate Soil Management Plan

The NSW Acid Sulphate Soil Management Advisory Committee - Acid Sulphate Soil Manual 1998 (ASSM 1998), identifies the percentage of oxidisable sulphur (S%) as the action criteria triggering the need for the preparation of an Acid Sulphate Soil Management Plan (ASSMP). The trigger value of oxidisable sulphur for disturbance of greater than 1000 tonnes of PASS is 0.03%.

Hastings DCP 34 – Acid Sulphate Soils - Section 2.4, also requires an ASSMP to be prepared for all works which will disturb acid sulphate soils.

The subject land contains some pockets of soils that exceed the trigger value as per the ASSM 1998 criteria and therefore the preparation of an ASSMP is required. The required ASSMP for the development proposal is contained within the Cardno Water Engineering and Environment Report. The ASSMP complies with the statutory requirements set out in the New South Wales Acid Sulphate Soil Manual 1998 (ASSM 1998).

## 5.3 Potential Acid Sulphate Soil Management

The implications for the development proposals of the presence of ASS and PASS soils and their management are set out in the Cardno Water Engineering and Environment Report.

Management provisions in the ASSMP include the directive that during the excavation of the constructed wetland, the high PASS material, “distinctive deeper grey clays of estuarine origin”, shall be avoided at all times. If excavation does expose this type of soil, it is to be treated in accordance with guidelines set out in the ASSMP. Therefore, the actual depth of the proposed constructed wetland, may vary from that proposed, should pockets of this type of material be found during excavation works.

The Cardno Water Engineering and Environment Report outlines a clear demarcation between soils with “low” potential acidity (PASS) requiring little or no treatment and deeper soils with “high” PASS requiring management and significant treatment. The report also states the maximum calculated required liming treatment rate as follows:

- “low” PASS soils the treatment rate is less than or equal to  $2.0\text{kg/m}^3$ , and
- “high” PASS soils the treatment rate is greater than  $2.0\text{kg/m}^3$ .

The depictions of the degree of potential ASS in the individual boreholes setout in Sections 6 and 7 of this report, is based on the qualitative assessment of ASS potential contained in the Holmes & Holmes reports (Annexure 1 to 4) and the above criteria.

## **6. Graphic Representation of Geotechnical Reports**

### **6.1 Borehole Locations**

Figure 2 shows the location of all boreholes over the subject land.

### **6.2 Summary of Acid Sulphate Soil Investigations, November 1993**

Twenty-six backhoe test pits were excavated (shown as BH1 to BH26) and a further 14 boreholes were drilled (BH27 to BH40) over the subject land, in order to obtain a general soil profile and undertake preliminary assessment for PASS soils. The boreholes identified the variety of soils present on the site arising from a complex geomorphologic history. These are shown graphically in Figures 3 and 4.



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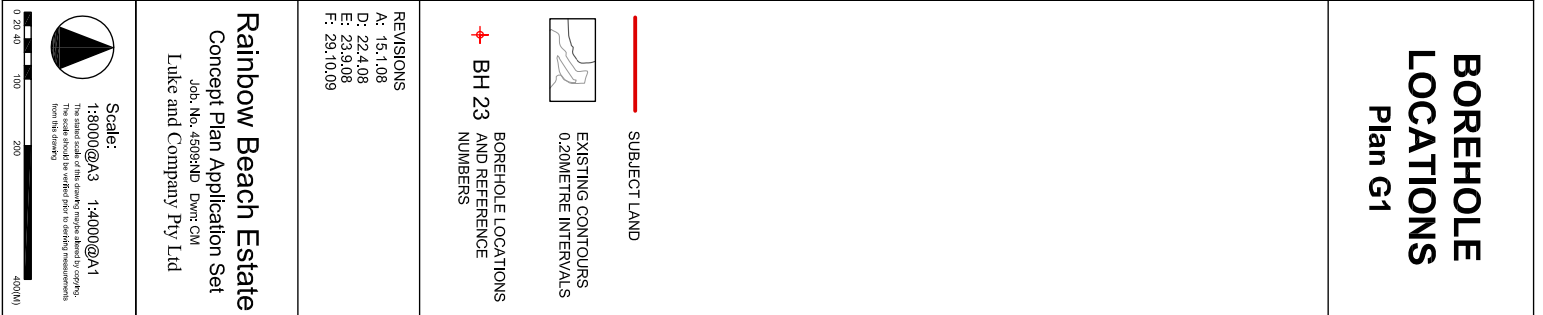
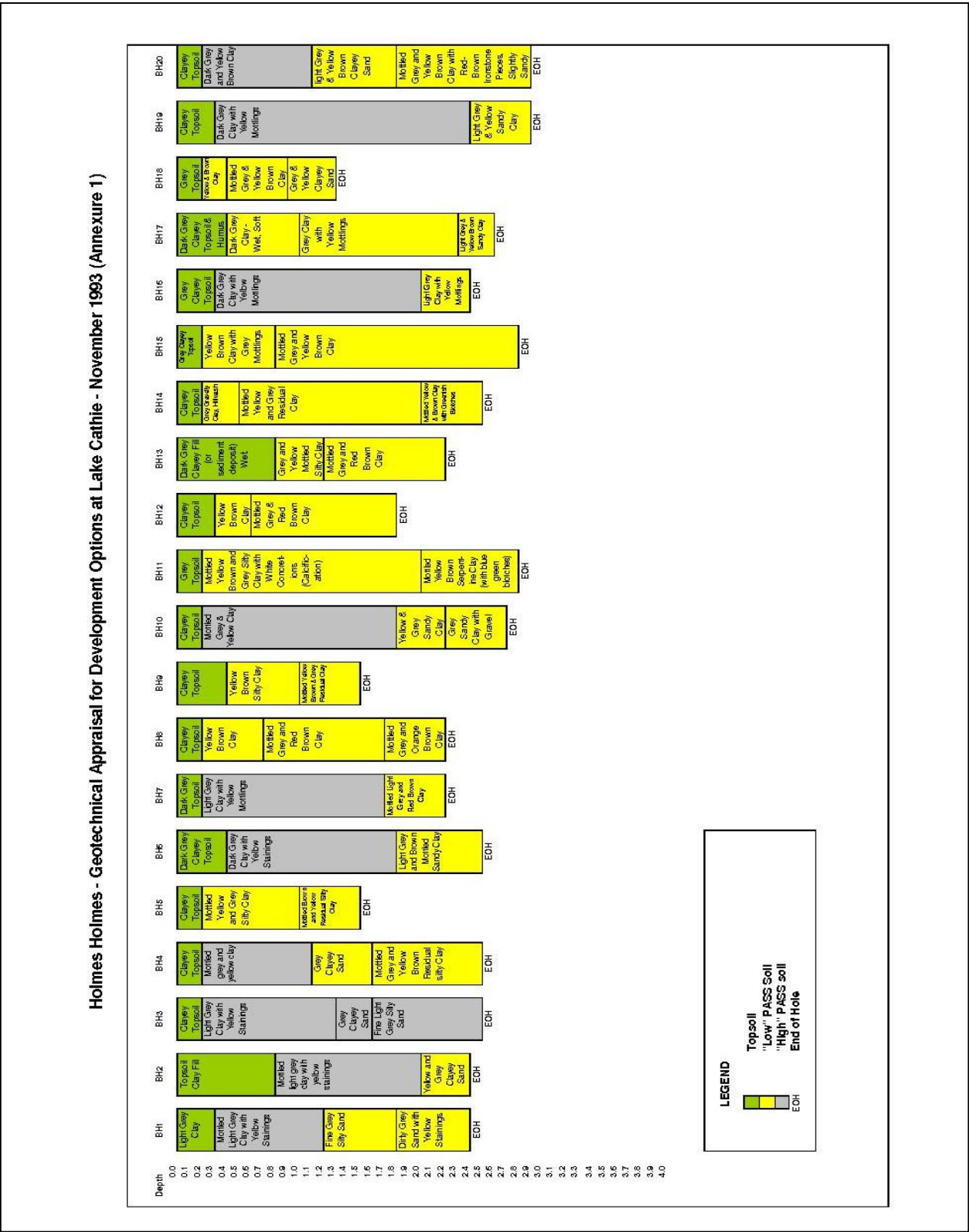


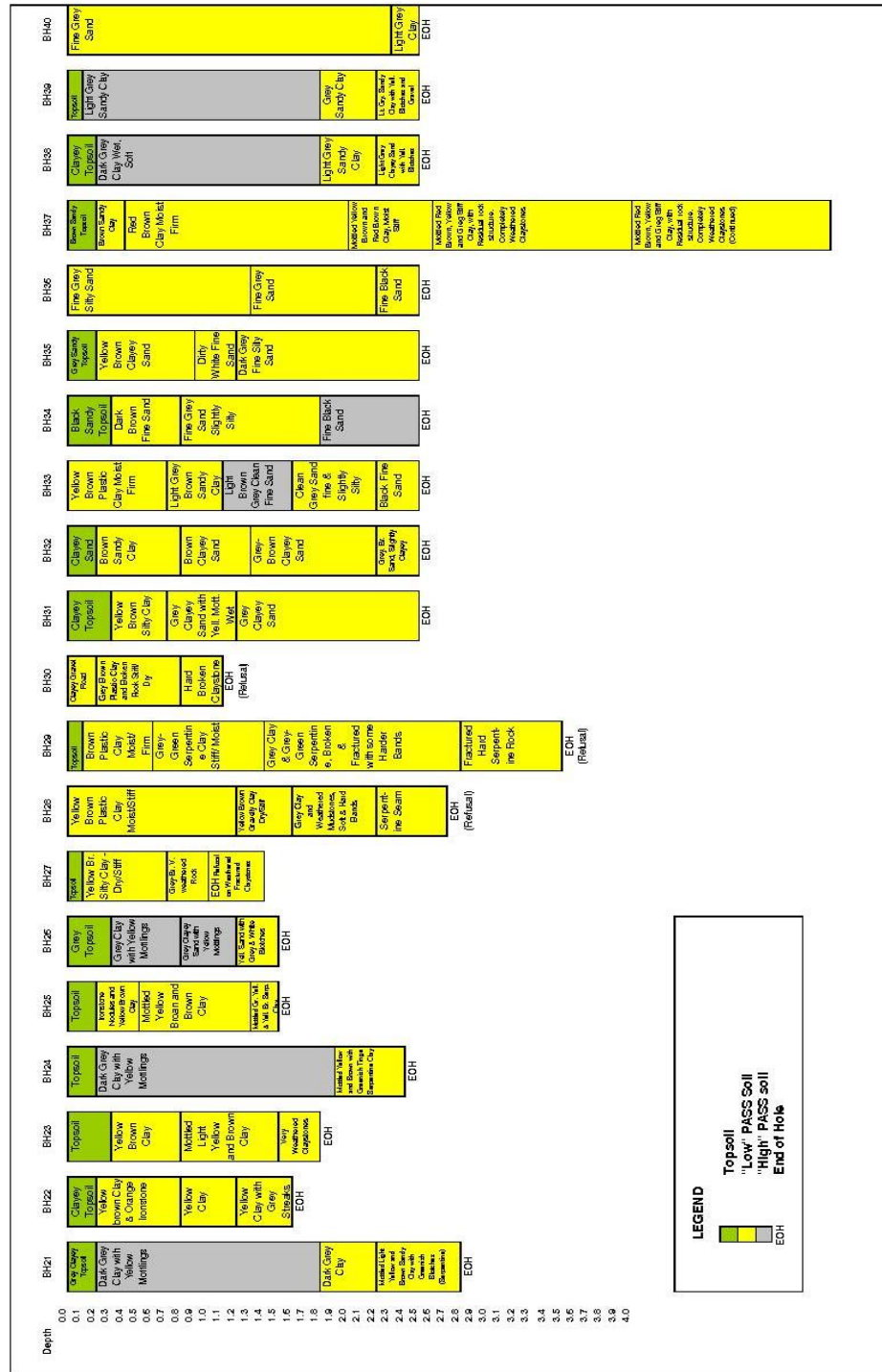




Figure 3: Results for Boreholes BH1 to BH20



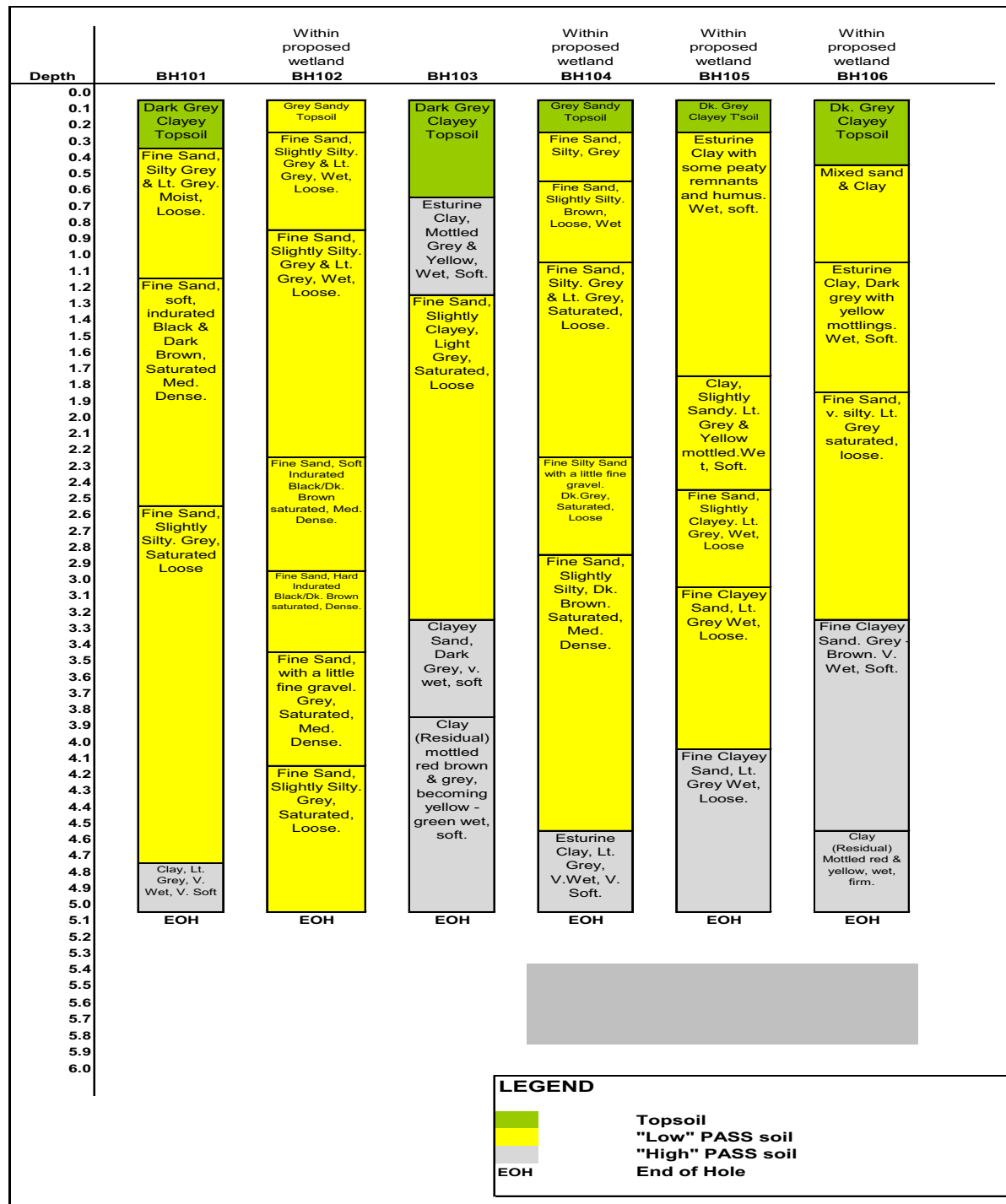
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### 6.3 Summary of Acid Sulphate Soil Investigations, December 1998

Six (6) boreholes (BH101 to BH106) were drilled, sampled and tested for PASS. All of the boreholes encountered high PASS (requiring remediation if disturbed) at depths varying between 3m and 5m below the natural surface level (NSL). These are shown graphically in Figure 5.

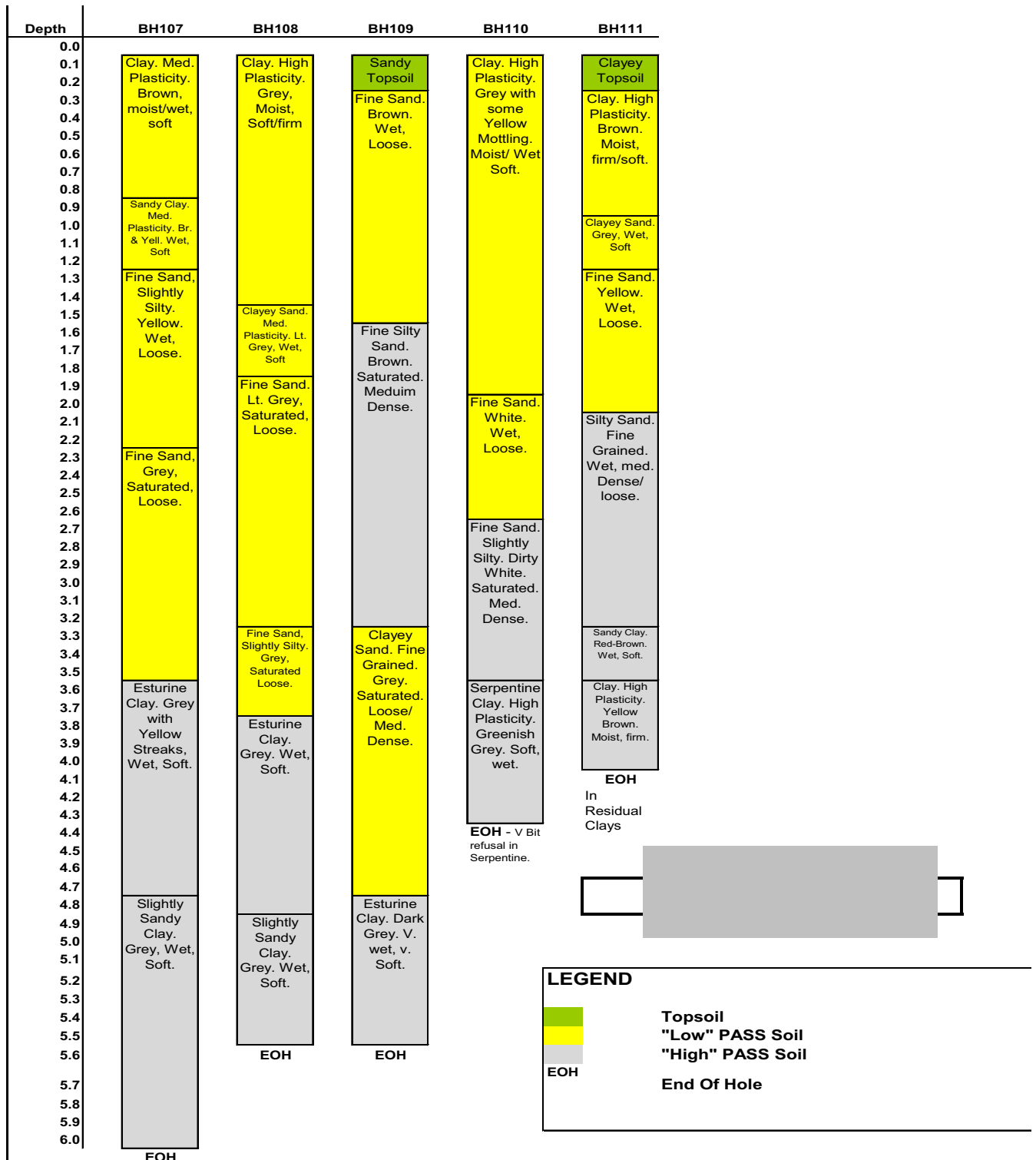
Figure 5: Summary of results for Boreholes 101 - 106



## 6.4 Summary of Acid Sulphate Soil Investigations, March 2003

Five boreholes (107 to 111) were drilled, sampled and tested for PASS in the area proposed for filling. Each of the boreholes encountered high PASS at varying depths. These are shown graphically in Figure 6.

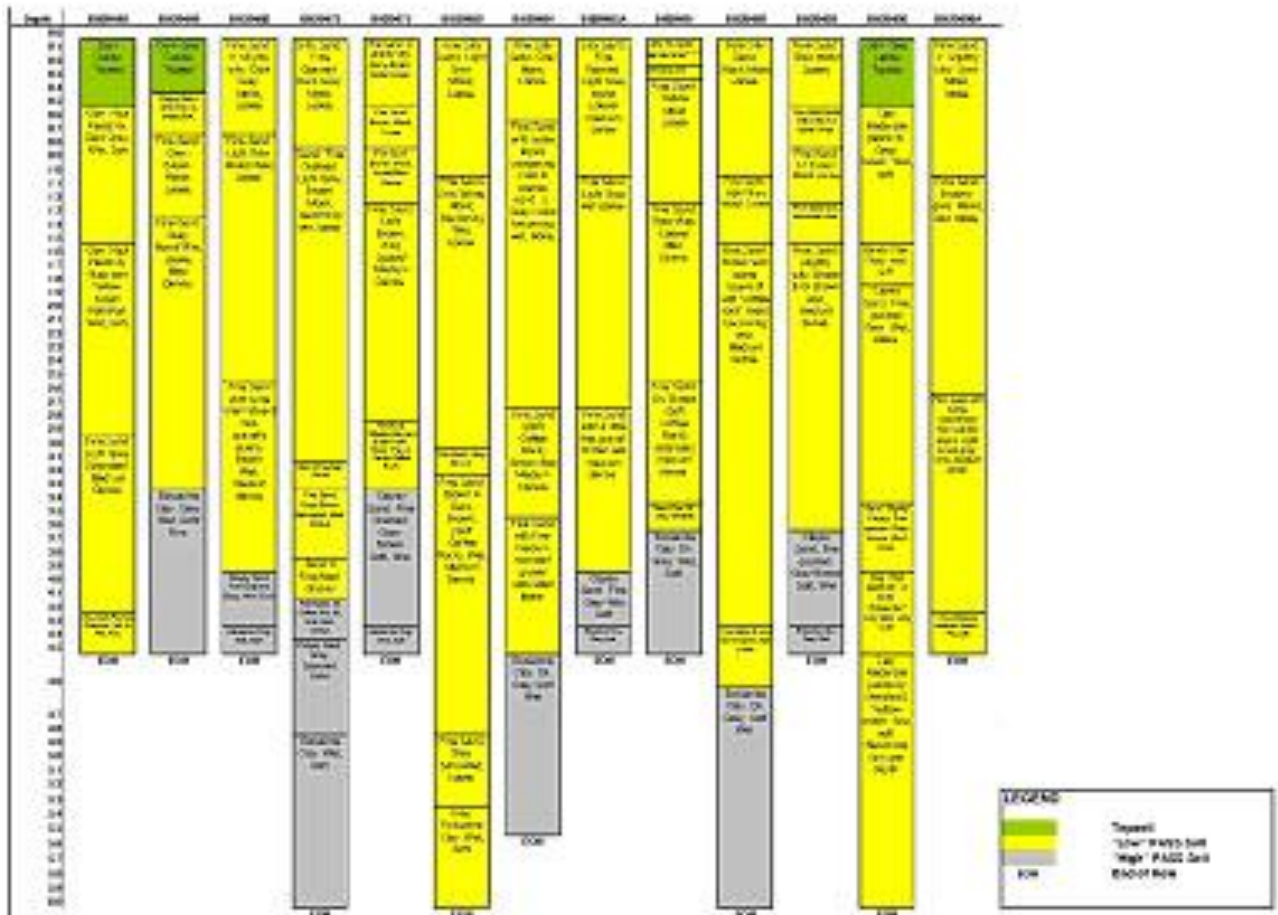
Figure 6: Summary of results for Boreholes 107 – 111



## 6.5 Summary of Acid Sulphate Soil Investigations, April 2003

Thirteen boreholes were drilled, sampled and tested for PASS (Nos 29448, 29449, 29466, 29472, 29475, 29482, 29484, 29485A, 29491, 29492, 29493, 29496, 29498A). These are shown graphically in Figure 7.

Figure 7: Summary borehole results for PASS testing



## **6.6 Summary of Acid Sulphate Soil Investigations, April 2004**

Four boreholes (BH1 to BH4) were drilled, sampled and tested for PASS to supplement earlier investigations by Holmes and Holmes. Two of the holes encountered PASS at depths of 3.5m below Natural Surface Level.

## **7. Boreholes in the Constructed Wetland Area & ASS**

### **7.1 Location Plan**

A more detailed plan of the boreholes in the locality of the proposed constructed wetland is shown in Figure 8.

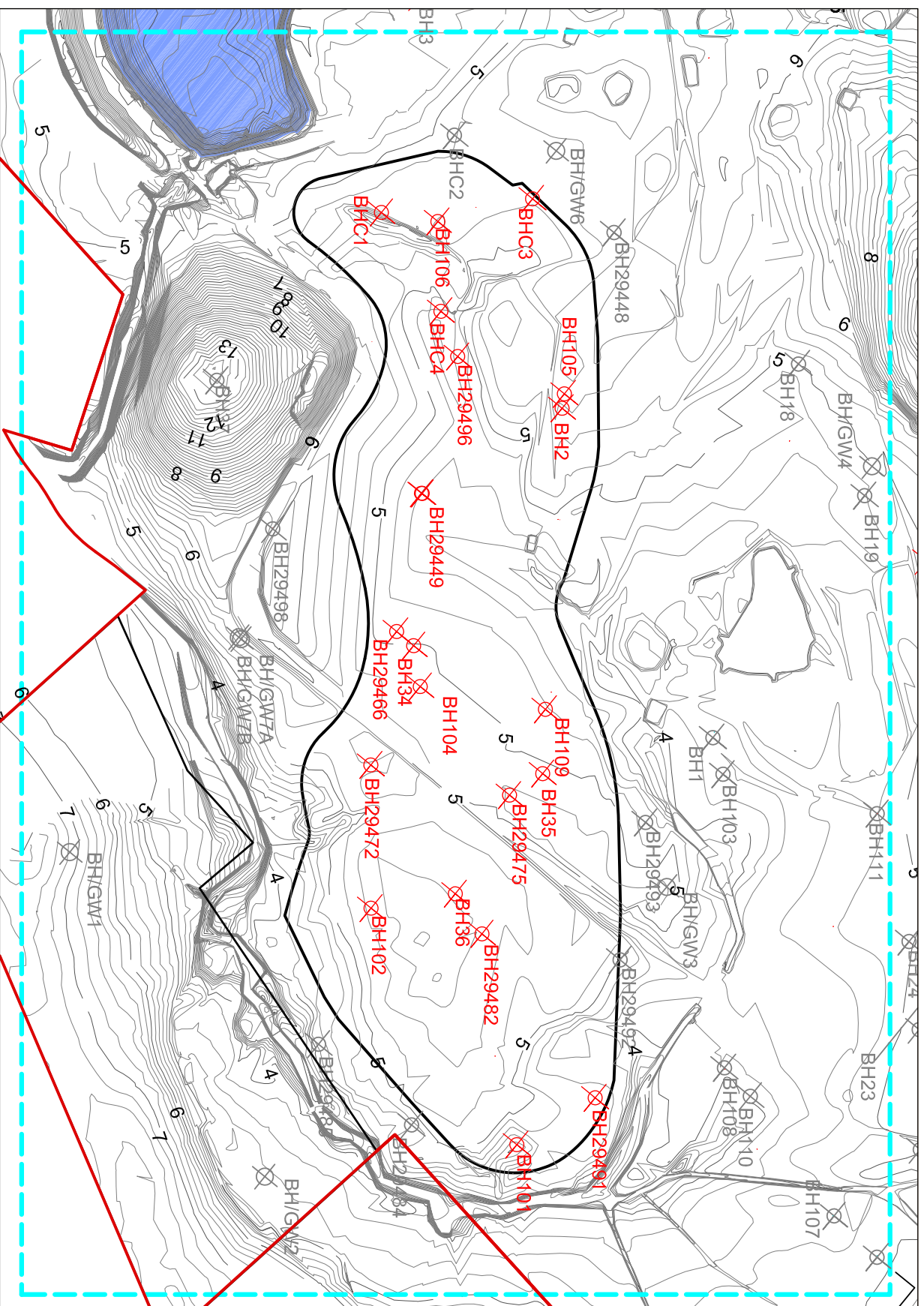
### **7.2 Borehole Logs**

The borehole logs shown graphically in figure 9 demonstrate that the boundary between the “low PASS soils” (requiring minimal or no treatment) and the high PASS soils (requiring significant treatment) is clearly defined.

The Cardno Water Engineering Report (Section 2.5.2 and Section 4.15) describes the subsurface stratigraphy and the clear definition of the boundary between the “low” PASS soils and the “high” PASS soils. The clear definition provides the ability to set the level of the bed of the constructed wetlands so as to minimise intersection of the “high” PASS soils.



REFER TO BOREHOLE  
LOCATIONS PLAN G1



Concept Plan Application Set  
Job. No. 4509;ND Dwn: CM  
Luke and Company Pty Ltd

**REVISIONS:**  
A: 15.1.08  
D: 22.4.08  
E: 23.9.09  
F: 29.10.09

~~BH 23~~  
REFERENCE NUMBERS  
LOCATED OUTSIDE OF  
PROPOSED WETLAND (ARE  
OF EXCAVATION)

**BH 23**  
BOREHOLE LOCATIONS AND  
REFERENCE NUMBERS  
LOCATED WITHIN AREA OF  
PROPOSED WETLAND (AREA  
OF EXCAVATION)

**EXISTING CONTOURS  
0.20 METRE INTERVALS**

**SUBJECT LAND**

Scale:

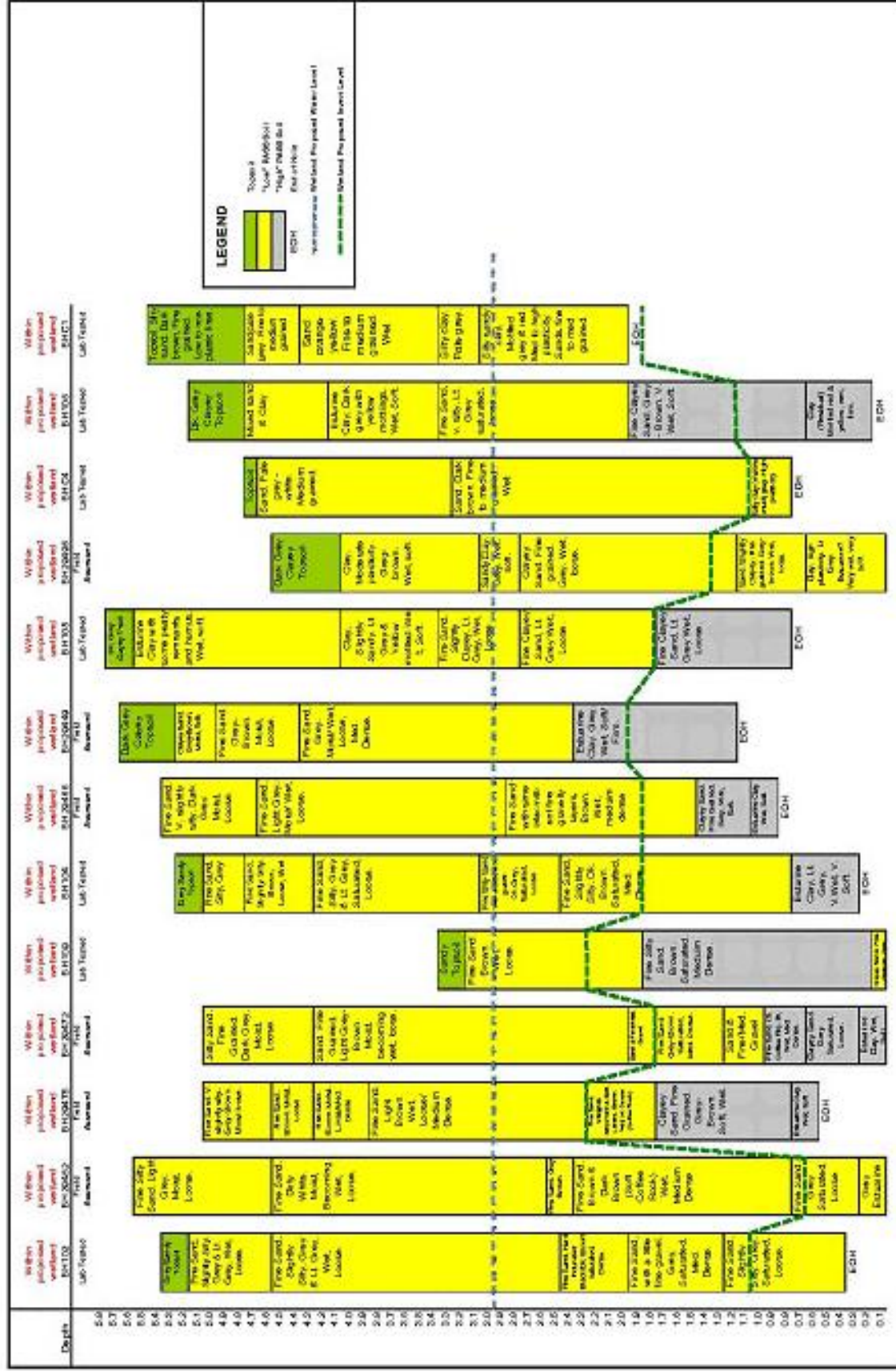
1:500@A3    1:250@A1





Figure 9: Wetland Borehole Logs

Rainbow Beach Proposed Wetland Borehole Logs



### **7.3 Calculation of the “High” PASS Profile**

The estimated “high” PASS profile has been modelled using laboratory tested or field assessed results from all boreholes within the “constructed wetlands”, excluding BH106 and BH29449. These boreholes have been omitted from the “high” PASS model as they represent isolated pockets of high level “high” PASS not common to the surrounding area.

The “constructed wetland” bed has been designed to reside at 0.5 metres above the estimated “high” PASS profile. The actual “constructed wetland” bed level may differ to design if areas of “high” PASS material are found during excavation works. “High” PASS material is to be avoided at all times. Fill may be reclaimed in other areas of the wetland if free of “high” PASS material, or alternatively any shortfall of fill may be imported to meet demand.

### **7.4 Proposed Cut and Fill**

Map 4 (Plan W9) shows the proposed cut and fill plan with a reference line for cross sections of the excavation for the proposed constructed wetlands and fill for residential lots and recreational areas.

Figures 1 to 4 (Sections W10, W6, W7 & W8) show the proposed cross sections of cut and fill in relation to the “high” PASS profile.

## 8. Conclusion

### 8.1 The geotechnical investigations indicate:

- The material to be excavated from the constructed wetland is a sandy alluvium suitable for use as filling on residential allotments, roads *et al.*
- Acid Sulphate Soil and Potential Acid Sulphate Soils occur throughout the area of the proposed constructed wetland.
- There is a clear demarcation between the surface soils with “low” potential acidity requiring little or no treatment and soils at deeper levels with “high” potential acidity requiring management and significant treatment.
- This demarcation boundary corresponds consistently with the occurrence of distinctive deeper grey clays of estuarine origin.

### 8.2 A description of the implications for the development proposal, of the presence of ASS and PASS soils and their management is contained in the Cardno Water Engineering and Environment Report.

### 8.3 The majority of the areas for excavation lie within an area classified as Class 4 in Hastings LEP 2001 *Acid Sulphate Soils Maps*. Hastings DCP 34 – *Acid Sulphate Soils* determines that development of Class 4 areas involving excavation beyond 2 metres below the natural ground level require the preparation of an Acid Sulphate Soils Management Plan (ASSMP). Therefore, an ASSMP is required for the proposed wetland excavation.

### 8.4 Borehole data has allowed the “high” PASS profile to be plotted and the excavation levels of the floor in the proposed constructed wetland, to be designed to minimise interception of the “high” PASS layer.

### 8.5 The Acid Sulphate Soil Management Plan (ASSMP) contained in the Cardno Water Engineering and Environment Report has been developed by Cardno to comply with Hastings Council DCP 34 and ASSM 1998.

**8.6** The ASSMP stipulates that “high” PASS material shall be avoided at all times during excavation works. Constructed wetland bed levels may differ to design if areas of “high” PASS material are encountered. Fill may be reclaimed in other areas of the wetland if free of “high” PASS material, or alternatively any minor shortfall of fill may be imported to meet demand. Additional boreholes are to be undertaken within the proposed constructed wetland area prior to excavation to confirm the “high” PASS profile.

**8.7** Therefore it may be seen that the extensive investigations over the subject land, have identified the presence and extent of potential acid sulphate soils over the site. This information has been used to develop an Acid Sulphate Soils Management Plan which is consistent with the requirements of the NSW Acid Sulphate Soil Manual 1998. In this manner, the DGRs identified as CP 4.3 for the Concept Plan application, and PA 6.3 for the Project Application, have been addressed.