RAINBOW BEACH

EARTHWORKS REPORT

Luke & Company Pty Ltd

June, 2010

EARTHWORKS 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

Luke & Company Pty Ltd
98 William Street, Port Macquarie NSW 2444
Telephone: 02 65832677
Facsimile: 02 65840103
Web: www.lukeandcompany.com.au
Email: info@lukeandcompany.com.au

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Appendix 1 Extract from Cardno Pty Ltd - *Water Engineering and Environment Report: Appendix A: Acid Sulphate Soil Management Plan* – April 2010

Note: This is a repetition of the document contained within the Cardno Water Engineering & Environment Report and is used here for reference and ease of use of this Earthworks report.

1. Scope of Document

1.1 Scope of Document

This document is relevant to two Applications pursuant to Part 3A of the EPA 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. The Concept Plan is shown in Figure 1.

1.3 DGRs addressed in the report

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

The following Concept Plan (CP) Application and Project Application (PA) DGRs are addressed in this report:

CP 2.3	*Consider alternative sources of fill for the residential subdivision.*
PA 3.1	*Provide a detailed survey showing existing and proposed levels and quantities of fill required.*
PA 3.2	*Describe the methods for excavation, transportation and spreading of fill. Address potential alternative sources of fill required for the residential subdivision and playing fields.*

2. Introduction

The subject land is located at Rainbow Beach approximately 18km south of Port Macquarie. The site is situated between the coastal villages of Lake Cathie to the north and Bonny Hills to the south. The majority of the site is undeveloped and is used primarily for agricultural activities such as cattle grazing. The location of the subject land is shown in Figure 2.

It is proposed to excavate and create a constructed wetland of approximately 10 hectares to the north east of the existing lagoon which will restore the natural flows to Duchess Gully while mitigating the effects downstream from increased runoff from developed areas. The material excavated will be utilised as fill to reclaim low-lying parts of the site for future residential areas, playing fields and a school site.

Potential acid sulphate soil (PASS) conditions are present within the site. The profile of the excavation for the wetland is designed to negate interception of identified high to very high PASS. A description of the implications for the development proposals of the presence of Acid Sulphate Soil and Potential Acid Sulphate Soil and their management, together with the Acid Sulphate Soils Management Plan is contained in the Cardno Water Engineering and Environment Report (April 2010).

The design process has used an iterative approach to balance the excavation and fill volumes while meeting the objectives of:

- stormwater treatment and detention,
- water sensitive urban design principles,
- creation of recreational opportunities and wildlife habitat,
- minimise the effect on existing fauna habitat, groundwater levels and potential acid sulphate soils, and avoiding disturbance of a designated “Aboriginal archaeological heritage exclusion zone”.

External sources of fill material as an alternative to the excavation of the wetland are discussed. The investigations carried out have determined there is no suitable source of fill nearby, and it is unacceptable in terms of the environmental and economic considerations to haul such a large volume (in excess of 400,000 cubic metres involving approximately 40,000 truck movements) of fill material long distances over the local road network.

3. Existing Conditions

3.1 The Subject Land

The subject land is as Part Lot 1232 DP 1142133, Lots 1, 2, 3 & 4 DP 1150758 and Lot 5 DP 25886. The subject land is approximately 177.4 hectares in area. The land is mostly cleared and has primarily been used for cattle grazing over many years. The mostly cleared nature of the land is shown in the aerial photograph shown in Figure 3. This aerial photo was taken in July 2009.

The subject land is characterised by high land along the northern Ocean Drive frontage falling to a broad low-lying area, subject to periodic inundation during intense storm events. The land is traversed from west to east by "Duchess Gully" which has been subject to transformation and redirection by previous owners.

Extensive investigations for the proposed development have been undertaken over many years. A previous owner carried out excavation and filling works in the early 1980's to facilitate development of a residential and tourist resort which resulted in the creation of a 4.9 hectare lagoon. Some years previously, works were carried out to divert flows from Duchess Gully to maximize the use of the land for grazing.

3.2 Existing Topography - Terrain Model

The existing ground levels range from RL 4.2m AHD on the low lying areas rising up to RL 23.3m AHD in the more elevated sections of the subject land.

4. Design Profiles

4.1 Proposed Finished Surface Levels of Future Urban Areas

The proposed finished surface levels for future urban areas within the Concept Plan are based on the following criteria:

- Minimum level at boundary of residential allotments of 0.5 metres above the calculated 1 in 100 year ARI inundation levels at that location. This concurs with Port Macquarie - Hastings Council Auspec-1 – Stormwater Drainage Design (Section D5.12: Item 4). Note: In conjunction with the 300mm freeboard to the front of the lot, this provides 800mm freeboard above the 1 in 100 year ARI inundation levels.
- Maximum depth of water on any roadway of 200mm during a 1 in 100 year ARI event. This is to ensure the roadway remains within the low hazard category as per Port Macquarie - Hastings Council Auspec-1 – Stormwater Drainage Design (Section D5.12: Item 3) during the 1 in 100 year ARI event.
- Minimum grade on residential allotments of 1.0%.
- Minimum longitudinal grade on residential streets of 0.5%.
- Stormwater and stormwater treatment train designs in line with Ecologically Sustainable Development (ESD), Water Sensitive Urban Design (WSUD) and Total Water Cycle Management (TCM) and principles as per Port Macquarie - Hastings Council AUSPEC-1 (Section D07 – Stormwater Management).
- Minimum grade on sports fields of 0.5%.

4.2 Proposed Extent of Fill for Future Urban Areas

The proposed extent of fill, for the future urban areas within the Concept Plan, is designed to achieve a balance between the available excavated material from the Constructed Wetland and the volume of fill required for the reclamation of the future urban areas to inundation free levels. A balance between the volumes of cut and fill is desirable and obviates the need to source fill material from an alternative source – as fully described within Section 7 of this report

4.3 Filling Requirement

"Project Application – Open Space Corridor and Constructed Wetland" MP 07_0001 provides for the reclamation of future urban areas to inundation-free levels.

Figure 4 shows the proposed extent and finished surface levels of the areas to be filled, based on the criteria outlined (Section 4.2). Comparing the proposed design profiles to the existing topography (Section 3.2), the volume of fill required to reclaim future urban areas to inundation free levels can be calculated.

From the measured dimensions the total fill requirement is calculated to be 417,200 cubic metres. This total can be broken down further to 347,300 cubic metres of structural fill and 69,900 cubic metres of non-structural fill (Table 1).

4.5 Excavation Quantities – Constructed Wetlands

"Project Application – Open Space Corridor and Constructed Wetland" MP 07_0001, provides for the earthworks required for the Constructed Wetland and the reclamation of the future urban areas to inundation-free levels.

A comparison between the proposed design profiles and the existing topography (Section 3.2), allows calculation of the volume of material to be excavated from the Constructed Wetlands.

The quantity of material to be excavated from the Constructed Wetlands has been calculated to be 461,120 cubic metres (Table 1). The excavated material can be categorised as follows:

Sandy alluvium (structural fill)	437,120m3
Topsoil, average 150 thick (non-structural fill)	24,100m3
TOTAL	461,120m3

In addition to the 461,120 cubic metres of excavated material produced during excavation of the Constructed Wetlands, a further 57,360 cu m of topsoil (non-structural fill) shall be stripped from Fill Areas 1, 2 and 3 prior to the depositing of fill. This will result in a total of 528,480 cubic metres of bulk excavated material or **418,800 cubic metres** of net excavated material allowing for compaction losses.

4.6 Earthworks Balance

The tables below summarise the earthwork volumes required for the constructed wetlands and to reclaim future urban areas to flood free levels. These tables indicate that an earthworks balance is achieved utilising the current design.

Table 1: Earthworks Volumes

FILL VOLUMES

Location *(Refer to figure 4)*	***Structural Fill cu m***	***Non-structural Fill (topsoil) cu m***
Northern School Site – Site 1	27,300	3,340
North West Fill Area – Site 2	152,000	20,200
North East Fill Area – Site 3	168,000	14,700
Perimeter roads outer barriers	-	11,250
District Sporting Fields – Site 4	-	20,400
Total volume of consolidated fill required from measured dimensions	**347,300**	**69,900**

Total Fill ***417,200 cu m***

EXCAVATION VOLUMES

Location Refer to figure 4	***Structural Fill cu m***	***Non-structural Fill (topsoil) cu m***
Constructed Wetlands	437,120	24,000
Topsoil stripped from Fill Areas 1, 2 & 3	-	57,360
Total volume of excavated material	**437,120**	**81,360**
Allowance for compaction and other losses	20%	15%
Net material available for fill	**349,700**	**69,100**

Total ***418,800 cu m***

5. Acid Sulphate Soils

The majority of the areas proposed for excavation, lie within an area classified as Class 4 in Hastings LEP 2001 – Acid Sulphate Soil Maps. Port Macquarie - Hastings DCP 34 – Acid Sulphate Soils determine that Class 4 areas require all applications for excavation beyond 2 metres below the natural ground level, as in the case of the proposed wetland lagoon excavation, to be supported by an Acid Sulphate Soils Management Plan.

The Acid Sulphate Soil Management Plan (ASSMP) applicable to the site is included as Annexure A to the Cardno Water and Environment Engineering Report.

The Cardno Water and Environment Engineering Report (Section 4.8) details the:

- Site investigations undertaken for Acid Sulphate Soils.
- Clear demarcation between 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 boundary corresponds consistently with the occurrence of distinctive deeper clays of estuarine origin.
- Implications for the development proposals.
- ASS management and treatment.

Figure 5 shows the earthworks cross section in relation to the PASS profile.

The ASSMP stipulates that high PASS material shall be avoided 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 proposed prior to excavation, of the proposed wetland area, to confirm the high PASS profile.

6. Construction Methodology

Site management procedures are outlined in the Cardno Water Engineering and Environment Report, Appendix A - Acid Sulphate Soil Management Plan (ASSMP).

6.1 Proposed Excavation Methods

It is proposed that the excavation procedures will follow the ASSMP guidelines for excavation techniques as per the following extract from the Cardno Water Engineering and Environment Report: Appendix A, Section A6.3.

> *Excavation shall be undertaken in stages to ensure that groundwater drawdown associated with dewatering of the excavation areas is minimised.*
>
> *Only a single excavation cell within the waterways shall be completely dewatered at a time. Each excavation cell will be separated by a section of unexcavated material and once excavation of each cell is complete the cell will be re-flooded to reduce the potential for groundwater drawdown associated with the dewatering and excavation of the adjacent cell.*
>
> *Excavated slopes shall be inspected on a daily basis and shall be treated by surface sprays and liming to prevent any acid formation.*
>
> *All excavation and treatment areas shall be isolated from external areas by perimeter drains and/or bunds. All waters collected on the site shall be contained, collected, tested and treated prior to disposal to external areas. All excavated material shall be subjected to appropriate testing, and treated where required.*
>
> *All soils including sands and the clay strata shall be sampled during excavation. The sampling frequency shall be 1 sample per 500 cubic metres. The soils Acid Neutralising Capacity (ANC) shall also be undertaken throughout the construction phase. The samples shall be tested in accordance with the Acid Sulfate*

Soils, Laboratory Methods Guidelines. The location and depth of all test samples shall be accurately recorded on a plan of the works area.

6.2 Proposed Transportation Methods

The material will be transported by motorised scrapers and/or dumper trucks, depending on the method chosen for excavation. The transport route shall be entirely within the property such that road registered vehicles are not required. The transport route shall also be selected to ensure any material lost during transport shall be contained within the acid sulphate soil treatment areas.

6.3 Proposed Spreading Methods

The base of fill areas where treated PASS are to be placed, will be treated prior to the spreading and compacting of fill as per ASSMP guidelines for the treatment of fill areas (Cardno Water Engineering and Environment Report: Appendix A, Section A6.6). The material will be spread and compacted using graders and rollers in accordance with the requirements of AS3798-2007 – *Guidelines on earthworks for commercial and residential developments*.

7. Alternative Sources of Fill Material

7.1 Alternative Sources of Fill Material

The volume of structural fill material required for the proposed roads, residential building sites and the school site is calculated to be 347,300 cubic metres. Applying a bulking factor of at least 20% indicates approximately 416,000 cu metres of 'structural' fill would need to be imported to the site by road transport.

Extensive enquiries have been made, and only two possible external sources of this quantity of fill material have been identified, namely:

i) Hurd's Quarry, Ocean Drive, Bonny Hills located approx. 5km from the site. This quarry has suitable material but it is of road

pavement quality, not generally used for bulk filling, and is very expensive. Other material of lesser quality is available from the quarry but not in the quantities required.

ii) Bago Quarry, Milligans Road, Wauchope, operated by Volcanic Resources Pty Ltd. The quarry advises to have sufficient fill material available, but is located approximately 21km from the site.

The location of the identified two possible sources of fill material is shown on Figure 6.

7.2 Alternate Fill Procurement Costs

The procurement of fill material from the closer Hurd's Quarry is not considered financially feasible due to the insufficient quantity of material in the quarry suitable for use as bulk filling, and thus the need to use the more expensive road pavement quality material.

A costing exercise has been carried out based on the delivery of material from the more distant Bago Quarry.

The estimated cost of material supplied to the site by Bago Quarry (as at June 2007) is $17 per cubic metre (loose truck measure). Therefore the total cost of obtaining structural fill material from Bago Quarry is estimated to exceed $5.8 million, which is economically prohibitive.

7.3 Environmental, Traffic and General Amenity Impacts

Obtaining fill material from Bago Quarry would have a significant impact on the environment, traffic and general amenity of areas along the haulage route. The material would be hauled using "truck and dog trailer" combinations which deliver approximately 22 cubic metres (loose truck measure) per trip. More than 40,000 trips would be required to supply the required amount of fill.

The route is firstly along the gravel surface of Milligans Road. The increased truck movements on this road would result in increased dust impacting on adjacent flora and fauna.

The route then uses Bago Road resulting in an increased maintenance requirement on that road.

From Bago Road, trucks will then turn onto the Pacific Highway and into Houston Mitchell Drive. At both intersections additional truck turning movements will increase the hazard to other vehicles at these intersections.

Trucks would then utilise Houston Mitchell Drive, which has a poor alignment and surface condition in some sections. The increased truck movements on this road would result in reduced safety to other road users and an increase in the required maintenance of the road.

7.4 Alternate Sources Summary

From the above, a number of alternative sources of fill material were investigated and only one preferable source has been identified - Bago Quarry.

Transportation of the fill material from Bago Quarry would involve an estimated 40,000 truck movements. These trips result in some 840,000 kilometres of travel by heavy vehicles, and consequent significant energy usage, emissions, damage to local roads and reduced safety for other road users.

It is concluded that the estimated economic, social and environmental cost of importing fill material is prohibitive.

The use of material sourced from the Constructed Wetland, which is more environmentally and economically feasible compared to the importation of material, as well as fulfilling a role in water quality improvement and mitigation of inundation.

8. Conclusion

8.1 The two Part 3A applications will advance the project to the point where future urban areas are reclaimed to inundation free levels.

8.2 The geotechnical investigations have determined that sufficient suitable structural material is available from the on-site excavation of the Constructed Wetlands to achieve the required fill levels in the proposed location.

8.3 The Cardno Water and Environment Engineering Report determined that the Constructed Wetland fulfils a role in water quality improvement and mitigation of flooding. The Constructed Wetland is also an integral component of the Open Space, Drainage and Wildlife Habitat Corridor.

8.4 The existing and proposed levels are shown on the "Terrain Model" and also the "Proposed Design Profile" Figures included within this report. ***(DGR: PA 3.1)***

8.5 Alternative sources of fill material have been investigated, but sources of fill are limited and neither environmentally nor socially acceptable. The importation of fill has also been shown to be environmentally and economically prohibitive. ***(DGR: CP 2.3 & PA 3.2)***

8.6 The majority of the areas for excavation, within the proposed development, lie within an area classified as Class 4 in Hastings LEP 2001 – Acid Sulphate Soil Maps.

8.7 The proposed methods for excavation, transportation and spreading of fill addressed in this report will comply with the Acid Sulphate Soil Management Plan (ASSMP) applicable to the site, included as Annexure A to the Cardno Water and Environment Engineering Report. ***(DGR: PA 3.2)***

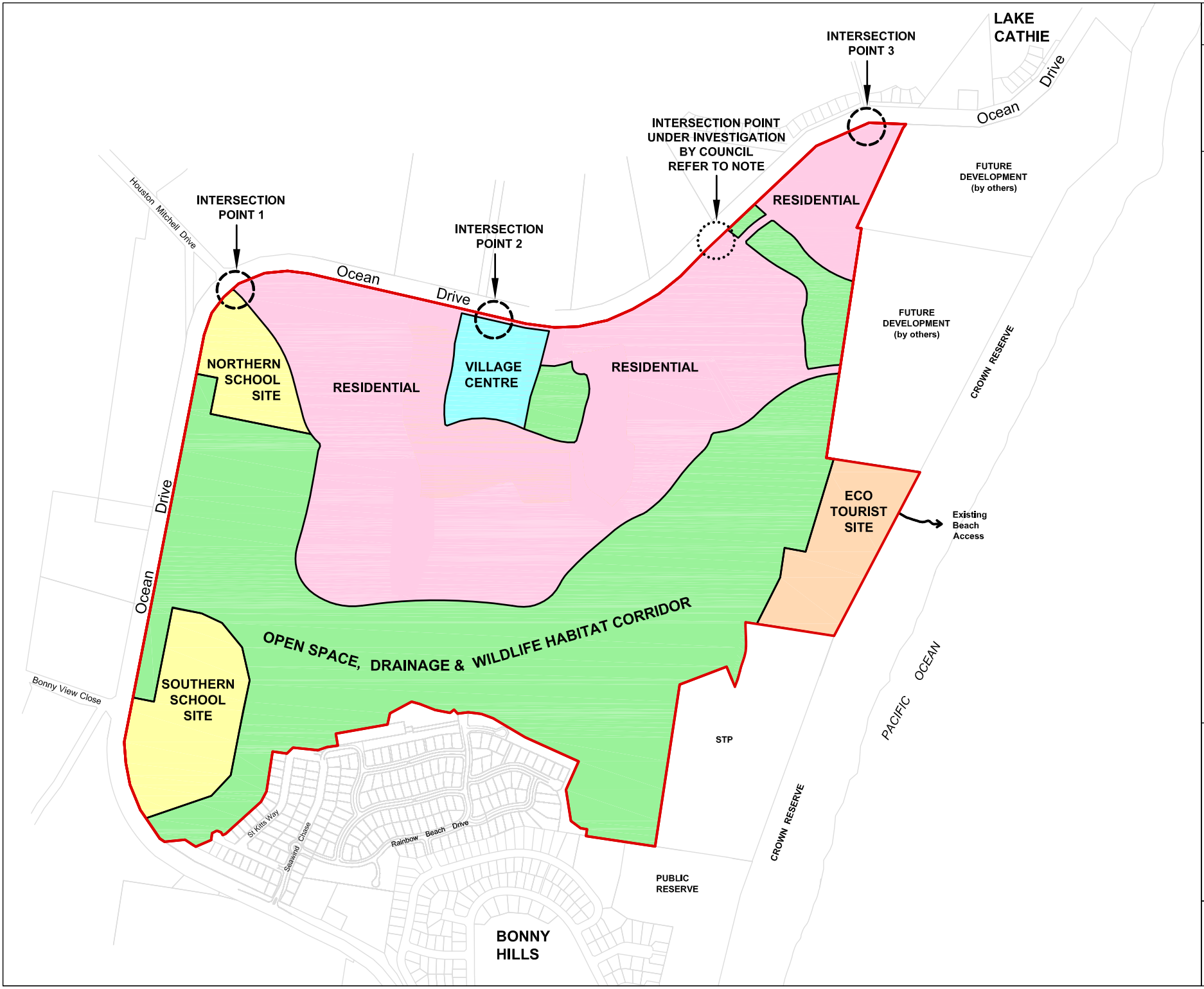

FIGURE 1

CONCEPT PLAN

- SUBJECT LAND
- OPEN SPACE/ DRAINAGE/ WILDLIFE HABITAT CORRIDOR
- RESIDENTIAL
- VILLAGE CENTRE
- SCHOOLS
- ECOTOURIST SITE
- INTERSECTION POINT
- INTERSECTION POINT UNDER INVESTIGATION BY COUNCIL TO PROVIDE ACCESS TO LANDS ON NORTH OF OCEAN DRIVE

Rainbow Beach Estate

Concept Plan Application Set

Job. No. 4509:ND Dwn: RM

Luke and Company Pty Ltd

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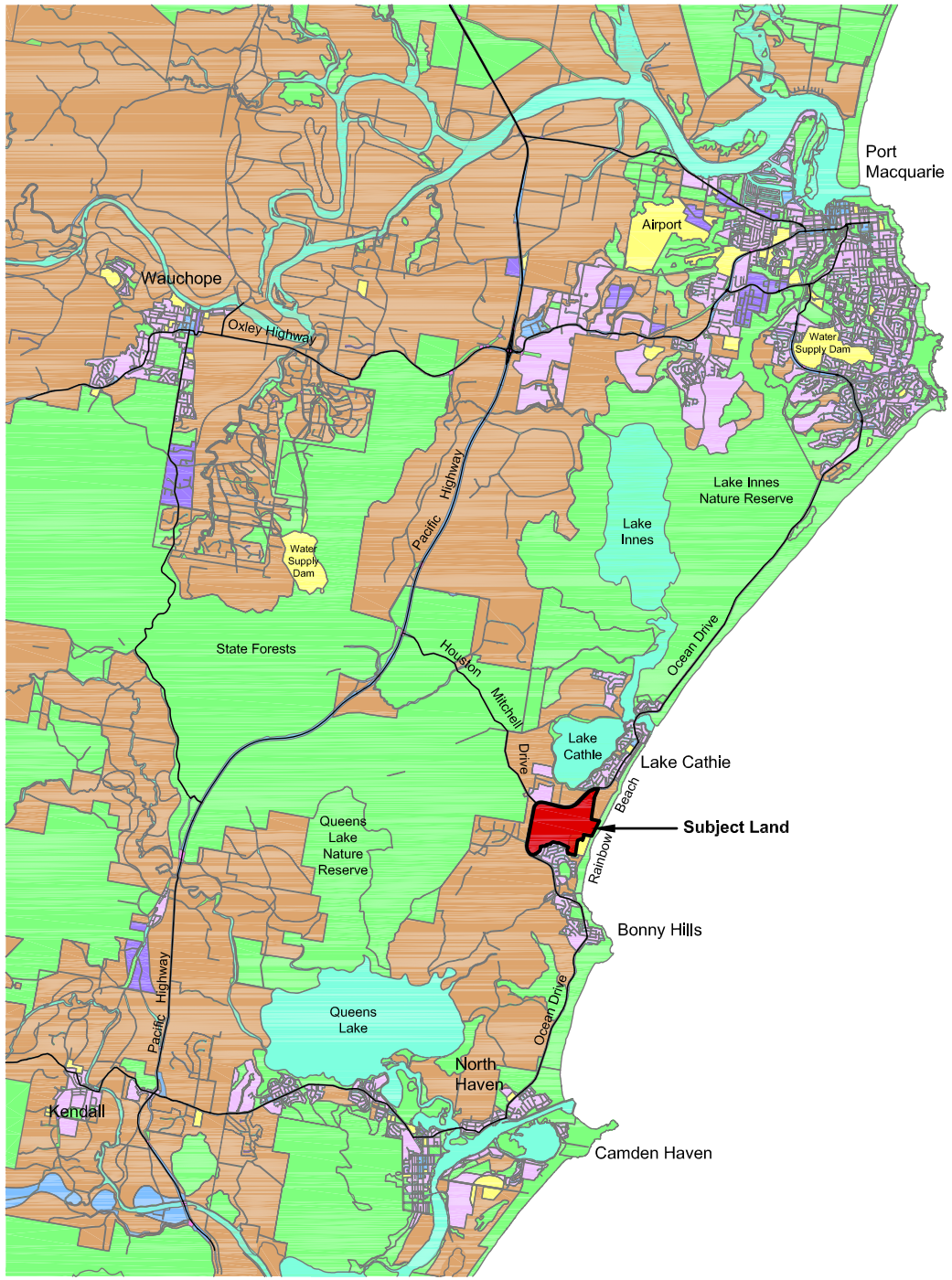
FIGURE 2

LOCATION PLAN



- Residential Land
- Commercial Land
- Industrial Land
- Special Uses Land
- Rural Land
- State Forests & Reserves
- Major Waterways

Rainbow Beach Estate

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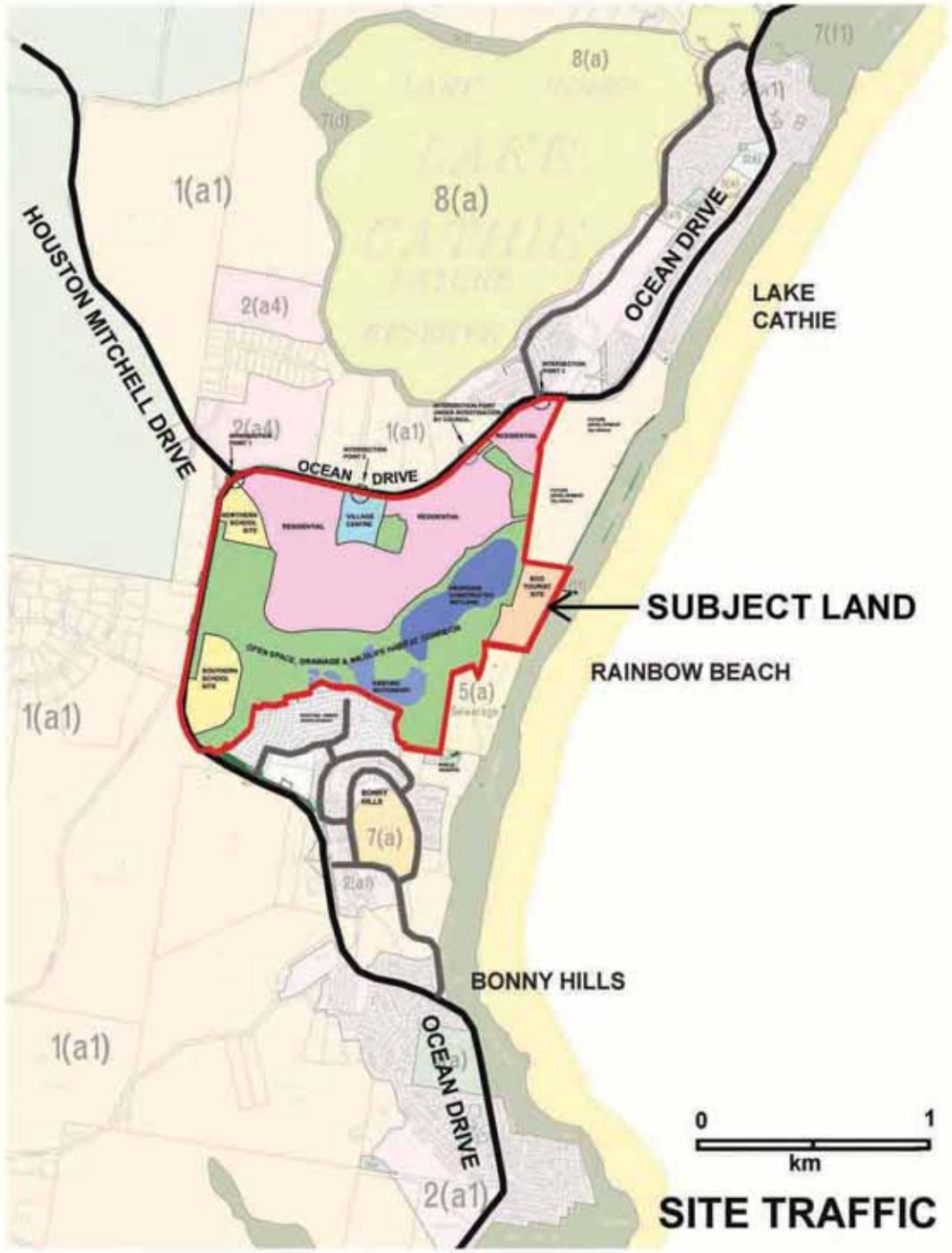
FIGURE 3

LOCAL ROAD NETWORKS



Collertor Roads

Local Roads

Rainbow Beach Estate
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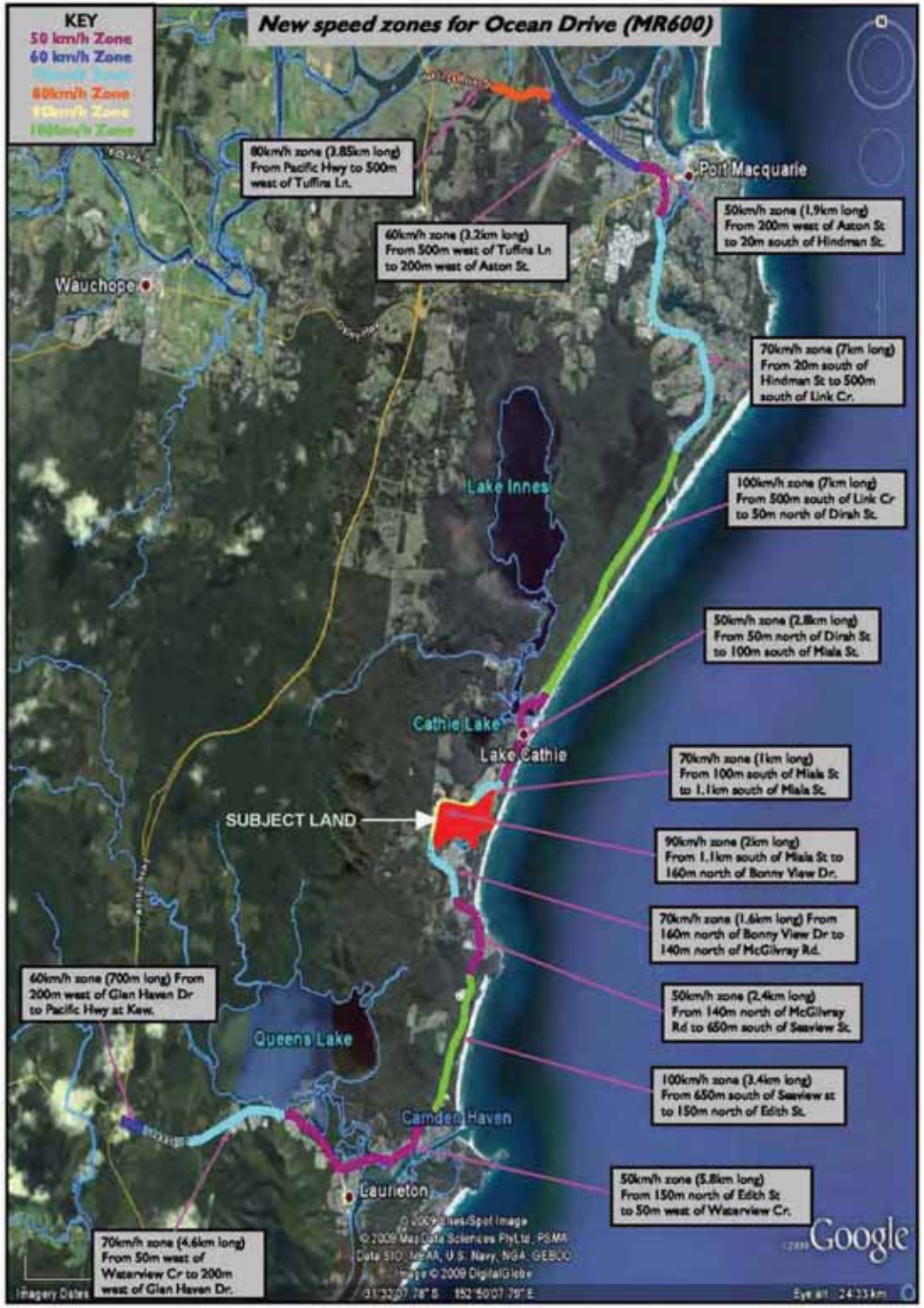
FIGURE 4

NEW SPEED ZONE FOR OCEAN DRIVE



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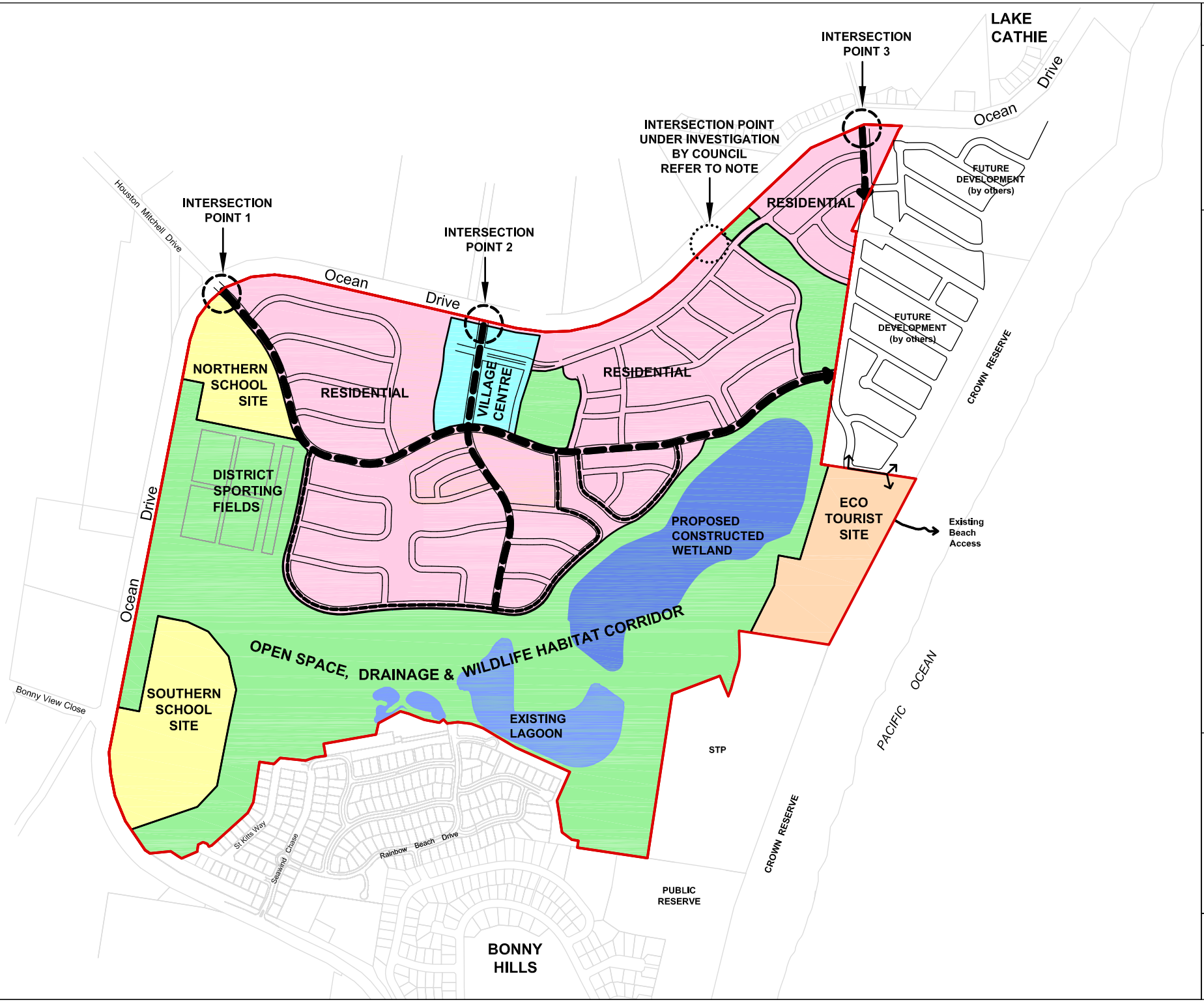

FIGURE 5

PROPOSED ROAD HIERARCHY & ACCESS

- SUBJECT LAND
- OPEN SPACE/ DRAINAGE/ WILDLIFE HABITAT CORRIDOR
- RESIDENTIAL
- VILLAGE CENTRE
- SCHOOLS
- ECOTOURIST SITE
- INTERSECTION POINT
- INTERSECTION POINT UNDER INVESTIGATION BY COUNCIL TO PROVIDE ACCESS TO LANDS ON NORTH OF OCEAN DRIVE
- PROPOSED COLLECTOR ROADS
- PROPOSED PERIMETER ROADS

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FIGURE 6

COORDINATION PLAN FOR BONNYHILLS & LAKE CATHIE AREA COASTAL WALKING & CYCLE TRACKS

St Vincents - proposed cycleway & walking paths
proposed as part of Rainbow Beach Estate development including the East-West linkages through the Open Space Corridor*

Lake Cathie & Bonny Hills Progress Association - proposed cycleway & walking paths
Proposed to follow site of existing service corridor (water & sewer mains, effluent main, overhead tension powerlines & unformed service road)
Location of walking and cycling track to be negotiated by progress associations with Council, taking into account suitable bridge crossing of Duchess Creek & Council's operating requirements of the Bonny Hills STP*

Milland & Seawide Properties - proposed cycleway & walking paths
taken from King & Campbell proposals*

Existing and future road cycleways*

* Subject to detailed planning and consent authority approvals

Rainbow Beach Estate

Concept Plan Application Set

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Appendix 1

Cardno Pty Ltd

Water Engineering and Environment Report

Appendix A: Acid Sulphate Soil Management Plan

April 2010

APPENDIX A

Acid Sulfate Soil Management Plan

TABLE OF CONTENTS

LIST OF TABLES

A1. ASS MANAGEMENT PLAN OBJECTIVES AND METHODOLOGY

This ASS (Acid Sulfate Soils) Management Plan (ASSMP) has been compiled to-

- Ensure that the construction of the proposed development does not result in release of acidic leachate and subsequent environmental harm;
- Provide appropriate design, management, monitoring and corrective action measures required to minimise the potential impact on the environment.
- Comply with relevant legislation and regulations.

The ASSMP has been prepared in accordance with the NSW Acid Sulfate Soils Manual 1998 prepared by the Acid Sulfate Soils Management Advisory Committee (ASSMAC) (ASS Manual) as required under the Hastings Local Environment Plan 2001.

The ASSMP is designed to assist construction staff in complying with their obligations under the NSW Protection of the Environment Operation Act 1999 (PEOA 1999).

A2. PROPOSED CONSTRUCTION ACTIVITIES

Construction activities associated with the subject development may cause potential oxidation of the PASS materials. These include:

- bulk earthworks including the excavation of material from the waterways at the site;
- dewatering associated with the above; and
- excavation associated with the construction of stormwater, sewer and other buried infrastructure during civil works.

Detailed control measures, in line with the construction activities listed above, are provided in the following sections.

A3. RESPONSIBILITY OF THE CONTRACTOR

The Contractor(s) for earthworks and civil works on the site shall conduct operations in accordance with this ASS Management Plan. Prior to the commencement of works, the Contractor shall provide the following information to the Consultant:

- Contractor's environmental policy.
- Names and responsibilities of supervisory staff involved with the implementation of the ASS Management Plan.
- Schedule of site inspections (and personnel responsible) to identify environmental problems, and maintenance actions to remedy any environmental problems identified.
- An Incidents and Events Register, in which all environmental problems identified during inspections and monitoring, and complaints received are recorded and acted upon.
- Environmental Training Plan and Training Record Plan for all personnel involved in development of the site.

Emphasis shall be placed upon the timely resolution of any complaints received in relation to development of the site and the development and implementation of corrective actions in response to non-conformities to the Management Plan (identified by the monitoring process).

The Performance Objective regarding complaint resolution is for the issue causing each complaint to be resolved in such a manner that there is no further complaint for the same reason.

The Contractor is to maintain an "Incidents and Events Register" which lists the date of the incident or complaint and the type of incident or complaint. For each incident, an incident/complaint log is to be completed nominating:

- Date of incident;
- Nature of incident and associated information;
- Location of incident;
- Name of person or body which reported incident;
- Employee who received notice of incident;
- Project Manager's review and comment;
- Recommended action to resolve incident;
- List of organisations to be contacted with regard to incident;
- Outcome of actions undertaken subsequent to incident being recorded; and
- Date of resolution of incident.

Each incident is to be assigned a number to be entered on the master Incident and Event Register. Further, Council and the Environment Protection Agency are to be notified with regard to corrective action sought for incidents which have the potential to cause environmental harm.

A4. POLICY STATEMENT

- To avoid detrimental impact on the water quality through the effective identification, treatment and management of acid sulfate soils at the site.

- To comply with the *NSW Protection of the Environment Operation Act 1999 (PEOA 1999).*

- To manage acid sulfate soils in accordance with the NSW *Acid Sulfate Soils Manual 1998* prepared by the Acid Sulfate Soils Management Advisory Committee (ASSMAC) (ASS Manual).

A5. PERFORMANCE OBJECTIVES

The objectives of the ASS Management Plan are to ensure the following:

- Implementation of additional assessment procedures during earthworks operations to confirm neutralising dosing rates for the effective treatment and management of any drained, disturbed or excavated ASS in accordance with the *ASS Manual*.
- Remediation of acid trend waters if discovered, and provision of control structures to prevent leachate discharge off-site which does not meet specific water quality criteria.
- The control of erosion and sedimentation of ASS during earthworks.
- Where possible all site water shall be reused on site. If it is necessary to discharge site water off site it shall comply with the following criteria:

Table A1 Water Quality Release Criteria

Water Quality Parameter	Release Criteria
pH	6.5 - 8.5
Oil and grease	No visible film. No detectable odour.
Iron floc and scum	None visible
Floating matter	None visible
Suspended Solids	< 50 mg/L
Dissolved Oxygen	80-100 %
Iron	300 µg/L
Aluminium	Equal to background levels

The performance criteria for hydrosluiced materials are specified below.

- No sample shall exceed 25 moles H^+/tonne (0.04% S).
- If any single sample exceeds 18 moles H+/tonne (0.03% S), then the average of any 6 consecutive samples (including the exceeding sample) shall have an average not exceeding 25 moles H+/tonne (0.03% S).
- If more than one sample in any 6 consecutive sample exceeds 25 moles H^+/tonne (0.03% S), then the average of any 6 consecutive samples (including the exceeding samples) shall have an average content not exceeding 16 moles H^+/tonne (0.03% S).

The following best environmental management practices shall also be employed:

- The area of disturbance during construction shall be limited to the immediate construction area and access routes.

- All earthworks areas shall be isolated by the provision of perimeter cutoff drains or bunds.
- Excavated material shall be retained within secure bunded areas until it has been assessed for acid sulfate potential and treated as required.
- Runoff shall be contained within the construction site for treatment prior to reuse on site, or if necessary discharge off site. This will require the construction of catch drains, perimeter bunds, temporary sediment ponds, etc.

A6. SITE MANAGEMENT PROCEDURES

A6.1 Introduction

Management of both excavated and in-situ soils are required under this Plan to ensure that the impacts of disturbance are within acceptable limits.

A6.2 Training

The Contractor shall employ suitably qualified personnel during all earthworks operations to supervise and monitor acid sulfate assessment, management and treatment, so as to comply with this Plan. These personnel shall be trained in the recognition of possible ASS.

A6.3 Excavation Techniques

Excavation shall be undertaken in stages to ensure that groundwater drawdown associated with dewatering of the excavation areas is minimised.

Only a single excavation cell within the waterways shall be completely dewatered at a time. Each excavation cell will be separated by a section of unexcavated material and once excavation of each cell is complete the cell will be re-flooded to reduce the potential for groundwater drawdown associated with the dewatering and excavation of the adjacent cell.

Excavated slopes shall be inspected on a daily basis and shall be treated by surface sprays and liming to prevent any acid formation.

All excavation and treatment areas shall be isolated from external areas by perimeter drains and/or bunds. All waters collected on the site shall be contained, collected, tested and treated prior to disposal to external areas. All excavated material shall be subjected to appropriate testing, and treated where required.

All soils including sands and the clay strata shall be sampled during excavation. The sampling frequency shall be 1 sample per 500 cubic metres. The soils Acid Neutralising Capacity (ANC) shall also be undertaken throughout the construction phase. The samples shall be tested in accordance with the Acid Sulfate Soils, Laboratory Methods Guidelines. The location and depth of all test samples shall be accurately recorded on a plan of the works area.

A6.4 Treatment

All soils indicated to exceed the oxidisable sulphur criteria shall be treated with fine agricultural lime after excavation. If ANC is included in calculations for liming rates, a fineness factor of at least 1.5 must be applied to account for likely lower acid neutralising capacity in the field.

The base of any stockpiling areas of excavated PASS shall be limed with a guard layer of at least 5kg/m^2/m depth of material excavated.

Mixing shall be carried out by spreading in layers of not more than 300 mm, and use of an agricultural spreader and disc plough, rotary hoe or similar. Care shall be taken to ensure that mixing occurs throughout the depth of the layer prior to placement of new material. The rate of lime application shall be determined in accordance with the Acid Sulfate Soils, Laboratory Methods Guidelines.

Following the successful treatment of the lot (as determined through the verification testing), the material shall be compacted and the next layer of excavated material to be treated shall be placed over the already treated material. This process shall be continued until the required site elevation is achieved.

A6.5 Validation Testing

The treated PASS shall be subject to validation testing at a rate of 1 test per 500 m^3 of treated soil (as per the QASSIT *2003 Laboratory Methods Guidelines*). The validation testing shall consist of the measurement of Scr, TAA, the pH of the soil (pH_{KCL}) and the measurement of excess acid neutralising capacity (ANC). A soil may be deemed to be effectively treated when it has no net acidity.

An excess ANC of 0.5 times the existing + potential acidity shall be used as the criteria for adequate neutralisation of ASS.

Verification testing shall include retained acidity where pH is < 4.5.

A6.6 Treatment of Fill Areas

The base of all fill areas where treated PASS are to be placed shall be treated with a guard layer of 5 kilograms per square metre of fine agricultural lime per metre depth of fill prior to the placement of any fill soils.

A6.7 Control of Discharge

All water generated from dewatering activities, seepage and site runoff shall be held on site. Ponded water shall be tested for pH on a daily basis, and no water shall be discharged from site unless it complies with the requirements of Table 1.

Treatment may include the addition of flocculating agents to reduce the suspended solids concentration, and the addition of hydrated or agricultural lime to control pH.

A6.8 Groundwater Monitoring and Treatment

Groundwater monitoring bores shall be drilled approximately 50 metres beyond the excavated area to monitor the effect of the earthworks operations on the surrounding groundwater. In addition, a baseline groundwater monitoring bore shall also be drilled at the boundary of the site remote from the excavations.

The groundwater level and pH in the bores shall be monitored prior to commencement of dewatering of the water body at the site and shall be monitored on a daily basis during excavation to determine if any remedial works are required. The groundwater pH value shall be maintained to within 1 of the baseline monitoring bore pH reading.

Remedial works may include temporary halt of excavation works to allow sufficient time for groundwater recharge, the construction of recharge trenches and addition of soluble lime to the water in recharge trenches.

A6.9 Storage of Lime

A sufficient supply of agricultural lime ($CaCO_3$) shall be retained at the site at all times for treatment of ASS. The supply shall be stored in a covered and bunded area to prevent accidental release to waters.

A quantity of hydrated lime shall be retained at the site at all times for treatment of acidic waters. Storage requirements for hydrated lime shall be identical to that specified above for agricultural lime.

A6.10 Monitoring

The Contractor shall monitor the works on a daily basis for evidence of:

- yellow efflorescence on soil surfaces
- sulfurous odour.

Laboratory analysis of soils during construction shall be in accordance with the ASS Manual.

Excavated soils subjected to analysis shall be sampled and tested at the rate of one test per 500 m^3 of placed material.

Satisfactory completion of treatment shall be validated in accordance with the ASS Manual. Validation testing of PASS material shall be undertaken at the rate of one test per 500 m^3 of placed material.

Lime delivery dockets are to be collected and checked against calculated amounts of lime used.

Daily on-site monitoring of water quality shall be required. All discharges from the site shall be continuously monitored for pH and turbidity. All water discharged from the site shall comply with the requirements of Table 1. Specifically, pH level must be between 6.5 and 8.5, and suspended solids (or equivalent turbidity) must not exceed 50 mg/L.

A7. REPORTING

The Contractor shall submit monthly reports on his activities to the Consultant and the Council including any non-conformances with this plan.

A8. CORRECTIVE ACTION

Corrective action shall be implemented if any complaints are received by the Contractor, Council or EPA.

Non-conformance with this plan shall be documented and a Corrective Action Request (CAR) issued. All CARs shall be included in the Non-Conformance Register.

The Contractor shall implement the corrective action as required within the agreed time frame noted on the CAR.

The Contractor shall advise Council and the Consultant upon completion of the corrective action.