AECOM Design + Planning

Preferred Project Report

Rainbow Beach Project Application
MP 07_0001

Part 3A Project Application | St. Vincent's Foundation Pty. Ltd. | 9 May 2011

BLANK PAGE

Preferred Project Report

Rainbow Beach Project Application MP 07_0001

Prepared for

St. Vincent's Foundation Pty Ltd

Prepared by

AECOM Australia Pty Ltd
Level 8, 17 York Street, Sydney NSW 2000, Australia
T +61 2 8023 9333 F +61 7 8023 9399 www.aecom.com
ABN 20 093 846 925

09 May 2011

Quality Information

Document	Preferred Project Report, Rainbow Beach Project Application MP 07_0001
Date	09 May 2011
Prepared by	Natasha Ridler
Reviewed by	Vince Berkhout

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
Revision 1	10/03/2011	DRAFT		
Revision 2	18/03/2011	DRAFT		
Revision 2	14/04/2011	FINAL DRAFT		
Revision 4	18/04/2011	FINAL		
Revision 5	09/05/2011	FINAL		

Table of Contents

List of Appendicies

List of Tables

List of Figures

BLANK PAGE

1.0 Introduction

1.1 The proposal

The St. Vincent's Foundation Pty Limited (the proponent) is seeking approval for a Concept Plan (MP 06_0085) and Project Application (MP 07_0001) on a 177.4 ha parcel of land located within the Port Macquarie – Hastings local government area (LGA) between the coastal villages of Bonny Hills and Lake Cathie. The Project Application is the initial development stage of the overall Concept Plan and comprises drainage, open space and habitat restoration works. This Preferred Project Report relates to the Project Application component of the proposal, as described below.

1.1.1 Project Application

The Project Application seeks approval for the Central Corridor (located within the open space, drainage and wildlife habitat corridor of the Concept Plan), and associated works as follows:

- Works located within the Central Corridor:
  - open space, environmental and recreational elements;
  - excavation works required to construct wetlands;
  - stormwater treatment and management elements; and
  - establishment works for the district sporting fields.
- Works located outside of the Central Corridor:
  - placement of fill won from wetland excavation; and
  - a formalised access way on Crown land to allow access to Rainbow Beach.

Details of the Project Application and environmental assessment are outlined in the *Environmental Assessment Report: Rainbow Beach Project Application Central Corridor and Associated Works*, dated 8 July 2010, prepared by AECOM.

1.1.2 Preferred Project Application

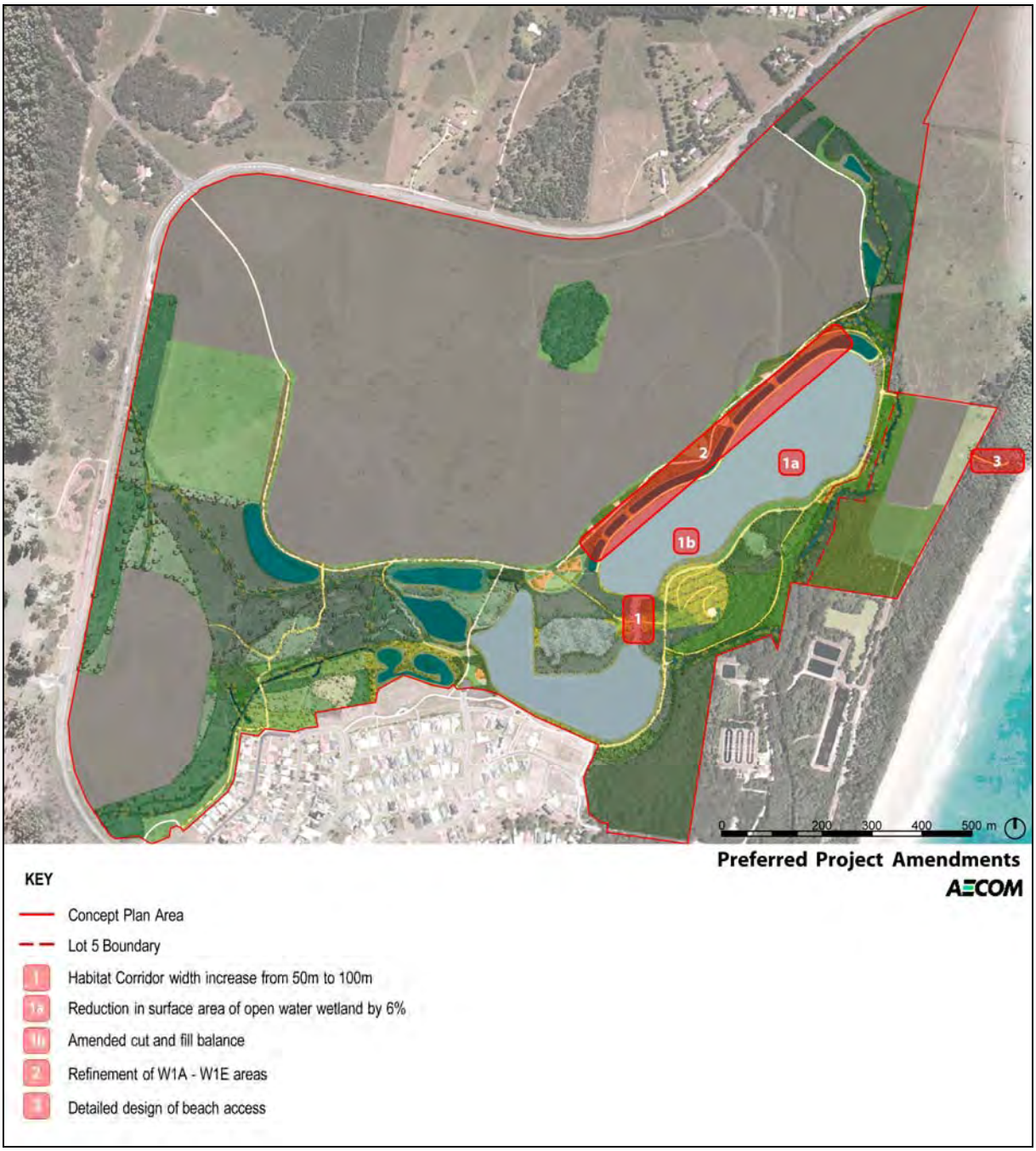
The exhibited proposal has been amended in a number of respects in response to submissions received during the exhibition period and following review by the proponent.

The primary change proposed is the relocation of the western end of the open water wetland to allow for an increase in width of the habitat corridor between the existing lagoon and open water wetland. With the exception of the detailed design of the beach access and refinement of W1 treatment areas, the proposed amendments listed below have been made as a result of the increased habitat corridor width.

The preferred project amendments, which are shown in Figure 1 and detailed in Section 2.0 of this report include:

- Increase in width of the habitat corridor between the existing lagoon and the proposed open water wetland from 50 m to 100 m, resulting in:
  - reduction in surface area of the open water wetland by 6%;
  - revision of original Environmental Land Use Management Plan (ELUMP) to reflect minor modifications to the breakdown of open space areas within the Central Corridor; and
  - amended cut and fill balance.
- Refinement of wetland treatment areas W1A – W1E within the proposed open water wetland.
- Detailed design of proposed beach access over Crown land.

Figure 1 Preferred project amendments



1.2 Purpose of the document

During the exhibition of the Concept Plan and Project Application environmental assessments, 25 submissions were received. The Director-General of the DoP provided copies of the submissions to the proponent. In accordance with section 75H(6) of the EP&A Act, the Director-General required the proponent to address the issues raised in the submissions. If the response required changes to the Concept Plan or Project Application to minimise environmental impact, a preferred project report was to be prepared and the statement of commitments to be revised for both the Concept Plan and Project Application.

This report outlines the proposed amendments to the Project Application specifically. These changes are detailed in Section 2.0.

A number of addendum specialist assessments have been provided as a result of design changes. These specialist assessments are listed in Section 1.3 and discussed in Section 2.0.

The statement of commitments has been revised to clarify and strengthen planning and environmental management actions, as outlined in Section 3.0.

This report is accompanied by two additional reports prepared by AECOM, being the Concept Plan and Project Application Submissions Report and the Concept Plan Preferred Project Report. The Submissions Report identifies the issues raised during exhibition of the Concept Plan and Project Application environmental assessments (EAs) and provides the proponent's responses. The Concept Plan Preferred Project Report includes a description of changes to the Concept Plan and a revised statement of commitments.

The three volumes outlined above should be read concurrently. These reports should also be read in conjunction with the Project Application EA prepared by AECOM (referenced above) and the Concept Plan application details and environmental assessment contained within the *Concept Plan 06_0085 Rainbow Beach Environmental Assessment Report*, dated August 2010, prepared by Luke & Company Pty Ltd.

1.3 Specialist assessments

Addendum specialist assessments have been provided in response to proposed design changes as follows:

- Darkheart Eco-Consultancy (Darkheart), *Assessment of Doubling of Corridor Width at the Constructed Wetland/Eastern Lagoon Spillway*, April 2011, (Appendix A).
- Cardno Pty Ltd (Cardno), *SVF Rainbow Beach Development Application MP 06_0085 Rainbow Beach Concept Plan, MP 07_0001 Project Application – Open Space Corridor and Constructed Wetland, Assessment of Modifications to West End of W1 Waterway, Hydrology and Flooding,* February 2011 (Appendix C).
- University of NSW Water Research Laboratory (WRL), *Assessment of Modifications to Waterbody 'W1' and Implications for Groundwater*, February 2011 (Appendix E).

2.0 Proposed design changes

2.1 Increased habitat corridor width

The width of the habitat corridor between the existing lagoon (E3) and the proposed open water wetland (W1) has been increased from 50 m to 100 m to improve east-west habitat connectivity. This has been achieved by reducing the surface area of W1 by 6% from 10.5 ha to 9.9 ha and relocating the western end of W1 northwards.

Fauna migration through this widened corridor is enhanced by replacing the original hydraulic flood control connection channel S2 with a wildlife friendly channel with gentle side slopes. The revised channel will be shaped as a wide rock-protected V-notch weir, with an invert level of RL 3.4 and 1:10 side slopes. The widened connection channel will be protected against erosion by rock placement and vegetation suitable for negotiation by fauna. A pedestrian bridge will cross the corridor between E3 and W1 at an elevation of RL 4.85.

Figure 2 illustrates the amended landscape master plan resulting from the above changes. Details of the revised S2 control structure and connecting channel are illustrated in Figures 3, 4 and 5.

Figure 2 Amended landscape master plan

Figure 3 Habitat corridor width increase

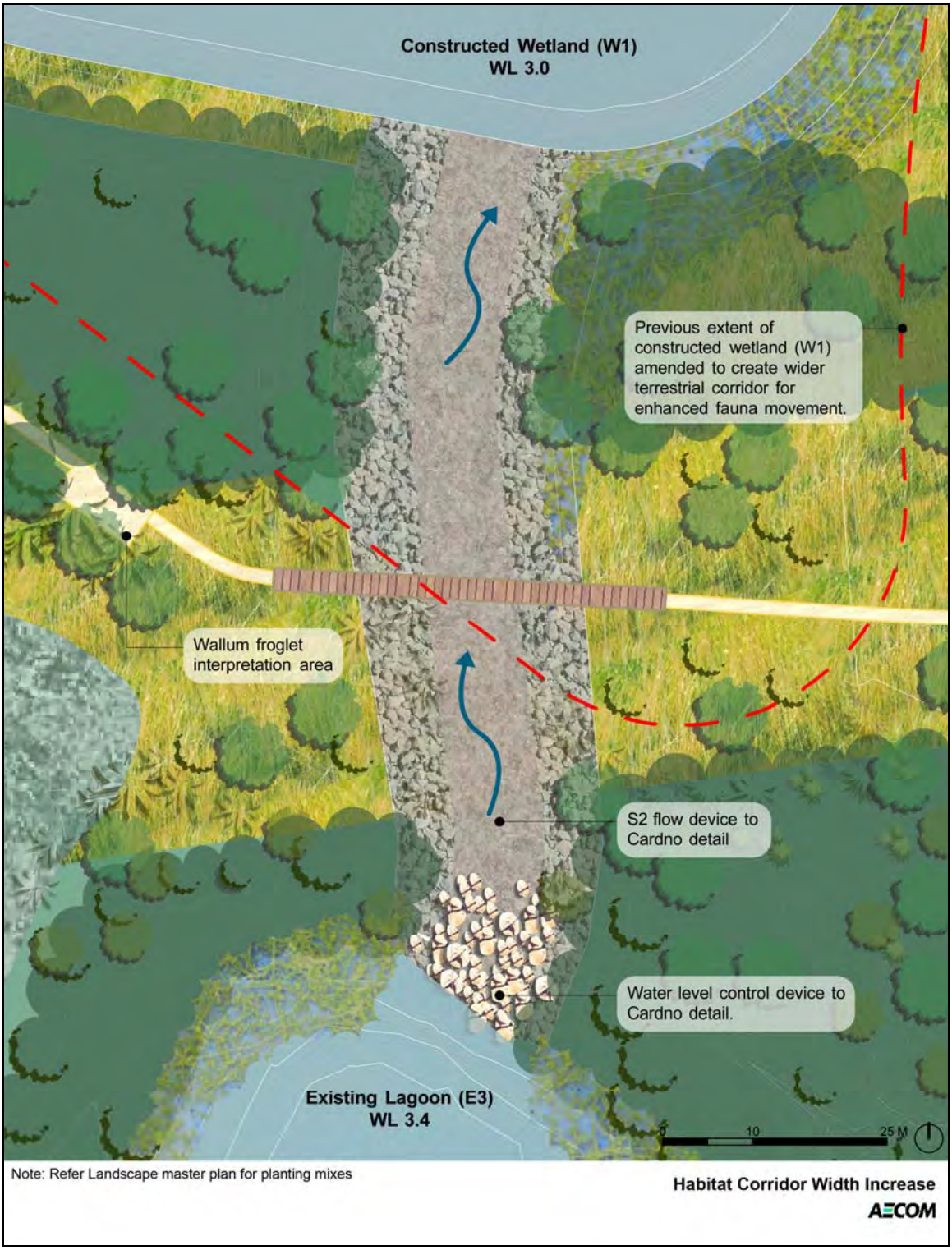
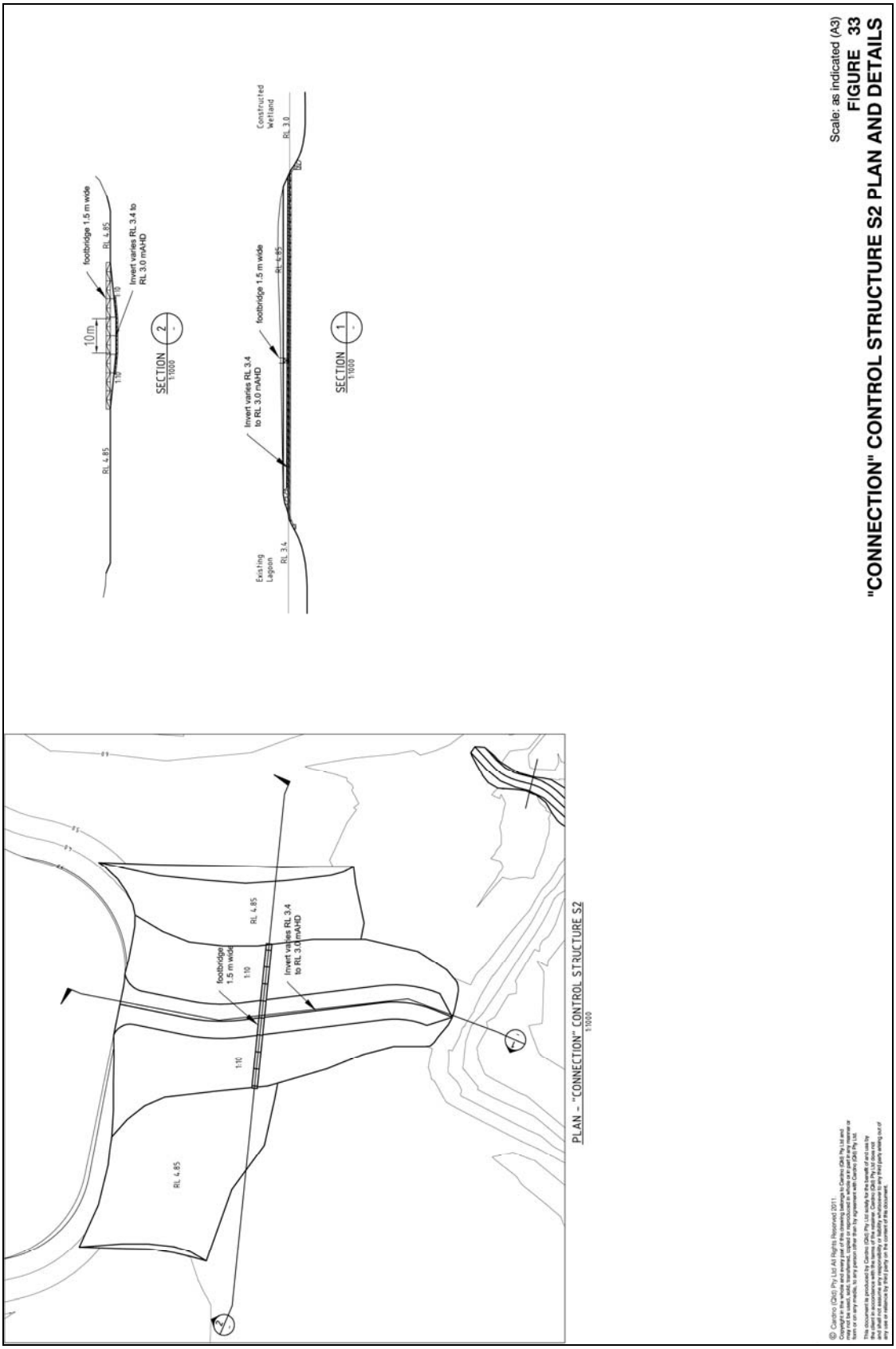


Figure 4 Connection control structure S2 features

Source: Cardno 2011

Figure 5 Connection control structure S2 detail



Source: Cardno 2011

2.1.1 Ecological assessment

An ecological assessment of the changes to W1 has been undertaken by Darkheart (2011) (see Appendix A). The assessment found that the proposed amendments to W1 represent a significant enhancement from the original design. The proposed changes and their added ecological benefits are outlined in Table 2.1.

Table 2.1 Ecological benefits of amendments to W1

W1 amendment	Ecological benefits
Increase in width of the habitat corridor from 50 m to 100 m	• Amended design will provide an effective linkage for target species including the Koala and Squirrel Glider. • Amended design will also provide in situ habitat for a range of native species. • Increased width allows for further expansion of Core Koala Habitat by increasing land available for planting of Koala food species. • Increased width moves pedestrian access further away from the Wallum Froglet area, benefiting hygiene and disease control for the Wallum Froglet habitat area.
Redesign of S2 connection control structure	• Proposed structure now mimics a natural watercourse with strategic placement of large rocks, snags derived from removal of large Forest Red Gums from grazed areas of the site and appropriate planting of sedges and riparian vegetation along the edges, resulting in increased provision of habitat resources and crossing mechanisms. • Natural slopes with embedded rocks and established logs and riparian vegetation will enclose the flow path and further minimise the canopy gap. • Flow device will convey water only intermittently and will be dry for the majority of the time, mimicking the regime of a natural drainage line in a forested context and hence pose no barrier to movement of fauna.

2.1.2 Hydrology and flooding assessment

Cardno (2011) have assessed potential impacts on hydrology and flooding as a result of changes to W1 (see Appendix C). The assessment found that the revised S2 control structure will be hydraulically equivalent to the hydraulic flood control design included in the original project and that amendments will not alter the flooding behaviour of Duchess Creek. The proposed weir has the same hydraulic characteristics as the originally proposed 5 m wide weir and the regraded embankment is equivalent to the overbank overflow area originally proposed. The flow characteristics within the revised channel will not cause any tailwater interference with the operation of the control weir.

Flood events up to and including the 5 year ARI event will be contained within the central channel. In higher floods shallow flow will also occur across the embankment adjacent to the channel. The pedestrian bridge will be level with the regraded overflow embankment and will connect with a pedestrian pathway at this elevation, avoiding interference with the operation of the S2 hydraulic control which manages flows between E1 and W1. The bridge soffit will be above the water level in the connection channel during flood events and will not interfere with the operation of the S2 hydraulic control.

2.1.3 Groundwater assessment

Potential impacts on groundwater resulting from changes to W1 have been remodelled and assessed by University of NSW Water Research Laboratory (WRL) (2011) (see Appendix E). Results found that the revised W1 design will result in reduced groundwater drawdown over the site compared to the original design. Although the changes are minor, groundwater monitoring will be carried out as recommended by WRL (see revised statement of commitments in Section 3.0 of this report).

2.2 Amendments to Central Corridor areas

Amendments to W1 have resulted in minor modifications to the breakdown of areas within the Central Corridor. Table 2.2 outlines the amended areas as proposed within the preferred project (changes in bold italics). Amended areas are illustrated in Figure 6.

Table 2.2 Original and proposed open space areas

Component	Original area (ha)	Proposed area (ha)
Central Corridor		
District sporting fields	7.7	7.7
Existing lagoons, water bodies and wetlands		
• E1 existing treatment area	0.7	0.7
• E2 existing treatment area	0.7	0.7
• E3 existing lagoon	4.9	4.9
Proposed constructed wetlands		
• W1 open water wetland	10.5	***9.9***
• W1 treatment areas (W1A – W1E)	1.9	***1.2***
• W2 and W3 stormwater treatment areas	1.3	1.3
Habitat / open space	47.5	***48.8***
Total Central Corridor	**75.2**	**75.2**

Source: Luke & Co, 2011

An Environmental Land Use Management Plan (ELUMP) was prepared by Cardno for the Project Application (Appendix D of the Project Application EA). Sections of this plan have been revised to reflect the above changes. The amended ELUMP is included in Appendix H.

Figure 6 Open space, drainage and habitat areas

Source: Luke & Co 2011

2.3 Amended cut and fill balance

The proposed extent of fill for the future urban areas has been designed to achieve a balance between the available excavated material from W1 and the volume of fill required for the filling of future urban areas to flood free levels. The preferred project seeks to maintain this balance. However as the area of W1 has been reduced by 6%, there is a corresponding reduction in the volume of excavation material available. To make up for this material loss and achieve the desired cut/fill balance as originally proposed, additional excavated material is obtained by varying and in places deepening the floor level of W1. Figure 7 shows proposed floor levels for the wetland excavation. Table 2.3 demonstrates the close balance between the volumes of fill required and volumes of fill excavated.

Table 2.3 Fill volumes required and fill volumes available (preferred project)

Fill area	**Structural fill (sandy alluvium) (m^3)**	**Non-structural fill (topsoil) (m^3)**
Northern school site – fill area one	27,300	3,350
Northern school site – fill area two	152,000	20,200
Northern school site – fill area three	168,000	14,700
Perimeter roads and outer boundaries	-	11,250
District sporting fields – fill area four	-	20,400
Total consolidated fill	**347,300**	**69,900**
Total structural and non-structural fill	**417,200**	
Excavation	**Structural fill (sandy alluvium) (m^3)**	**Non-structural fill (topsoil) (m^3)**
Open water wetland – W1	433,900	23,500
Topsoil from fill areas 1, 2 & 3	-	57,360
Total volume excavated	**433,900**	**80,860**
Allowance for losses and compaction	20%	15%
Net material (solid measurement) available for fill	**347,100**	**68,700**
Total material (solid measurement) available for fill	**415,800**	

Source: Luke & Co, 2011
NOTE: Losses and compaction for excavated material (sandy alluvium) is likely to be in the range of 17% to 20%. To be conservative, the upper range of 20% has been applied.
NOTE: Total volumes have been rounded to the nearest hundred below.

After calculating a 20% allowance for earthworks losses (relating to losses in working the earthworks and compaction), the net volume of structural fill (sandy alluvium) available from the excavation of W1 is 347,100 m3. The volume of structural fill required is 347,300m3, for practical purposes a close balance. For the topsoil the quantities of excavation and fill are in close balance, when considering the large areas involved and the variable thickness and compaction of the insitu topsoil to be stripped, stockpiled and later respread.

2.3.1 Acid sulphate soil assessment

The excavation of W1 has been designed as a series of level benches set at a minimum of 400 mm above the estuarine clay layer. Limiting the bed of the W1 excavation to 400 mm above the estuarine clay layer means that identified potential acid sulphate soils (PASS) are avoided and disturbance of acid sulphate soils is minimised. The estuarine clay layer will be readily identifiable as construction proceeds.

The management measures for acid sulphate soils remains unchanged from those provided by Cardno as part of the Project Application EA.

Figure 7 W1 excavation plan and W1A to W1E treatment wetland areas

Source: Luke & Co 2011

2.4 Refinement of W1 wetland treatment areas

Wetland treatment areas W1A to W1E within W1 have been refined to improve accessibility for ongoing management and maintenance purposes. The revised water treatment areas are set out in Table 2.4 and shown in Figure 7.

Table 2.4 Original and proposed wetland treatment areas

Wetland name	Original wetland area (m^2)	Proposed wetland area (m^2)
W1A	960	970
W1B	800	810
W1C	4,050	4,060
W1D	1,620	1,620
W1E	4,750	4,320

NOTE: Original wetland areas as per Appendix M of Project Application EA

2.4.1 Water quality assessment

With the exception of W1E, the proposed footprints of wetland treatment areas W1A to W1D are generally consistent with those originally outlined in Appendix M of the Project Application EA. Minor increases in areas are proposed for wetland treatment areas W1A – W1C. As increases are negligible they do not alter water quality recommendations provided by AECOM as part of the Project Application EA.

The footprint of W1E is 430 m^2 smaller than the area required to meet Council's water quality criteria (as outlined in Appendix M of the Project Application EA). The additional treatment required will be provided through the inclusion of supplementary bioretention systems within future urban areas, as discussed in Section 4.2.9 of Appendix M of the Project Application EA. The details of supplementary bioretention systems will be devised during detailed design undertaken as part of separate project or development application(s) for urban components of the Concept Plan.

2.5 Beach access

Following consultation undertaken with the Land and Property Management Authority (LPMA) regarding provision of beach access, detailed design of the proposed beach access has been undertaken in accordance with LPMA's recommended conditions of approval (see Table 3.1.10 within the Submissions Report).

Proposed beach access is made up of two path treatments as follows:

- Path A comprises a 2.5 m wide path of bago gravel with timber edges and a post and wire fence 1.4 m in height.
- Path B comprises a 2 m wide floating timber boardwalk and 1.4 m high post and wire fence.

Detailed design of the beach access complies with the *NSW Coastal Dune Management Manual 2001*. Materials have been selected to stabilise pathways and avoid land degradation. Fencing is proposed to direct access towards the beach and deter access to adjoining bush. Figure 8 and Figure 9 details the proposed beach access.

Owner's consent for proposed works on Crown land has been provided by the LPMA and is attached at Appendix I of this report.

Figure 8 Beach access detail

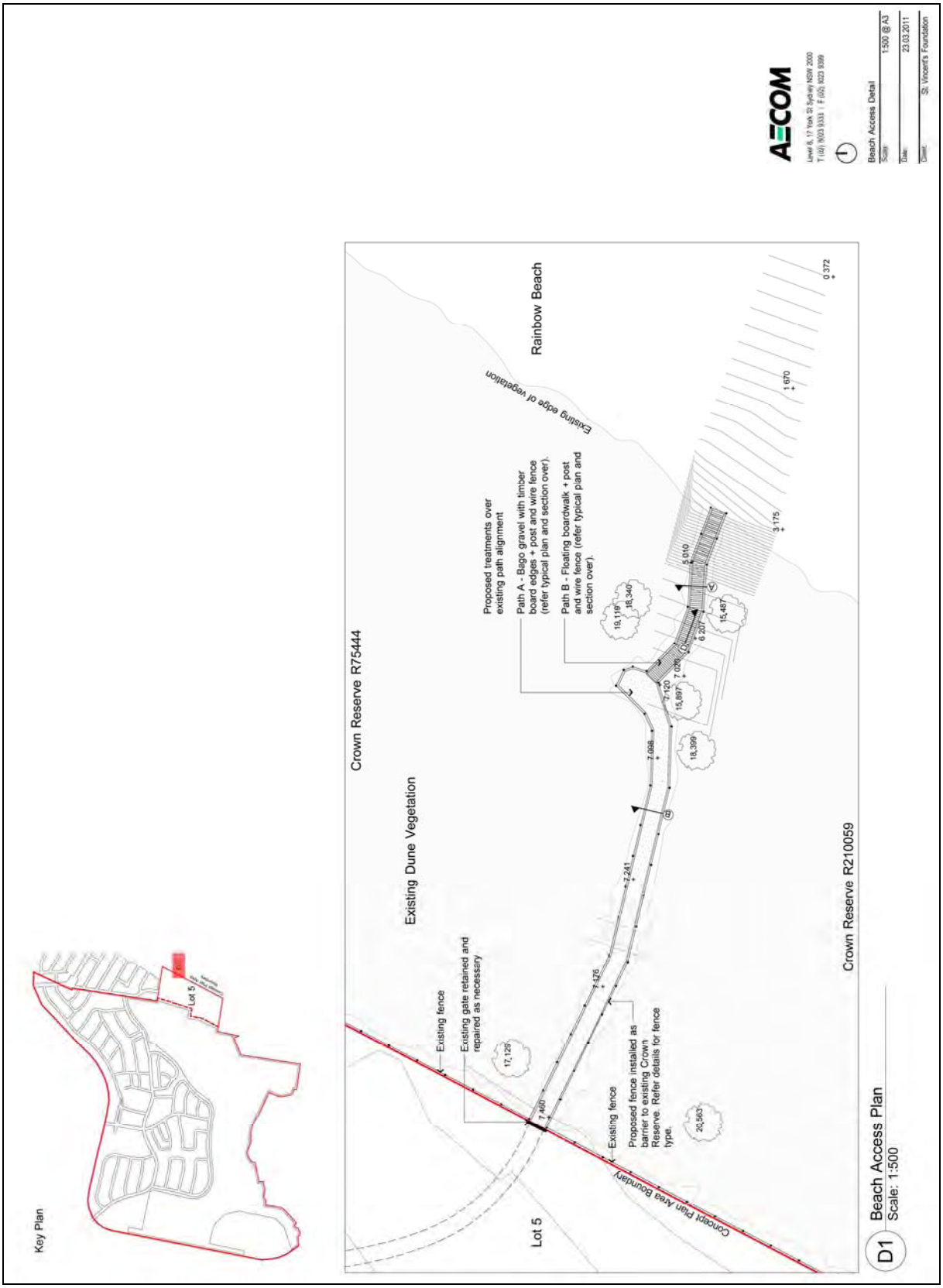
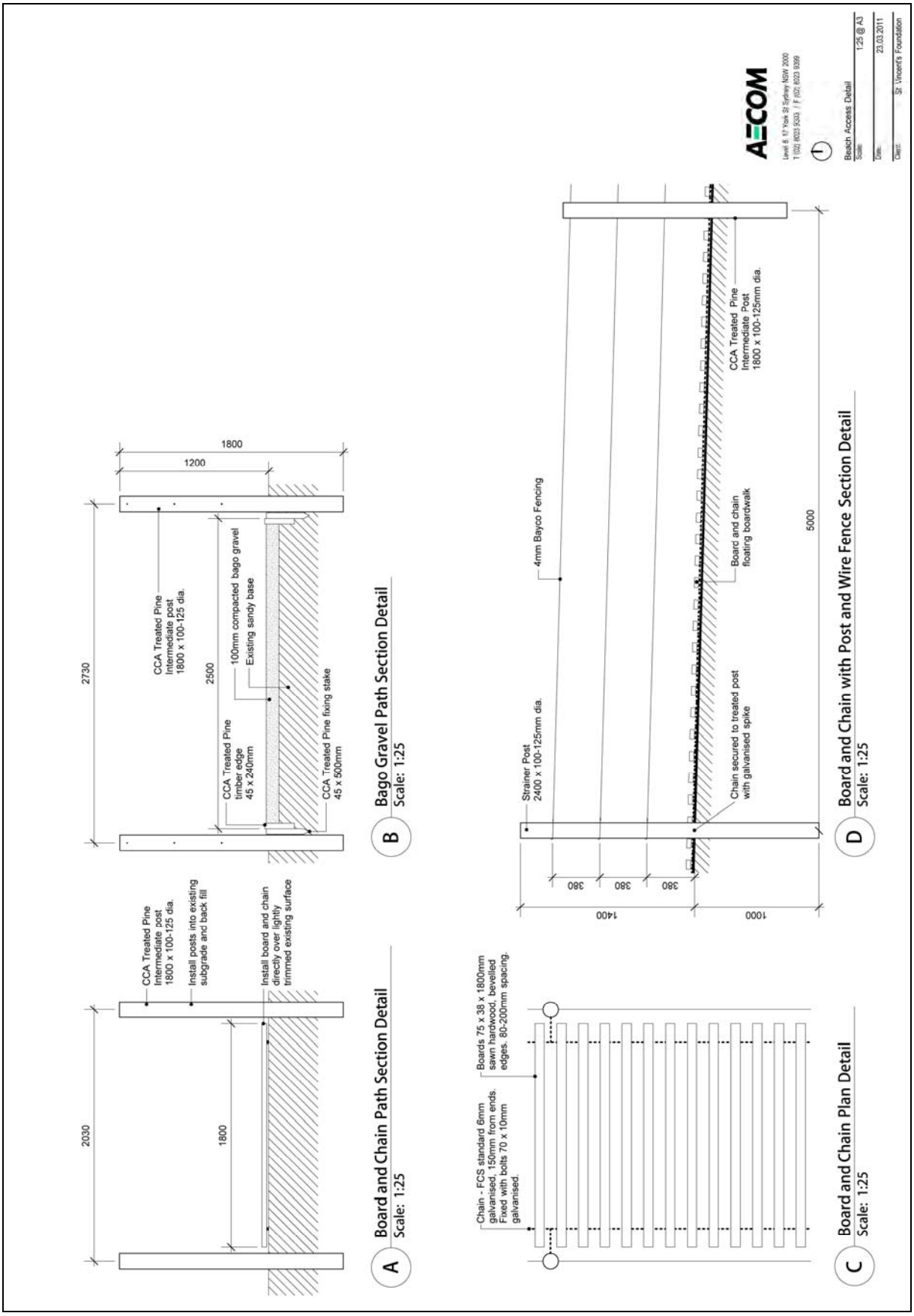


Figure 9 Beach access sections



3.0 Revised statement of commitments

The environmental assessment for the Project Application identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts.

After consideration of the issues raised in submissions, the draft statement of commitments for the Project Application (refer to **Chapter 13.0** of the EA) has been revised. Should the project be approved, the revised commitments would guide the subsequent phases of the Project Application development.

In addition, the proponent is committed to integrating the constructed wetlands proposed for the Central Corridor within the overall stormwater treatment train and that the design of the urban area will result in overall compliance with Council's IWCM policy. This has been discussed and agreed with Storm Consulting as an appropriate methodology with respect to WSUD. A specific commitment in this regard is included within **Table 3.1**.

The following definitions apply in relation to the revised statement of commitments:

- Pre-construction – work in respect of the project that includes design, survey, fencing, investigative drilling or excavation, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing ancillary facilities such as site compounds or other relevant activities determined to have minimal environmental impact (eg minor access tracks and adjustments to services/utilities etc).
- Construction – all work in respect of the project other than that defined as a pre-construction activity/work.
- Operation – the operation of the project, but not including temporary use of parts of the project during construction.

The revised statement of commitments, including commitments relating to the key issues described in the DGRs is provided in **Table 3.1**.

Table 3.1 Revised statement of commitments

Issue	Commitment	Timing
Detailed design	Final detailed design and specifications for the Central Corridor will be completed at the construction certificate stage. Details will include: • provision of habitat within the open water wetland; • separation of key fish habitat of Duchess Gully and water quality infrastructure.	Pre-construction
Open space management	The proponent is to enter into a VPA with Port Macquarie – Hastings Council under Section 75F(6) of the EP&A Act in regards to the management and dedication of the Central Corridor.	Pre-construction
	The Central Corridor is to be managed in accordance with the Open Space Management Strategy (OSMS) prepared by Cardno (April 2010) and in accordance with Council requirements as per the VPA.	Operation
Habitat protection and rehabilitation	The rehabilitation of the Central Corridor is to be undertaken in accordance with the OSMS prepared by Cardno (April 2010).	Construction
	The OSMS is to be amended to include measures for underpass and overpass connectivity to link the area of Swamp Oak Floodplain Forest EEC to the Central Corridor at the northern boundary of the Central Corridor.	Pre-construction
Surface water quality monitoring	Ongoing surface water quality monitoring is to be undertaken in accordance with the Surface Water Monitoring Plan prepared by AECOM (July 2010) for the duration of the management and maintenance period of the VPA (20 years).	Construction and operation
Groundwater quality monitoring	Ongoing groundwater monitoring is to be undertaken in accordance with the Groundwater Monitoring Plan prepared by WRL (March 2010) for a period of 2 years.	Construction and operation
	The Groundwater Monitoring Plan is to be amended to include monitoring of analytes in the water treatment wetlands.	Pre-construction
Water licensing	Consultation with NoW regarding the need for water licenses for works proposed as part of the Project Application.	Pre-construction
Stormwater management	Stormwater is to be managed in accordance with the Water Engineering and Environment Report prepared by Cardno (April 2010) and the Stormwater Treatment and Wetland Functionality Report prepared by AECOM (2010). For stormwater management matters not detailed in the above reports, management is to be in accordance with the Port Macquarie - Hastings Council Integrated Water Cycle Management (IWCM) policy for Area 14.	Construction and operation
	Examine ways to consolidate and optimise the total number and performance of the treatment wetlands to reduce maintenance costs where reasonably feasible, without increasing the overall footprint proposed.	Pre-construction
Bushfire management	A Fire Management Plan will be prepared to address those measures required to meet the provisions of Section 63 of the *Rural Fires Act 1997.*	Pre-construction

Issue	Commitment	Timing
Contamination	Compliance with SEPP No. 55 – Remediation of Land for areas of localised soil impact identified, or additional areas identified during future site works.	Construction
ASS management	Acid sulfate soils are to be managed in accordance with the *NSW Acid Sulfate Soils Manual 1998*, as referenced within the Acid Sulfate Soil Management Plan prepared by Cardno (April 2010) and the Groundwater Monitoring Plan prepared by WRL (March 2010).	Construction
	Consultation with NoW regarding the payment of a security bond to enable remediation of any ASS impacts should they occur.	Pre-construction
Aboriginal heritage	Works are to comply with relevant DECCW Aboriginal cultural heritage guidelines and requirements of the *National Parks and Wildlife Act 1974.*	Construction
Beach access	The beach access will be maintained by the proponent until a separate project or development application for Lot 5 DP 25866 is prepared, at which time responsibility for permanent maintenance will be agreed as part of a separate VPA.	Operation
	Crown land will not be used for bushfire protection measures.	Construction and operation
	Stormwater runoff from future adjacent residential areas, including runoff from future hard surfaced roads and car parks will not be directed onto crown land.	Construction and operation
Construction management	Construction works are to be managed in accordance with the Construction Environment Management Plan prepared by Cardno (April 2010).	Construction
	An application for the issue of an Environmental Protection License will be made to DECCW.	Pre-construction

4.0 Glossary of terms and abbreviations

Terminology	Description
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
Area 14 Structure Plan	Port Macquarie – Hastings Council adopted Lake Cathie & Bonny Hills Master Plan 2004 for the Area 14 Release Area
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soil Management Plan
CEMP	Construction and Environmental Management Plan
Concept Plan	Major Project 06_0085
Council	Port Macquarie – Hastings Council
DCP	Development Control Plan
DECCW	NSW Department of Environment and Climate Change and Water
DG	Director General
DGRs	Director General's Environmental Assessment Requirements
DoP	NSW Department of Planning
DP	Deposited Plan
E1	Existing Lagoon
EA	Environmental Assessment
ECC	Endangered Ecological Community
ELUMP	Environmental Land Use Management Plan
EP&A Act 1979	*Environmental Planning and Assessment Act 1979*
EPBC Act 1999	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
HLEP 2001	*Hastings Local Environmental Plan 2001*
IWCM	Integrated Water Cycle Management
KPOM	Koala Plan of Management
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MP	Major Project under Part 3A of the EP&A Act
NoW	NSW Office of Water
OSMS	Open Space Management Strategy
Part 3A	Part 3A Major Project or Part 3A of EP&A Act
PASS	Potential Acid Sulfate Soil
PMHC	Port Macquarie – Hastings Council
PMHLEP 2011	*Port Macquaire – Hastings Local Environmental Plan 2011*

POEO Act 1997	*Protection of the Environment Operations Act 1997*
Project Application	Major Project 07_0001
Proponent	St Vincent's Foundation Pty Ltd
Proposal	Rainbow Beach Concept Plan (MP 06_0085) and Project Application (MP 07_0001)
RFS	NSW Rural Fire Service
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
SSFCF	Swamp Sclerophyll Forest on Coastal Floodplains
STP	Sewerage Treatment Plant
Structure Plan	Area 14 Structure Plan
Subject Site	Part Lot 1232 DP 1142133, Lots 1, 2, 3 and 4 DP1150758 and Lot 5 DP 25886
SVF	St Vincent's Foundation Pty Ltd
VPA	Voluntary Planning Agreement
WSUD	Water Sensitive Urban Design
W1	Proposed Open Water Wetland

Appendix A

Ecological supplementary assessment

Appendix A Ecological supplementary assessment

DARK HEART
Eco-Consultancy

Thursday, 7 April 2011

Mr Brian Tierney
Tierney Property Services
PO Box 493
PORT MACQUARIE NSW 2444

Dear Brian,

RE: Rainbow Beach Project Application (07_0001):-
Assessment of Doubling of Corridor Width at the Constructed Wetland/Eastern Lagoon Spillway.

Further to your request to review the updated Landscape Masterplan (March 2011) prepared by AECOM, which shows detail regarding the above, I provide the following.

Subsequent to submissions from Government Agencies and local community members, the representatives of St Vincent's Foundation consulted this firm in regards to whether a doubling of the corridor width (from 50m to 100m) between the two major waterbodies (the proposed constructed wetland and the eastern lagoon), and revisal of the design of the interlinking spillway, would significantly improve the functional effectiveness of the habitat corridor in the context of the comments and the broader Central Corridor, and threatened species likely to use this corridor to access the coastal fringe habitats.

We advised that the relatively short width of this particular section of the Central Corridor was a pinch point that would significantly benefit (in terms of effectiveness for target species and coverage of potential species) from widening to at least 100m and revegetation with structured forest. This width is line with research and practise for a local corridor (Scotts 2002, Gibbons and Lindenmayer 2002, Lindenmayer 2008, CHCC 2009, Lindenmayer and Fisher 2006).

We also advised that the design of constructed spillway needs to mimic a natural watercourse in terms of strategic placement of large rocks, snags derived from removal of the large Forest Red Gums in the pastoral woodland, and appropriate plantings of sedges and riparian vegetation along the edges. These measures were recommended to provide both habitat resources and crossing mechanisms eg snags may provide bridges, vegetation and rocks provide cover, large rocks providing basking sites, and overhanging trees providing arboreal fauna crossing points.

The revised concept plan illustrates that these recommendations have been adopted.

This widened section of the corridor and other measures incorporated within the new concept plan for this area overall represent a significant enhancement from the original concept via:

- Doubling the terrestrial width of the section of the corridor between the eastern lagoon and the proposed constructed wetland from 50m to 100m.

39 Lake Ridge Drive Via Laurieton NSW 2443
Phone: (02) 65 59 00 75 ♦ Fax (02) 65 59 00 75 ♦ Mobile: 0409 833 968
E-Mail: darkhearteco@gmail.com
Member: NSW Ecological Consultants Association
NSW Royal Zoological Society, Australian Plant Conservation Network
Australasian Bat Society, Australian Herpetological Society, Restoring Biodiversity Industry Association

- This provides a significant width of forest which will not only provide an effective linkage for target species such as the Koala and Squirrel Glider (recorded on or adjacent to the site), but also provide suitable in situ habitat for a range of native species;

- The doubling in width will allow for a further expansion of Core Koala Habitat by increasing the extent of land available for planting of Koala browse species eg Swamp Mahogany, and hence habitat for the local Koala population. This is significant given recent loss of habitat in the adjacent Sewage Treatment Plan upgrade.

- Changing the flow device S2, from being a simple, hard concrete structure, to mimicking an ephemeral drainage line with more natural slopes with embedded rocks of various sizes, and eventually establishing logs and appropriate riparian vegetation which will enclose the flow path and minimise the canopy gap.

    - It is also notated the flow device will only convey water intermittently and for the majority of time will be dry. This should in effect mimic the regime of a natural drainage line in a forested context, and hence pose no barrier to movement of fauna as a result;

It is also noted that the concept moves pedestrian access further away from the Wallum Froglet area than previously delineated (which benefits hygiene/disease control); and access will be restricted to a gravel pathway enclosed by fully structured native vegetation. We envisage this pathway will resemble the boardwalk through Sea Acres Rainforest, allowing residents to appreciate the ecological assets of the area and encouraging stewardship, but also limiting any impacts to a defined area which may be readily controlled. The access will also be useful for weed, pest and bushfire control.

Overall, these measures support the conclusion of our assessment that the proposal will have a net positive ecological impact.

Yours faithfully,

Jason Berrigan.
Senior Ecologist, D.E.C.
B. Nat. Res. (Hons).Grad. Cert. (Fish.).
MECANSW, MRZSNSW, MABS, MAHS, MAPCN, MRBIA.

References:

Coffs Harbour City Council NSW (2009). *Coffs Harbour Priority Habitats and Corridors Strategy 2010 – 2030*, Consultation draft, Coffs Harbour, NSW.

DECCW (2010). **Priorities for Biodiversity Adaptation to Climate Change.** DECCW, Hurstville.

Lindenmayer, D. and Fisher, J. (2006). **Habitat fragmentation and Landscape Change: An ecological and conservation synthesis**. CSIRO Publishing, Collingwood.

Lindenmayer, D.B. (1998). **The Design of Wildlife Corridors in Wood Production Forests** – Forest Issues 4. NSW NPWS, Hurstville.

Peel, B. (2010). **Rainforest Restoration Manual for South-Eastern Australia**. CSIRO Publishing, Collingwood.

Scotts, D. (2002) editor. **Key Habitats and Corridors for Forest Fauna of North-East NSW: A regional landscape to focus conservation, planning, assessment and management**. NSW NPWS, Hurstville.

Appendix B

Ecological response to submissions

Appendix B Ecological response to submissions

DARKHEART
Eco-Consultancy

Thursday, 7 April 2011

Mr Brian Tierney
Tierney Property Services
PO Box 493
PORT MACQUARIE NSW 2444

Dear Brian,

RE: Rainbow Beach Concept Plan (06_0085) and Project Application (07_0001) - Response to Agency Submissions

Reference is made to the abovementioned Concept Plan and Project Application for land located at Bonny Hills. I have considered the extracts from Agency Submissions you provided to me as they relate to the environmental assessment of the proposal. My responses are as setout below:

AGENCY SUBMISSION	DARKHEART COMMENTS
1.1 Central Corridor Ecological Impacts Concern is raised with regards to impacts on vegetation including Swamp Oak Floodplain Forest Endangered Ecological Community (EEC) from works proposed within the central corridor. It is suggested the proponent further consult the Department of Environment, Climate Change and Water (DECCW) on this issue.	The area of Swamp Oak EEC to be removed is mostly outside the Central Corridor, and is simply regrowth of Swamp Oak trees along fencelines and drains (often only single tree wide – refer to Figure 1) in or adjacent to pasture that has not been slashed. This vegetation is limited in width, is of minimal ecological value, provides minimal diversity and limited fauna support. In addition the extent of *Swamp Oak Floodplain Forest* EEC has been incorrectly mapped to the northeast of the Eastern Creek reserve. The band adjacent to Ocean Drive and adjacent to the area mapped for regeneration is well above the area of alluvial soils or the 1:100 year floodline and accordingly should not be classified as EEC. *(refer Figure 2)* Apart from the aforementioned Swamp Oak regrowth, the overwhelming majority and highest quality examples of this EEC are being retained in the protected Eastern Creek reserve area *(future public reserve – refer Figure 3).*

39 Lake Ridge Drive Via Laurieton NSW 2443
Phone: (02) 65 59 00 75 ♦ Fax (02) 65 59 00 75 ♦ Mobile: 0409 833 968
E-Mail: darkhearteco@gmail.com
Member: NSW Ecological Consultants Association
NSW Royal Zoological Society, Australian Plant Conservation Network
Australasian Bat Society, Australian Herpetological Society, Restoring Biodiversity Industry Association

AGENCY SUBMISSION	DARKHEART COMMENTS
	It is concluded that the proposal will not have a significant impact on Swamp Oak EEC as per the 7 Part Test.
1.2 Impacts on Threatened Species Based on the information provided in the Environment Assessments (EAs) for both the concept plan and project application it is understood that certain populations of Wallum Froglet, Eastern Chestnut Mouse and Common Planigale within the site will be unable to persist upon implementation of the project application. DECCW has advised that suitable offsetting of the impacts on these species will therefore be required. It is recommended the proponent consult DECCW with regards to this matter.	The Concept Plan and Project Application both show the proposed Southern school in accordance with PMHC's Area 14 Structure Plan. There is no actual development currently proposed. If at some stage in the future there is a school development proposed for this site, then further detailed ecological investigations will be undertaken to assess the impact of that particular future DA. At that time, the extent of sensitive habitat will need to be confirmed or re-confirmed; the extent of actual built form will need to be looked at in detail; and any APZs or offsets would be assessed and determined. The previously recorded location of these isolated fauna populations (being in a small area bound by Ocean Drive and maintained grazing land) also means that they may currently be low in number and hence of low long term viability. The regeneration works proposed and underway within the Central Corridor provide for a variety of habitats including those favoured by the Wallum Froglet, Eastern Chestnut Mouse and Common Planigale. One of the primary objectives of the Central Corridor and its associated regeneration works is to improve habitat values and allow these populations to expand away from the restricted area of habitat adjacent to Ocean Drive, and increase long term viability.
1.6 Increased Impacts on Adjoining Littoral Rainforest The tourist site proposed as part of the concept plan and upgraded beach access, as identified in the project application, will result in increased impacts to adjoining littoral rainforest areas. The EAs for both applications, as exhibited, do not adequately justify the cumulative impacts on the development interface with littoral rainforest areas. To this end, the proposal does not demonstrate that the mitigation measures proposed are adequate in respect to this area's significance as an EEC under the *Threatened Species*	The SVF property is zoned 2(a1) residential and was zoned residential prior to the gazettal of SEPP 26. Accordingly, SEPP 26 Littoral Rainforest does not apply to the subject site. In addition there is no Littoral Rainforest vegetation within the subject property that falls under the *Threatened Species Conservation Act 1995* nor the *Environmental Protection and Biodiversity Act 1999.* The proposed beach access design is to ensure wind funnelling effect does not occur and hence the Crown reserve's littoral rainforest is not impacted. The existing beach access requires formalisation given the likely increased foot traffic along this track and the potential for erosion will need to be carefully controlled by standard measures as outlined in the

AGENCY SUBMISSION	DARKHEART COMMENTS
Conservation Act 1995 and *Environment Protection and Biodiversity Conservation Act 1999*. In addition, the Landscaped Masterplan prepared by AECOM does not provide sufficient design detail of all proposed works located near or within these areas, notably the proposed beach access.	*NSW Coastal Dune Management Manual 2001*. Weeds at the edges are currently being eliminated by bush regeneration (including the removal of Bitou and Lantana, planting of pioneer littoral rainforest species), with indigenous plants established by planting and self-regeneration in order to establish a closed edge and to protect the interior vegetation north and south of the existing track. As reported previously, Darkheart have provided a detailed assessment of all impacts that development on the SVF property may have on the adjoining land and found that there would be no significant impact as: • most of the vegetation's edge currently has a closed edge of native species (eg Satinwood) along its western frontage (see attached photos in Figure 6), and the unclosed edge in the northeast will be treated with weed removal, plantings of indigenous species and establishment of a vegetated buffer to minimise turbulence and excessive salt deposits; • fencing, signage and barrier planting of spikey-tipped plants will exclude track-making through the dune vegetation; • no change to the current hydrological regime is expected; & • there will be no significant change to current risk of bushfire, noting that the establishment of residential accommodation will result in high surveillance and hence fire protection. Consequently, the proposal is not considered to have the potential to risk significant modification or loss of the local occurrence of littoral rainforest.
3.0 Mosquito/Sandflies Assessment An assessment should be carried out to identify the need for appropriate measures necessary to provide protection for residents from mosquito/sandflies. This requires analysis by qualified persons as to whether the mosquitoes/sandflies will have a detrimental impact on future residents of the development.	The presence of Plague Minnow in all existing water bodies should be noted.

AGENCY SUBMISSION	DARKHEART COMMENTS
5.7 Vegetation Removal and Impact upon Threatened Species The proposal will result in the direct loss of approximately 1.58 ha of native vegetation and up to 64.32 ha (including the Pastoral Woodland containing a number of habitat trees) of known or potential habitat for a number of threatened species including Wallum Froglet (*Crinia tinnula*), Koala (*Phascolarctos cinereus*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*). The proposed native vegetation removal includes 0.49 ha of Swamp Oak Floodplain Forest and 0.43 ha of Swamp Sclerophyll Forest, which are both Endangered Ecological Communities (EEC) listed under Part 3, Schedule 1 of the *Threatened Species Conservation Act, 1995*.	*Table A: Types and Extents of Vegetation Communities* (page 4), of the Executive Summary of the Darkheart report (June 2009) details the different vegetation types across the whole of the property. This table confirms that over 150ha of the total 179ha (approx) is pasture or pasture woodland (i.e scattered trees). As such, this part of the property is predominantly cleared pasture with limited habitat value to any threatened species, with scattered trees (predominantly isolated trees in severe decline) limited to localised areas, specifically the 14 hollow-bearing Forest Red Gums – refer also to Figure 4 of this response. As part of the bush regeneration process, the proponent intends to recover hollow-bearing tree and relocate them to within the Central Corridor as fallen logs for threatened species such as the Spotted-Tail Quoll and Common Planigale, and other non-threatened native species eg Antechinus. Table B: Estimated Areas of Loss per Vegetation Community *(Page 9 of the Darkheart Ecological Assessment)* notes that 62.85ha of Pasture/Pastoral Woodland *(currently zoned residential 2(a1)* will be removed or developed. As noted above, this part of the property has negligible habitat value, especially in comparison to habitat retained and being regenerated within the Central Corridor. In addition, the existing buffer to the Sewerage Treatment Plant is currently zoned Rural 1(a1), and vegetated. This includes identified Core Koala Habitat. This will be retained within the Central Corridor. Table C: Estimated Areas of Loss, Regenerated and Retained EEC *(*Page 9, Darkheart 2009*)* confirms that for the 0.8ha of EEC removed, some 29ha will be retained or regenerated, with an overall EEC offset of some 36:1. In conclusion, the extent of loss of EEC is not sufficient to have a significant impact on the viability of the local occurrence and the project will result in over 14.3ha of additional net EEC gain alone. Any offset that may be called for under a biodiversity offset scheme should thus be overwhelmingly catered for on-site.

AGENCY SUBMISSION	DARKHEART COMMENTS
DECCW acknowledges the positive contribution that the Central Corridor will make toward the retention and enhancement of threatened species habitat with the site, as well as the proponents current and proposed restoration efforts within this area. However, the following specific impacts upon a number of the threatened species recorded during surveys as well as impacts upon EEC vegetation have been identified.	Noted.
5.9 Wallum Froglet (*Crinia tinnula*) Section 5.3.3.1 of the Ecological Survey and Statutory Assessment prepared by Darkheart Eco-Consultancy (Project EA, Volume 3, Appendix G) states that the Western population of this species is not affected in any manner by the project application. However a review of the bushfire protection measures plan provided in the Project EA (Volume 1, Figure 25) depicts asset protection zones (APZ's) of up to 47m in this area that has been earmarked for future development of a school site. The habitat requirements of this species are not commensurate with the APZ management required for this style of development. It is therefore expected that this population will be unable to persist within the site. Should the Department of Planning (DoP) grant approval to the Concept Plan, DECCW advises that impacts upon this population will require adequate offsetting in accordance with DECC, 2008a.	The Concept Plan and Project Application both show the proposed Southern school in accordance with PMHC's Area 14 Structure Plan. If at some stage in the future, there is a school development proposed for this site, then further detailed ecological investigations will be undertaken to assess the impact of that particular future DA. At that time, the presence of the species and extent of sensitive habitat will need to be confirmed or reconfirmed; the extent of actual built form will need to be looked at in detail; and any APZs or offsets would be assessed and determined. As noted above, no actual development is currently proposed in these areas. Section 4.6.3.5.3 Property Occurrence Evaluation notes that there were at least 50 males recorded at the Wallum Froglet depression. By comparison there were only 2 males recorded at the western population site near to Ocean Drive. The assessment was that this was a small (potentially low viability) isolated population in the school site area, possibly washed down from an upstream habitat by a storm event. Potential habitat will be enhanced for this population in the adjacent Central Corridor where similar drains currently exist, but cover was limited by pasture management. These drains will be enclosed within swamp forest. The Corridor will also establish a forested linkage to the main depression where a larger population exists, and hence the potential for dispersal between both populations. At this stage, the proponent is also well advanced with regeneration work at the main depression which supports the larger Wallum Froglet population (see

AGENCY SUBMISSION	DARKHEART COMMENTS
	following photo). This area had previously been slashed when dry, grazed by cattle, and was being invaded by Torpedo Grass. Figure 5 shows current regeneration progress. Given the significant regeneration work to date on the Wallum Froglet depression, and as this location has the principal population on the site, the net benefit to the Wallum Froglet is considered likely to be significant in terms of effecting its long term viability.
5.10 Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) and Common Planigale (*Planigale maculata*). The Eco-tourist resort involves the direct removal of known habitat for the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*). In addition, the southern school site includes the densely vegetated drain adjacent to the southwest patch of dry sclerophyll vegetation. This area is known to support a small population of Eastern Chestnut Mouse and Common Planigale (*Planigale maculata*). Despite the recommendations of the ecological consultants (Darkheart Eco-Consultancy) that this habitat be excluded from development and fenced off, APZ's of up to 47m have been applied to this area. These APZ's will have a negative impact upon the habitat requirements for both of these species. The proposed revegetation and enhancement of the Central Corridor will not provide suitable habitat in accordance with the requirements of these species. It is therefore expected that they will be unable to persist within the site. Should the Department of Planning (DoP) grant approval to the Concept Plan, DECCW advises that impacts upon these species will require adequate offsetting in accordance with DECC, 2008a.	The Concept Plan and Project Application both show the proposed Southern school in accordance with PMHC's Area 14 Structure Plan. No actual development is proposed at this time. With respect to the bush regeneration within the Central Corridor, the significant extent of swamp forest will provide excellent potential habitat for the Common Planigale. The floristics and structure of this vegetation is at least similar to habitat it is currently occurring in on site, and to habitat it is known to occur in near and within Kooloonbung Creek Nature Reserve. A similar situation should also apply for the Eastern Chestnut Mouse, though its presence will also depend on a suitable disturbance regime, which is currently provided by periodic slashing, and its actual population size (which appears to be small). A suitable fire regime will thus be required to enhance the corridor's habitat potential for this species.
5.11 Swamp Oak Floodplain Forest	The EEC is almost entirely retained within the Eastern Creek public reserve to be dedicated to

AGENCY SUBMISSION	DARKHEART COMMENTS
The majority of this community has not been included within the Central Corridor; however this vegetation is significant for both regional connectivity and conservation purposes. As stated above, this community is commensurate with an EEC listed under Part 3, Schedule 1 of the Threatened Species Conservation Act, 1995. DECCW strongly recommends that the Swamp Oak Floodplain Forest EEC vegetation be included within the Central Corridor and adequately protected from further development such as the filling activities and detention basins proposed for in this area (refer to the Concept EA, Fig 20 'Open Space Areas').	PMHC. There is also substantial offset to the loss of low value fenceline and drain edge regrowth provided by the regeneration of 0.6 ha of land which is currently pasture. In addition, it would appear that DECCW have possibly misunderstood that the overwhelming majority of the Swamp Oak Floodplain Forest EEC is being retained within the Eastern Creek reserve. The Central Corridor is separated from this Eastern Creek by a proposed connector road, however, this road will be appropriately designed to maximise the connectivity between the Central Corridor and the Eastern Creek. This will include appropriate underpass connectivity and possible overhead connectivity. The Eastern Creek reserve will be dedicated to PMHC in a future stage of the overall development. The Concept Plan *(*specifically Figure i. of the Concept Plan EA*)* and Figure 34 of the EA, Environment Features, both clearly show that the significant areas of Swamp Oak Floodplain Forest EEC are being retained.
5.12 Vegetation Connectivity To provide a framework for conservation planning on a landscape scale, the NPWS developed a project that assessed key habitats and corridors (KHC) in the north-east of New South Wales. For this project, key habitats are areas of predicted high conservation value for forest fauna, and include many large areas of vegetated lands and important vegetation remnants on- and off-park. These corridors have been designed to facilitate important ecological processes such as migration, colonisation and interbreeding of plants and animals between two or more larger areas of habitat. Vegetation cover in corridors depicted in KHC is not always continuous. Mapped corridors may include smaller remnants, wetlands, roadside vegetation, groups of trees or even	The Eastern Creek reserve linking to Duchess Gully is to be retained, expanded and protected in a public reserve dedicated to PMHC in a future stage of the overall development. The Central Corridor aims to restore the east-west linkage across the property, providing linkage between the two regional corridors as mapped by DECCW, and also provides linkage to Lake Innes Nature Reserve. The proponent also intends to modify the design within the Central Corridor by widening the corridor between the existing open waterbody and the proposed waterbody to 100 metres (effectively doubling the current width here). This will greatly enhance the connectivity in the east-west direction between the two waterbodies, especially to and from the coastal Crown reserve. Further complimenting this, about 5.2ha of Lot 5 will also be rehabilitated to enhance the coastal linkage north-south, and the east-west linkage.

AGENCY SUBMISSION	DARKHEART COMMENTS
individual trees. Corridors may be broken or fragmented by degraded or cleared areas while still contributing to landscape connectivity. Discontinuous corridors often constitute important stepping-stones and many provide an obvious starting point for habitat restoration programs (NPWS, 2005). The majority of the vegetation on the site, including the Swamp Oak Floodplain Forest EEC, forms part of a mapped Regional Corridor identified by DECCW as having regional connectivity significance. It has also been identified as a Koala Habitat Link within the Port Macquarie – Hastings Council Area 14 Koala Plan of Management. As stated above, DECCW strongly recommends that the Swamp Oak Floodplain Forest vegetation is included within the Central Corridor and that any vegetation within this corridor be protected from any form of development, including bushfire protection measures.	
5.14 Voluntary Planning Agreement DECCW notes that a Voluntary Planning Agreement regarding the future management of the open space areas of the site will be publicly exhibited at a later date. DECCW strongly recommends that the details of any proposed offset, including details of the mechanism(s) proposed for the long term protection and management of offset area(s) must be provided prior to Project Approval. It is proposed that the revegetation of the Central Corridor is the primary means of offsetting the impacts of the proposal. Whilst DECCW acknowledges the positive contribution that the Central Corridor will make toward the retention and	The Voluntary Planning Agreement *(VPA)* will be implemented, with the proponent undertaking all works to establish the Central Corridor and the subsequent maintenance of the Central Corridor for a 20 year period, whereupon Council will then resume all maintenance responsibilities for the areas within the Central Corridor. The VPA will: • make provision for the proponent to carry out works in the Central Corridor in accordance with the Project Application and in accordance with any additional requirements Council may have; • make provision for the proponent to dedicate the Central Corridor to Council; • make provision for the proponent to maintain the Central Corridor environmental lands for a period of 20 years; • be registered on the title to the land; • provide security for the obligations to be completed; &

AGENCY SUBMISSION	DARKHEART COMMENTS
enhancement of threatened species habitat with the site, it is apparent that the specific impacts upon a number of the threatened species recorded during surveys as well as impacts upon EEC vegetation are not being adequately addressed. DECCW advises that in order for the proponent to adequately address its requirements for offsetting impacts upon state listed species and communities, any offsets must consider and be consistent with DECCW's 'Principles for the use of Biodiversity Offsets in NSW' (DECC, 2008a). When undertaking its assessment of the adequacy of proposed offsets, DECCW will take into consideration the regeneration works undertaken to date.	• provide for the protection of the environment and ecologically sustainable development. At the appropriate time, a subsequent VPA will be entered into in order to protect, establish and maintain the habitat within the Eastern Creek reserve. Offset for the small areas of loss will be overwhelmingly compensated by the establishment of the Central Corridor. In summary: • 1.98ha of medium to high biodiversity value Blackbutt-Tallowwood-Needlebark Dry Sclerophyll Forest will be retained and protected; • 0.72ha of medium to high biodiversity value Brushbox Wet Sclerophyll Forest will be retained and protected; • 2.11ha of medium to high biodiversity value Blackbutt Dry Sclerophyll Forest will be retained and protected; • 2.39ha of medium to high biodiversity value Grey Ironbark-Grey Gum Dry Sclerophyll Forest will be retained and protected; • 10ha of high biodiversity value Paperbark-Swamp Mahogany-Swamp Oak Swamp Forest/Woodland (EEC) will be retained and protected; • 0.4ha of high biodiversity value Paperbark-Swamp Mahogany-Swamp Oak Swamp Forest/Woodland (EEC) will be removed; • 14.5ha of high biodiversity value Paperbark-Swamp Mahogany-Swamp Oak Swamp Forest/Woodland (EEC) will be regenerated; • Of the existing 150ha, some 62.85 ha of zero to low biodiversity value Pasture/Pastoral Woodland will be removed; • 1.19ha of medium to high biodiversity value Dune Scrub will be retained and protected; • 3.9ha of medium to high biodiversity value Swamp Oak (EEC)will be retained and protected; • 0.4ha of medium to high biodiversity value Swamp Oak (EEC) will be removed; • 0.6ha of medium to high biodiversity value Swamp Oak (EEC)will be regenerated; • 5.75ha of medium to high biodiversity value Aquatic habitat will be retained and protected;

AGENCY SUBMISSION	DARKHEART COMMENTS
	The proposed concept also currently includes about 15.1ha of vegetation *(predominantly EEC)* restoration/regeneration/creation to offset loss of about 1.58ha of intact native vegetation and scattered trees within the pasture. The remaining pasture is open grass. Almost all of the restored EEC should eventually provide high quality habitat for all recorded and a number of potentially occurring threatened species. Most of this regenerated EEC will be located within the 48.8ha of habitat within the Central Corridor and overall a total of 80.9ha of the original 179ha *(approx.)* is being retained with either existing or enhanced habitat value. The major area of Wallum Froglet habitat is currently under management, with major weed control works implemented as well as monitoring of the hydrological regime. Refer Figure 5. Works and maintenance will be on-going to ensure this population is secured. In conclusion the extent of loss of EEC is not sufficient to have a significant impact on viability of the local occurrence and the project will result in over 14.3ha of additional net EEC. Any offset that may be called for under a biodiversity offset scheme would be more than catered for on-site.
5.16 Prior to Project Approval. Compensatory Habitat Package DECCW recommends that this condition be satisfied prior to project approval. 1. The Proponent shall develop and submit for approval of the Director-General a Biodiversity Offset Package to detail how the ecological values lost as a result of the Project will be offset. The Biodiversity Offset Package shall be developed in consultation with DECCW and shall include, but not necessarily be limited to: (a) the identification of the extent and types of habitat that would be lost or degraded as a result of the final design of the Project (b) the objectives and biodiversity	As noted in 5.7, 5.9, 5.10, 5.11, 5.14 above, there is no justification for the request for off-site offsets. All biodiversity offsets are considered readily provided for within the project itself, as detailed above Monitoring will be by PMHC under the Voluntary Planning Agreement and in accordance with the Project Application.

AGENCY SUBMISSION	DARKHEART COMMENTS
outcomes to be achieved; (c) details of land offsets and biodiversity offset measures that have been selected to provide compensatory habitat within the region to offset the habitat loss; (d) the monitoring requirements for compensatory habitat works and other biodiversity measures proposed including: i. the monitoring of the condition of species and ecological communities at offset locations; ii. the methodology for the monitoring program(s), including the number and location of offset monitoring sites, and the sampling frequency at these sites; iii. provisions for the annual reporting of the monitoring results; (e) timing and responsibilities for the implementation of the provisions of the package.	
19.7 Public Comment We challenge the assertion cited in a report by Mackay and Bray which concluded that the conservation values of the land were considered low with no recovery potential. In fact the majority of the corridor is modified EEC (Endangered Ecological Community), a substantial portion of which has good to very good potential to recover as evidenced by the abundance of young trees and high component of native wetland species.	The Mackay & Bray report was cited only as part of review of previous studies. The conclusions reached in the Darkheart report are made having reviewed all the appropriate material available as well as having made extensive field trips over the last 7 years.

Yours faithfully,

Jason Berrigan.
Senior Ecologist, D.E.C.
B. Nat. Res. (Hons).Grad. Cert. (Fish.).
MECANSW, MRZSNSW, MABS, MAHS, MAPCN, MRBIA.

Appendix C

Hydrology and flooding supplementary assessment

Appendix C Hydrology and flooding supplementary assessment

Our Ref 7135/01-003 :jdb

Contact Doug Boys

Cardno
Shaping the Future

23 February 2011

Cardno (Qld) Pty Ltd
ABN 57 051 074 992

Level 11
515 St Paul's Terrace
Fortitude Valley QLD 4006
Australia

Locked Bag 4006
Fortitude Valley QLD 4006
Australia

Phone: 61 7 3369 9822
Fax: 61 7 3369 9722

www.cardno.com.au

Tierney Property Services
PO Box 493
PORT MACQUARIE NSW 2444

Attention: Mr Brian Tierney

Dear Sir

SVF RAINBOW BEACH DEVELOPMENT APPLICATIONS
MP 06_0085 "Rainbow Beach Concept Plan"
MP 07_0001 "Project Application - Open Space Corridor and Constructed Wetland, Rainbow Beach"

ASSESSMENT OF MODIFICATIONS TO WEST END OF W1 WATERWAY HYDROLOGY & FLOODING

In the Preferred Project it is proposed to improve fauna access across the Open Space Corridor by increasing the distance between the Existing Lagoon and the Constructed Wetlands W1. This will be achieved by relocating the western edge of the Constructed Wetland northwards thus reducing the extent of the W1 water body and doubling the distance between the two water bodies to 100 metres. Fauna migration through this widened corridor will be enhanced by replacing the hydraulic flood control Connection S2 channel with a widened channel with gentle side slopes. The widened channel will be protected against erosion by appropriate rock protection and vegetation suitable for negotiation by fauna. The arrangement and dimensions of these changes are shown in the attached revised Figure 8 and Figure 33 (dated 18-02-2011).

The S2 Connection structure is required to control outflows from the Existing Lagoon to the Constructed Wetlands as described in Section 4.3.8.3 of the Environmental Assessment Appendix N. During the most frequent flood events (up to and including the 5 year ARI event) most of the overflow will be contained within the central channel which has an invert varying from RL 3.4 at the Existing Lagoon to RL 3.0 at the Constructed Wetland and 1:10 side slopes. The invert widens to 10 metres bed width over most of the channel length. During major floods, shallow flow will also occur across the embankment adjacent to the channel. The embankment will be re-graded to RL 4.85 over the area shown on Figure 33 to allow this.

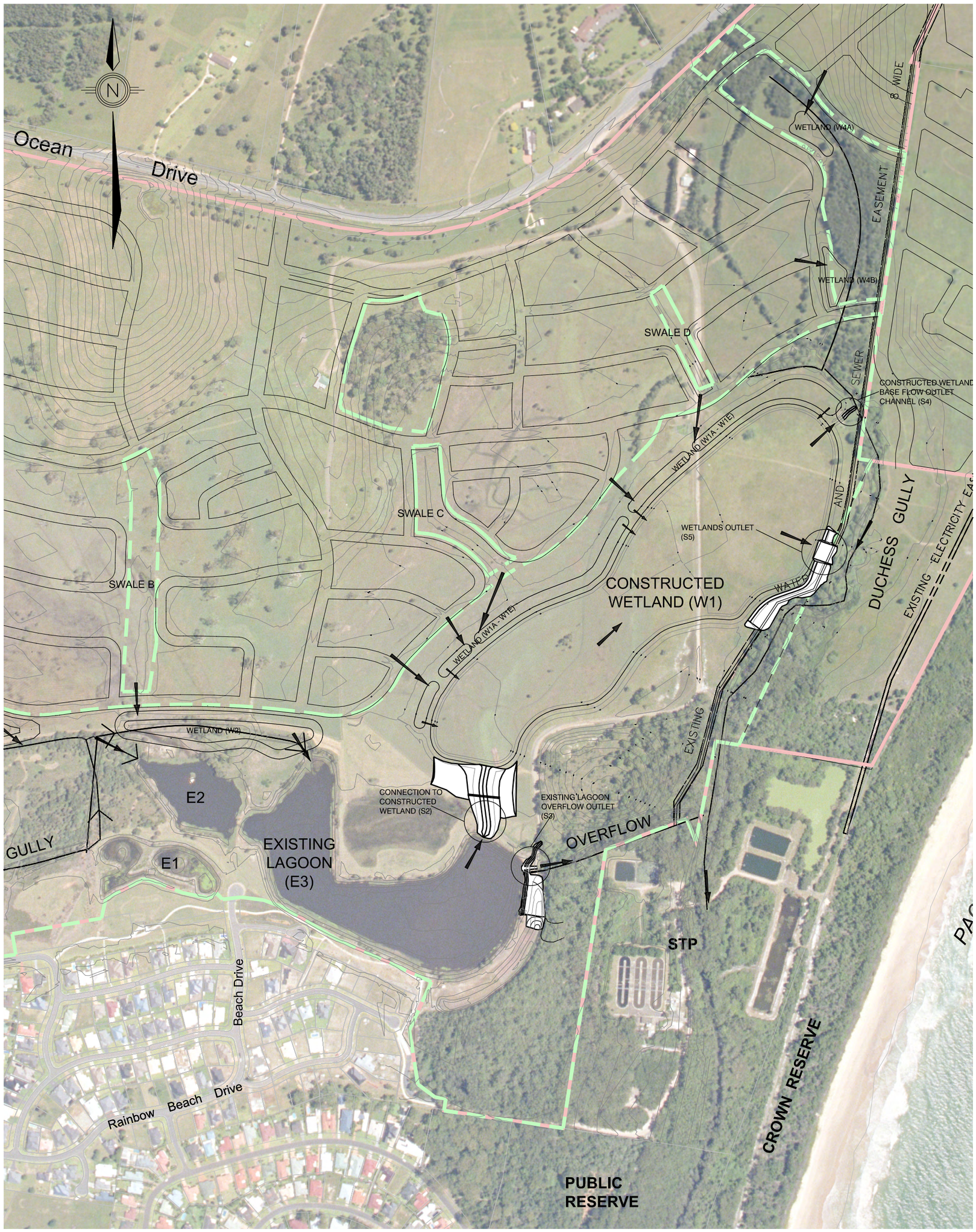
This revised control structure S2 will be hydraulically equivalent to the original proposals and the changes will not alter the flooding behaviour of the Duchess Gully system as described previously in Appendix N. Hydraulic control will still occur at the upper end of the channel at the edge of the Existing Lagoon. The revised channel at this location will be shaped as a wide rock-protected V-notch weir with an invert level of RL 3.4 and 1:10 side slopes. This weir has the same hydraulic characteristics as the original proposed 5 metre wide weir (see Table 47 Appendix N). Hydraulic losses within the revised channel do not cause any tailwater interference with the operation of the control weir. The regraded embankment shown on the revised Figure 33 is also equivalent to the overbank overflow area originally proposed in Appendix N.

It is also now proposed to include a pedestrian access bridge across the Connection channel as shown in Figures 8 and 33. The bridge will be at an elevation of RL 4.85, level with the regarded overflow embankment and will connect with a pedestrian pathway also at this elevation. The bridge and pathway will therefore not interfere with the operation of the S2 hydraulic control on flows between the Existing Lagoon and the Constructed Wetland W1. The bridge soffit will be above the water level in the Connection channel during flood events and will not interfere with the operation of the S2 hydraulic control.

Yours faithfully

Martin Giles
Manager, Water Resources & Coastal
for **Cardno**

Enc: Figure 8 Dev.Water Features (East) 18-02-11.pdf
Figure 33 18-02-11.pdf



50 0 50 100 150 200 250m
1:5000

Scale 1:5000 (A3)

LEGEND

Site Boundary

Open Space Corridor Boundary

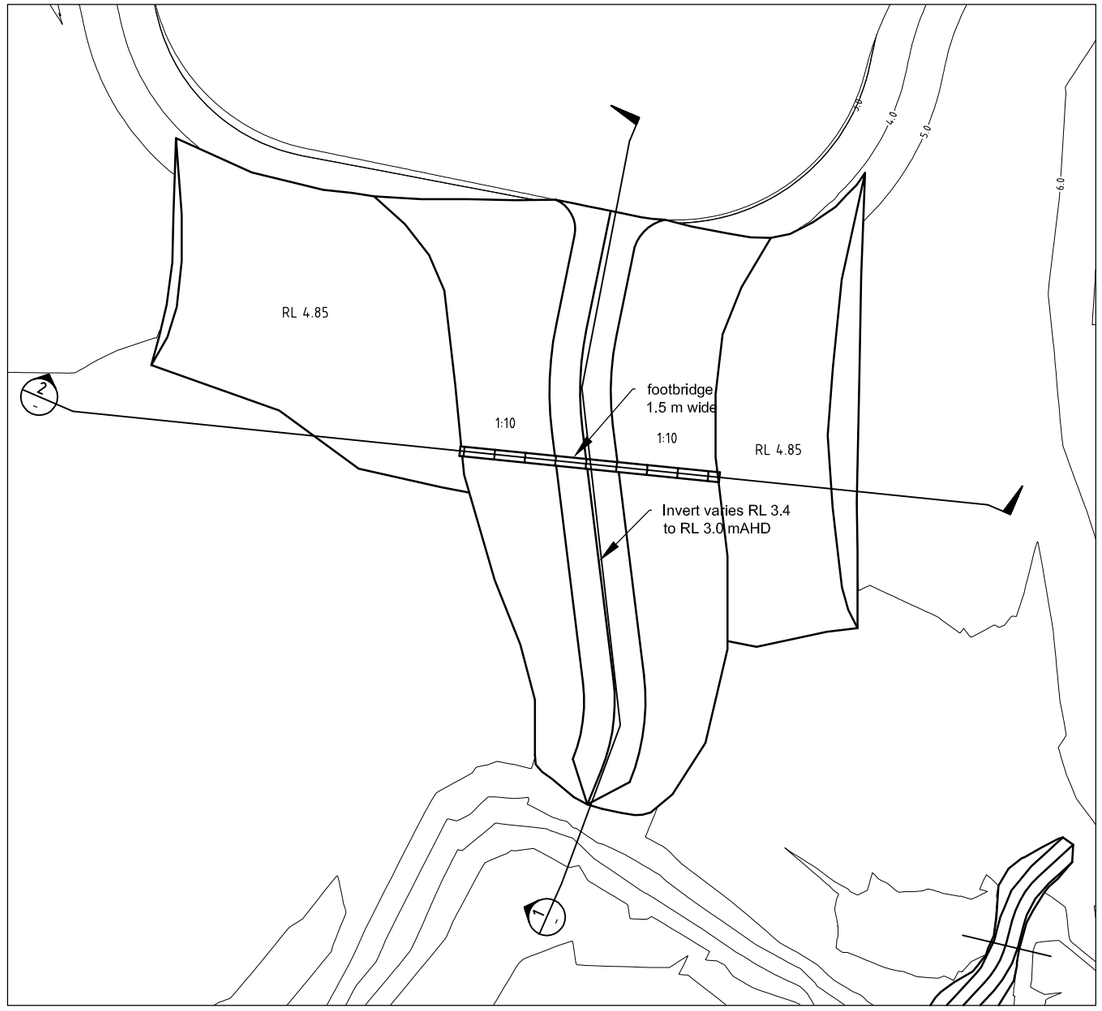
FIGURE 8
OPEN SPACE CORRIDOR PLAN - PROPOSED DEVELOPMENT WATER FEATURES - EAST

Ver. Date: 30 March 2011

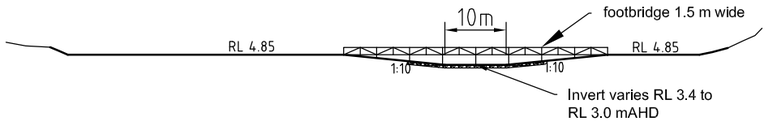
St. Vincents Foundation Pty Ltd

PRINT DATE: 30 March, 2011 - 5:45pm

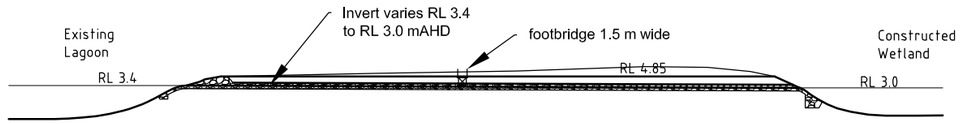
CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 7&8 Open space Corridor Plan - Proposed Dev Conditions.dwg
XREF's: wetland outline; Earthworks Update 14-02-2011



PLAN - "CONNECTION" CONTROL STRUCTURE S2
1:1000



SECTION 2 / 1:1000 / -



SECTION 1 / 1:1000 / -

Ver 3. Draft Date: 18 February 2011

St. Vincents Foundation Pty Ltd

CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 28 - 33 Outlet weirs.dwg
XREF's: wetland outline; Contours for weirs 21-2-08; Earthworks Update 14-02-2011

Scale: as indicated (A3)

FIGURE 33
"CONNECTION" CONTROL STRUCTURE S2 PLAN AND DETAILS

Appendix D

Hydrology and flooding response to submissions

Appendix D Hydrology and flooding response to submissions

Our Ref 7135/01-003 :jdb

Contact Doug Boys

Cardno
Shaping the Future

23 February 2011

Cardno (Qld) Pty Ltd
ABN 57 051 074 992

Level 11
515 St Paul's Terrace
Fortitude Valley QLD 4006
Australia

Locked Bag 4006
Fortitude Valley QLD 4006
Australia

Phone: 61 7 3369 9822
Fax: 61 7 3369 9722

www.cardno.com.au

Tierney Property Services
PO Box 493
PORT MACQUARIE NSW 2444

Attention: Mr Brian Tierney

Dear Sir

SVF RAINBOW BEACH DEVELOPMENT APPLICATIONS
MP 06_0085 "Rainbow Beach Concept Plan"
MP 07_0001 "Project Application - Open Space Corridor and Constructed Wetland, Rainbow Beach"
RESPONSE TO SUBMISSIONS

STORM CONSULTING (NSW PLANNING) (LETTER DATED 5 OCTOBER 2010)

Items 1 to 6, 8, 9. The inconsistencies in the various Appendices are resolved and explained in this Response document. It is intended that Appendices L (WRL) and M (AECOM), being the later and more detailed and advanced work, should apply where there is any remaining differences between these later recommendations and the text of Appendix N (Cardno).

Item 7. The figures given in the Appendix L (WRL) report (Section 6) confirm that groundwater flows into the wetland are very small compared with surface runoff into the wetland. This inflow amounts to 0.33 mm/month equivalent runoff from the catchment, which is much less than the actual surface runoff (of the order of 20 mm/month). Variations in groundwater flows will have no significant effect on the long-term behaviour of water levels compared with the influence of surface runoff.

The groundwater inflow rate from the Appendix L (WRL) report of 40 m3/day (Section 6) is the equivalent of 10 mm/month increase in wetland water level compared with the seepage loss rate (outflow) of 25 mm/month decrease in level adopted in the Appendix N (Cardno) water level study. Both seepage rates are very small compared with surface runoff. Therefore, the calculated range of water levels and the frequency of various amounts of drawdown in water level in Appendix N (Figure 10) will not change significantly if the seepage is amended to the WRL figure.

The results in Appendix N are in any case conservative; that is, if the seepage loss of 25 mm/month is changed to a 10 mm/month inflow then the drawdown in water levels during dry periods will generally be slightly less than shown in Figure 10. In other words, the "lake" would stay full more often than previously calculated in Figure 10.

Items 10, 11, 12, 22. The revised Appendix N Figures (7,8,23) attached to this Response document are now consistent with the proposals in Appendix M by AECOM. Appendix M describes the preferred project options.

Item 13. The treatment wetlands are hydraulically connected directly to the larger "lake" (Constructed Wetland W1) and the water levels will rise and fall together in these two water bodies.

The stormwater treatment wetlands will be inundated occasionally by backup from the Constructed Wetland when the rainfall event is large enough and depending on the water levels immediately prior to the event.

The water balance modelling in Appendix N showed that the constructed wetland will not dry out but the water level may be reduced during rare drought episodes. The water level in the treatment wetlands may also be reduced during drought periods but this is likely to be less severe in this case (being hydraulically connected to the larger Constructed Wetland) compared with normal behaviour of stormwater treatment wetlands.

Item 19. There was an error in the water level of wetland W3 previously shown in Figure 24. It should be RL 4.3. A corrected revised Figure 24 (dated 9-12-2010) is attached.

Item 20. The treatment wetlands W1A to W1E all receive runoff from various separate parts of the new development and discharge into the larger Constructed Wetlands W1 ("lake"). The attached revised Figures 7 & 8 make this clear.

Item 21. The attached revised Figures 7 & 8 correct and clarify the previous inconsistencies. The attached revised Figure 23 also shows the proposed drainage network with these updates.

Item 23. The attached revised Figures 7 & 8 show the final proposed contours.

Item 26. There are proposed playing fields located at the western (not eastern) edge of the residential development. The fill contours for this area indicate that the flood immunity for the playing fields will be at least 1 in 5 year ARI.

Item 27. An increase in the percentage impervious area of residential and rural residential areas would not significantly alter the overall WBNM Model hydrographs applied to the flood control structures proposed for the Open Space Corridor because the developed areas are not a large percentage of the total catchment.

Item 28. The cross sections used in the MIKE11 hydraulic model were in general taken perpendicular to the flow direction and selected to fairly represent the available flow conveyance. The chainage marks on Figure 27 are diagrammatic only and do not represent the alignment of the cross-sections actually used. The existing residential development protruding across the flow path at one point is a local constriction only which does not invalidate the model.

Item 29. Figures 28, 30, 31 and 33 had some printing errors which have now been corrected. Revised Figures are attached.

Item 30. The location of Chainage 60 (the adopted inflow location) can be interpolated on Figure 26 from the position of adjacent cross-sections which are marked.

Item 31. Figure 36A appears to be correct.

Item 32. Although there is a significant redirection of flows within the lower reaches of Duchess Gully, absolute velocities during flood events are low and are not significantly increased by the development proposals. It is not expected that there will be any significant morphological impacts from these changes. Diversion in the past of flow away from the "DUCH-N" reach via the Overflow Channel has not apparently altered the morphology of this reach compared with the rest of Duchess Gully. This indicates that flood runoff is not a major influence on the morphology or vegetation regime of the stream.

Item 33. The flood modelling shows that flood levels are not increased in this area by the proposed development. Port Macquarie Hastings Council requires that residential developments are above the 100 year ARI flood event. It is expected that this residential area satisfies that requirement. The present application does not contain any detailed information on surface levels or floor levels in this area but this development does not increase flood levels in this area.

Item 34. These existing properties are located well above the predicted flood levels in Duchess Gully.

Item 35. The flood modelling does compare future flood levels on the Milland site against existing conditions. The minimal impact on the Milland property is known by both parties and is the subject of an agreement between the landowners addressing this matter along with other joint development issues. Note that only a very small portion of Duchess Gully crosses the boundaries in question.

Item 36. It is unlikely that extreme ocean levels will occur without significant freshwater runoff from the catchment. The 1% AEP storm surge level is RL2.6 m AHD whereas the lowest hydraulic control for the Constructed Wetland is RL 3.0. Sea water inundation of the wetland would only occur with ocean surges far exceeding the 1% AEP event and/or with possible future climate change sea level rise and in the absence of concurrent freshwater runoff. Admittedly, it is possible that this could occur but it would be a very rare event. Such an event would cause increased levels of salinity in the wetlands with potentially some die-off of vegetation and loss of function in the treatment wetlands. The wetland freshwater regime would eventually re-establish after such an event. Such a temporary disruption to wetland function could be accepted as an inevitable impact of such rare events without adopting it as a reason to reject the proposals as unacceptable. The same impact will occur at countless other similar locations during such a rare event.

Item 37. Appropriate tailwater levels were adopted in the assessments for checking the design of local drainage systems. The local drainage systems will comply with performance standards of AUSPEC D5 and D7. In general, the volume of fill required is based on the need to provide appropriate flood immunity not on the requirements for local drainage.

NSW OFFICE OF WATER (NOW) (LETTER DATED 18 OCTOBER 2010)

Groundwater Management

The NOW criticisms have now been addressed in Appendix L (WRL) and Appendix M (AECOM) which are intended to supersede the Appendix N Environmental Assessments (Cardno) as the preferred project options. The NOW comments recommend lining the constructed wetlands but the AECOM and WRL studies demonstrate this is not necessary.

Water Quality

The NOW criticisms have now been addressed in Appendix L (WRL) and Appendix M (AECOM) which are intended to supersede the Appendix N Environmental Assessments as the preferred project options.

Stormwater Management

The NOW criticisms have now been addressed in Appendix M (AECOM) which is intended to supersede the Appendix N Environmental Assessments as the preferred project options.

Yours faithfully

Martin Giles
Manager, Water Resources & Coastal
for **Cardno**

Enc:
Figure 7 Dev.Water Features (West) 18-02-11.pdf
Figure 8 Dev.Water Features (East) 18-02-11.pdf
Figure 23 4509 - D1 - Drainage Concept Design 21-02-11.pdf
Figure 24 - Drainage Hydraulic Gradients 9-12-10.pdf
Figure 28 9-12-10.pdf
Figure 30 9-12-10.pdf
Figure 31 9-12-10.pdf
Figure 33 18-02-11.pdf

Cardno

N

EXISTING CULVERT

EXISTING CULVERTS

Drive

Drive

Ocean

CHANNEL DIVERSION,
1 M BED WIDTH

UPPER TRIBUTARY

SWALE A

SWALE B

WETLAND (W3)

WETLAND (W2)

E2

E1

EXISTING
LAGOON
(E3)

DUCHESS GULLY

EXISTING CULVERT

St Kitts Way

Beach Drive

Rainbow Beach Drive

LEGEND

Site Boundary

Open Space Corridor Boundary

40 0 40 80 120 160 200m
1:4000

Scale 1:4000 (A3)

FIGURE 7

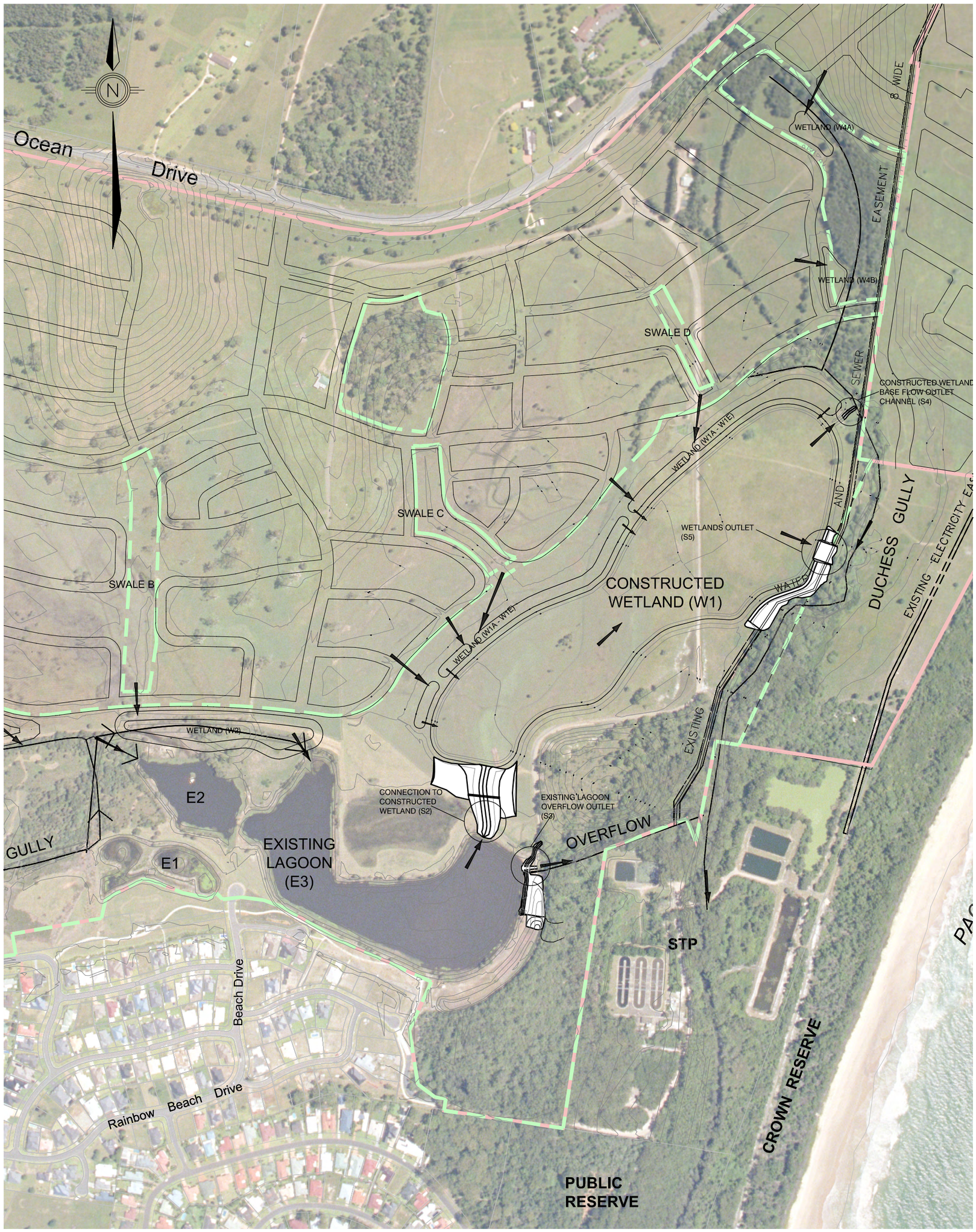
OPEN SPACE CORRIDOR PLAN - PROPOSED DEVELOPMENT WATER FEATURES - WEST

Ver. Date: 30 March 2011

St. Vincents Foundation Pty Ltd

CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 7&8 Open space Corridor Plan - Proposed Dev Conditions.dwg
XREF's: wetland outline; Earthworks Update 14-02-2011

PRINT DATE: 30 March, 2011 - 5:46pm



50 0 50 100 150 200 250m
1:5000

Scale 1:5000 (A3)

LEGEND

Site Boundary

Open Space Corridor Boundary

FIGURE 8
OPEN SPACE CORRIDOR PLAN - PROPOSED DEVELOPMENT WATER FEATURES - EAST

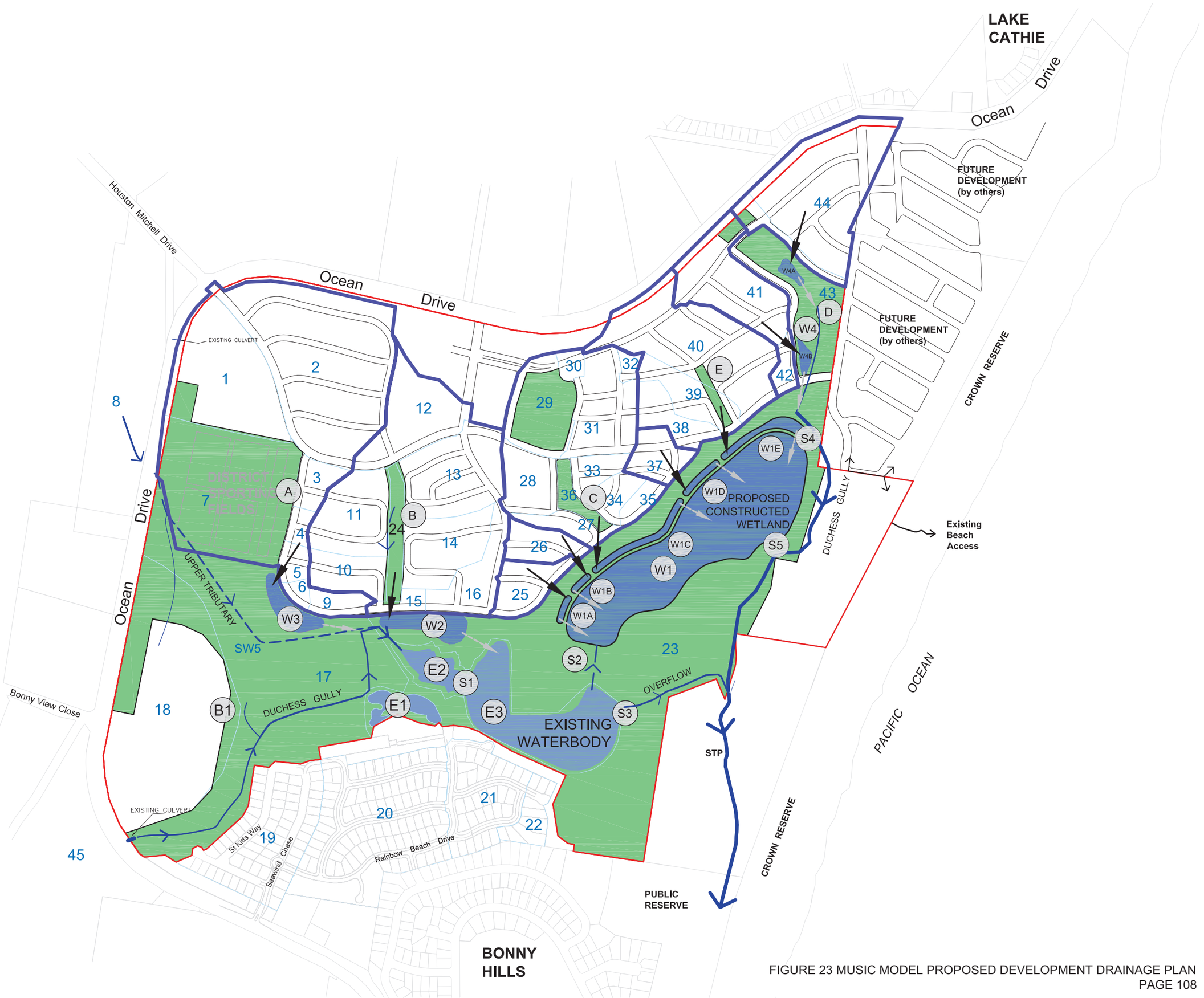
Ver. Date: 30 March 2011

St. Vincents Foundation Pty Ltd

PRINT DATE: 30 March, 2011 - 5:45pm

CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 7&8 Open space Corridor Plan - Proposed Dev Conditions.dwg
XREF's: wetland outline; Earthworks Update 14-02-2011

DRAINAGE CONCEPT PLAN
Plan D1



Drainage Catchment Area
1-45

Major Drainage Swales
A - E

Existing Waterbodies/Wetlands
- E1 - Prototype wetland for Southern Residential Development
- E2 - Western Lake
- E3 - Eastern Lake

Proposed New Waterbodies/Wetlands
- W1 - Large Waterbody
- W2 - Constructed Wetland for Central Residential area
- W3 - Constructed Wetland for Western Residential area
- W1A - Stormwater Treatment
- W1D - Wetlands Cells
- W4A - Bioretention system for North East Triangle Residential
- W4B - Bioretention system for North East Residential Area

Stormwater System Connections
- S1 - Low level Connection between northern & southern development
- S2 - Connection to proposed wetlands high flow bypass to Duchess Gully
- S3 - Water level control structure & low flow outlet
- S4 - Overflow spillway for Constructed Wetland
- S5 - High flow outlet to Duchess Gully

CONCEPT DRAINAGE SUBCATCHMENT AREAS

PROPOSED INTEGRATED DRAINAGE AND CONSTRUCTED WETLAND SYSTEM

TREATMENT WETLAND CATCHMENT BOUNDARY

WETLAND INLET

WETLAND OUTLET

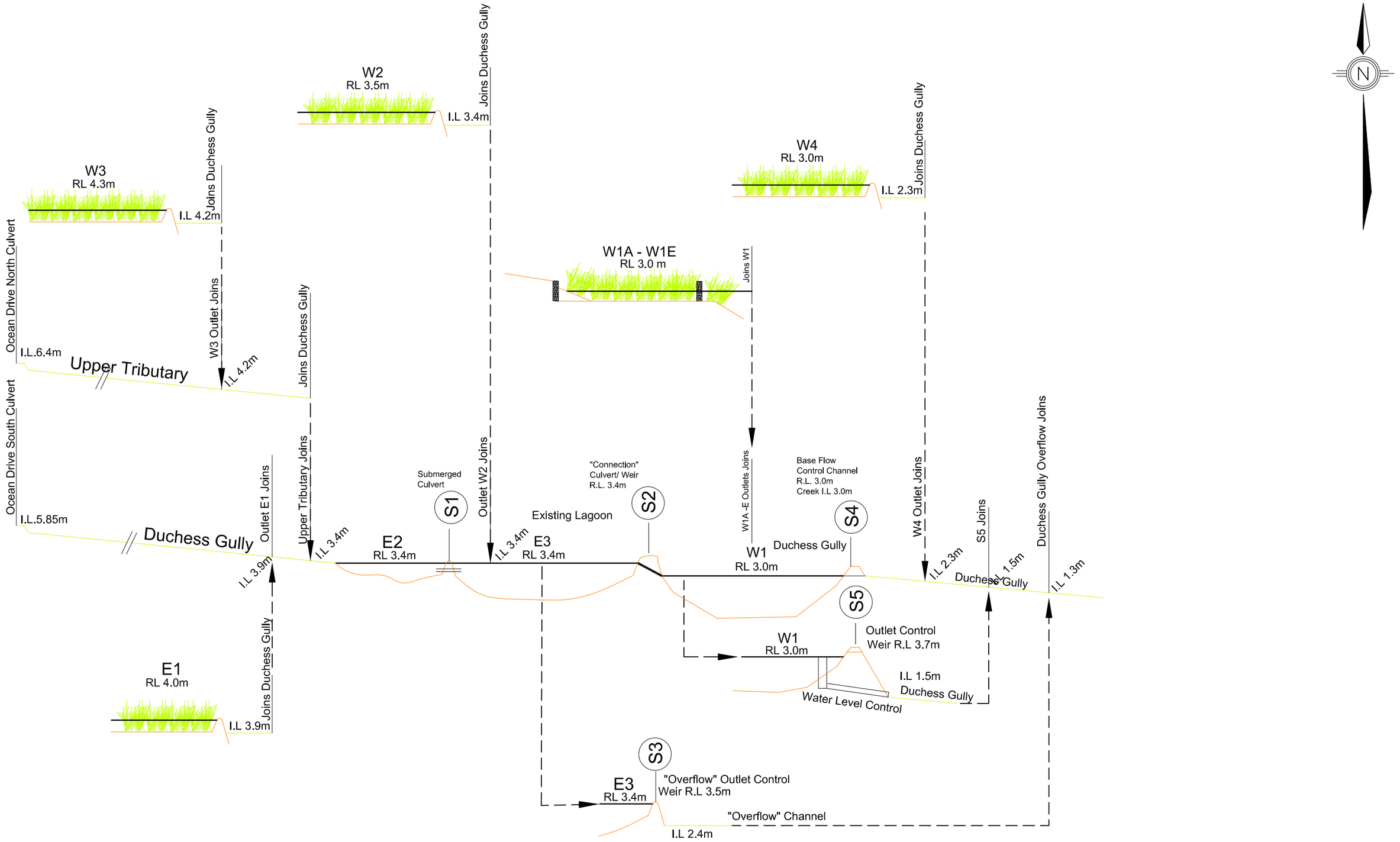
REVISIONS
E: 22.03.11

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

Scale:
1:8000@A3 1:4000@A1
The stated scale of this drawing maybe altered by copying. The scale should be verified prior to deriving measurements from this drawing

0 20 40 100 200 400(M)

FIGURE 23 MUSIC MODEL PROPOSED DEVELOPMENT DRAINAGE PLAN



PRINT DATE: 16 December, 2010 - 12:59pm

Ver 3 Date: 9 Dec 2010

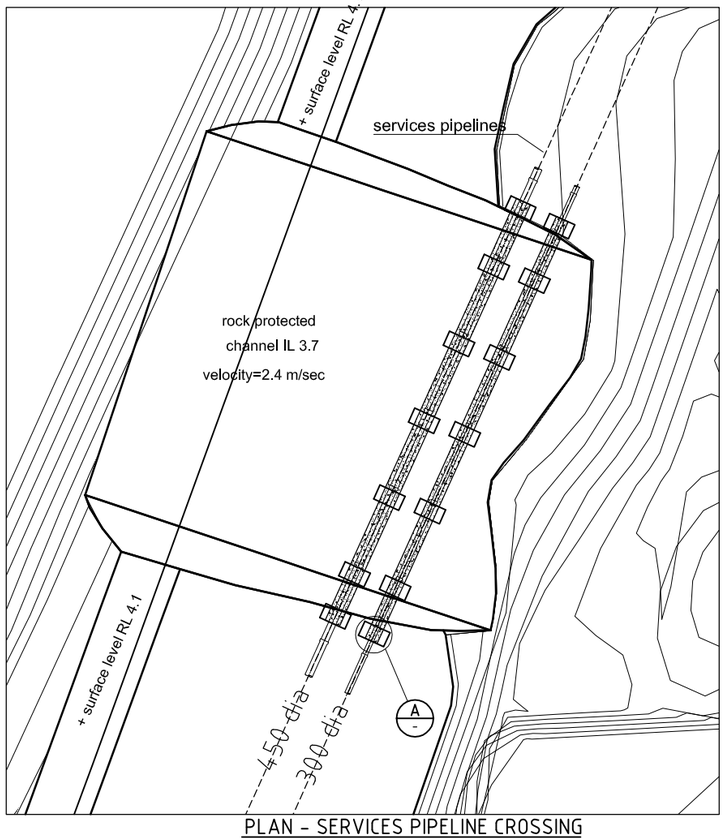
Scale NTS (A3)

FIGURE 24

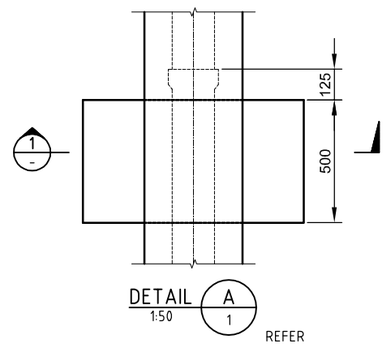
DRAINAGE HYDRAULIC GRADIENTS

Refer to Figure 29 for
Detail of cross sections

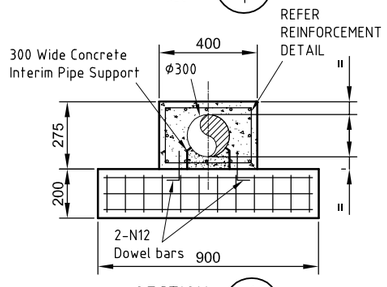
PLAN - CONSTRUCTED WETLAND OUTLET
1:1000



PLAN - SERVICES PIPELINE CROSSING
1:400



DETAIL A
1:50



SECTION 1
1:50

Scale: as indicated (A3)

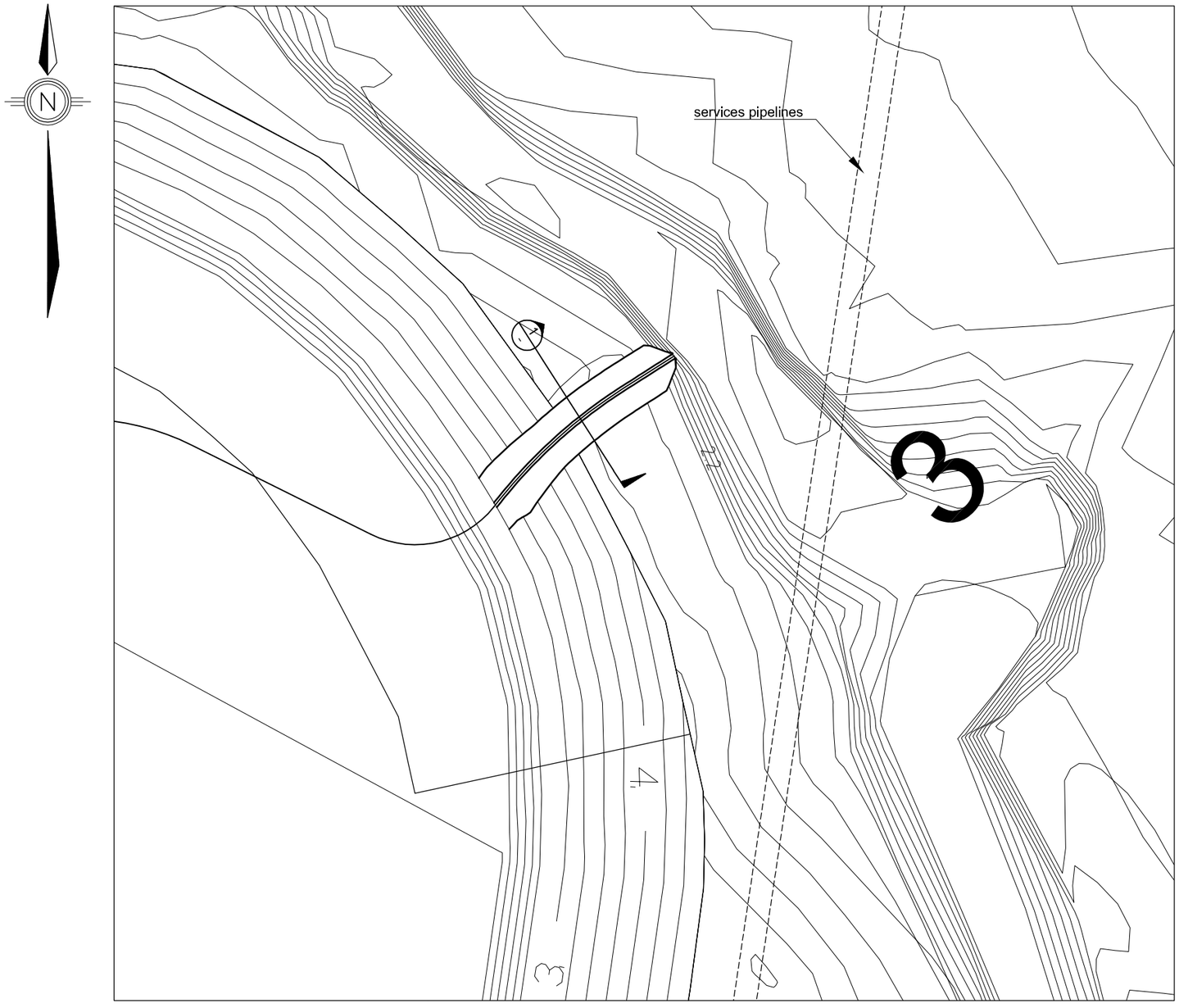
FIGURE 28

CONSTRUCTED WETLANDS OUTLET CONTROL STRUCTURE S5 PLAN

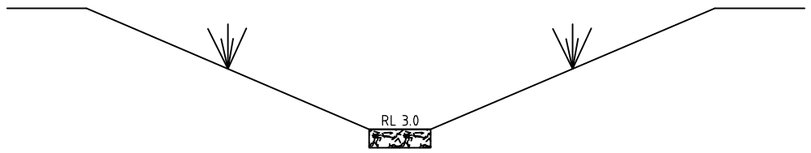
Ver 2. Date: 19 March 2010

St. Vincents Foundation Pty Ltd

CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 28 - 33 Outlet weirs.dwg
XREF's: wetland outline; Contours for weirs 21-2-08



PLAN - CONSTRUCTED WETLAND BASE FLOW OUTLET S4 CHANNEL
1:500



SECTION 1 / 1:50

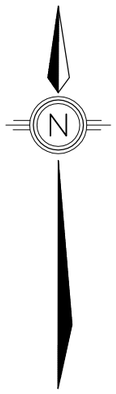
Ver 2. Date: 19 March 2010

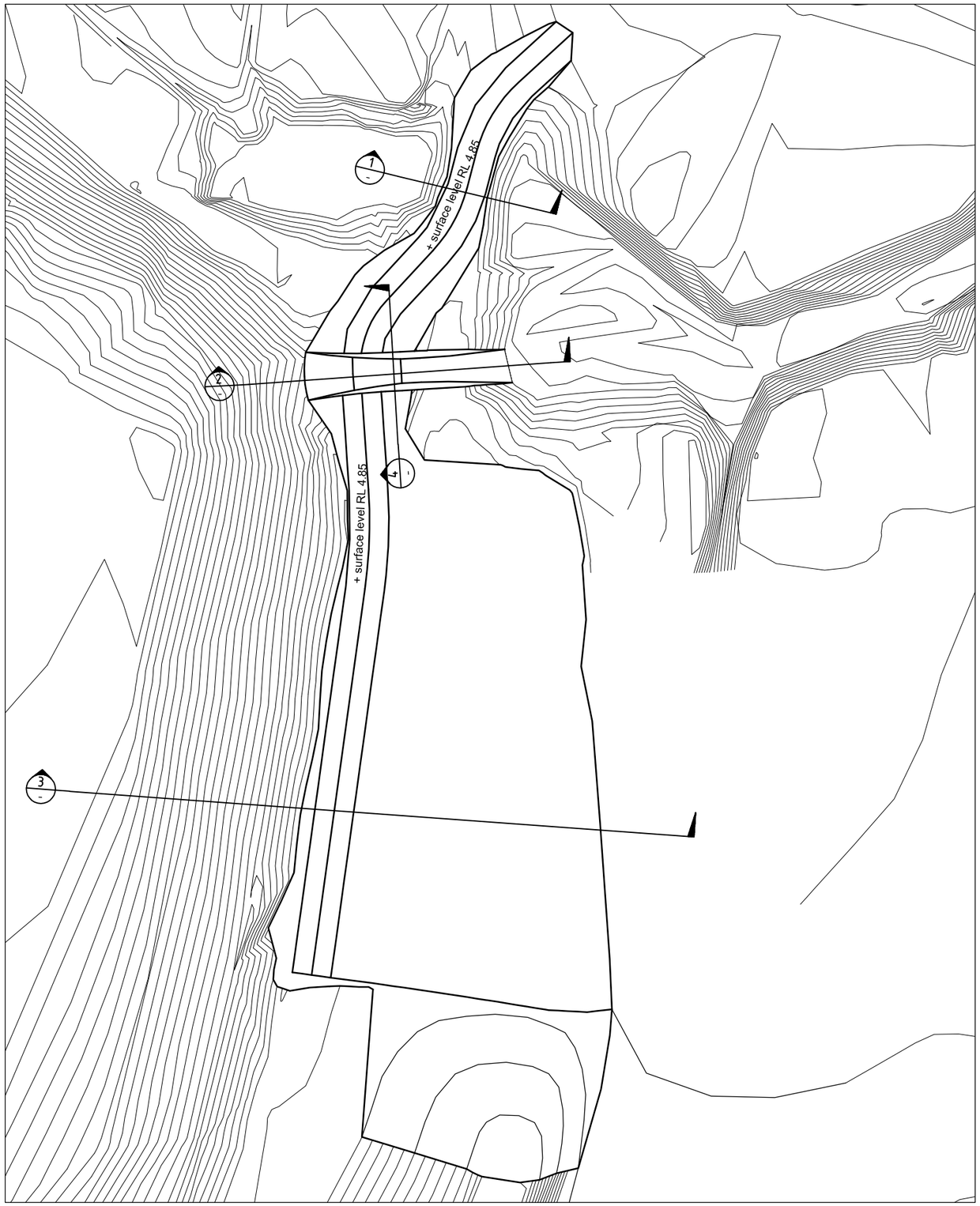
St. Vincents Foundation Pty Ltd
CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 28 - 33 Outlet weirs.dwg
XREF's: wetland outline; Contours for weirs 21-2-08

Scale: as indicated (A3)

FIGURE 30

CONSTRUCTED WETLANDS BASE FLOW OUTLET STRUCTURE S4 CHANNEL





Refer to Figure 32 for
Detail of cross sections

5 0 5 10 15 20 25m
1:500

Scale 1:500 (A3)

FIGURE 31

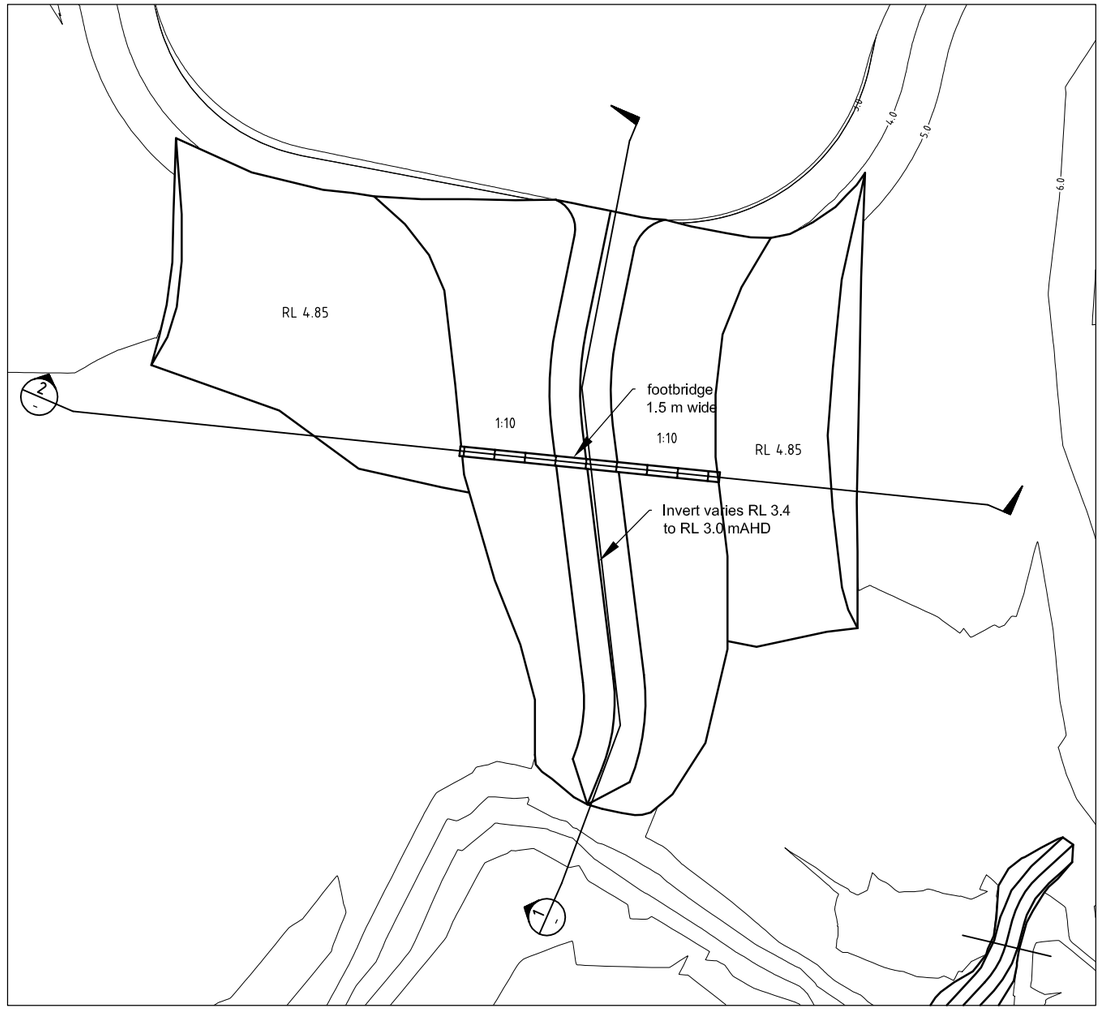
EXISTING LAGOON "OVERFLOW" OUTLET CONTROL STRUCTURE S3 PLAN

PRINT DATE: 09 December, 2010 - 4:53pm

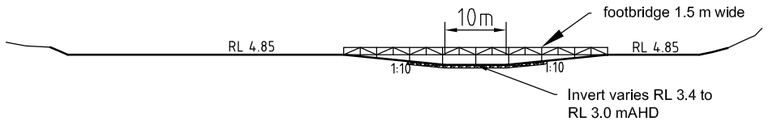
Ver 2. Date: 19 March 2010

St. Vincents Foundation Pty Ltd

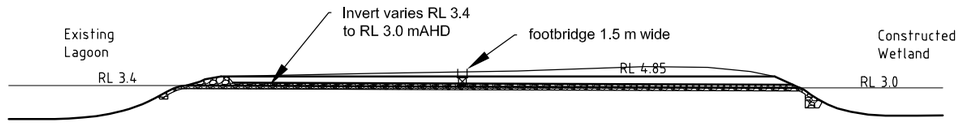
CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 28 - 33 Outlet weirs.dwg
XREF's: wetland outline; Contours for weirs 21-2-08



PLAN - "CONNECTION" CONTROL STRUCTURE S2
1:1000



SECTION 2 / 1:1000 / -



SECTION 1 / 1:1000 / -

Ver 3. Draft Date: 18 February 2011

St. Vincents Foundation Pty Ltd

CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Figure 28 - 33 Outlet weirs.dwg
XREF's: wetland outline; Contours for weirs 21-2-08; Earthworks Update 14-02-2011

Scale: as indicated (A3)

FIGURE 33
"CONNECTION" CONTROL STRUCTURE S2 PLAN AND DETAILS

Appendix E

Groundwater supplementary assessment

Appendix E Groundwater supplementary assessment

THE UNIVERSITY OF NEW SOUTH WALES

Water Research Laboratory

School of Civil and Environmental Engineering

3rd March 2011

WRL Ref: WRL09056SEP L110303

Mr Brian Tierney
Tierney Property Services
PO BOX 493
PORT MACQUARIE NSW 2444

Via email: briantierney@midcoast.com.au

Dear Brian,

ASSESSMENT OF MODIFICATIONS TO WATERBODY 'W1' AND IMPLICATIONS FOR GROUNDWATER

Following a public submission process, minor amendments have been proposed to the Part 3A Concept Plan (MP06-0085) and Project Application (MP07-0001) prepared for the proposed residential development of 'Rainbow Beach Estate'. Tierney Property Services (TPS) requested WRL to update assessments of groundwater impacts with respect to: a proposed modification to the W1 Waterbody, and; review of continuing groundwater monitoring that has been undertaken.

At the time of preparation of the groundwater characterisation study (WRL Technical Report 2009/32) and Groundwater Management Plan (*ibid*) for the site, there was 5 months of data available. Routine groundwater level monitoring has been undertaken since August 2009, and there is now data covering a period of 16 months. WRL have reviewed the currently available water level data. Based on review of this data, WRL's previous advice regarding water levels remains relevant.

The 'beneficial usage' of the groundwater, based on water quality, is characterised in WRL Technical Report 2009/32. Additional groundwater monitoring undertaken since the date of the WRL Report has been reviewed. The additional groundwater data do not alter the recommendations previously given by WRL.

The current Preferred Project features changes to the Waterbody 'W1', comprising: an alternative outflow weir design, and; a minor reduction to the south-western extent of Waterbody W1 to improve fauna access between W1 and the Existing Lagoon.

The changes to the design of the weir on Waterbody W1 do not affect the assessment of the groundwater regime as the revised weir is hydraulically equivalent to the old.

The impact on groundwater from changes to the extent of Waterbody W1 were examined by re-running the 3D numerical groundwater model (described in WRL Technical Report 2009/32) using the revised extent of the Waterbody as a constant head boundary condition with an elevation of 3 m AHD. The 'medium' rainfall scenario was used, with recharge and aquifer characteristics remain unchanged from previous assessments. The results are presented in Figures 1 to 3, as attached to

this letter. These Figures correspond to and supersede Figures 26, 29 and 30 from WRL Technical Report 2009/32 respectively.

From review of the modelling results, it is evident that the revised Waterbody W1 is associated with reduced drawdown over the site compared to the previous design. However, the changes are very minor.

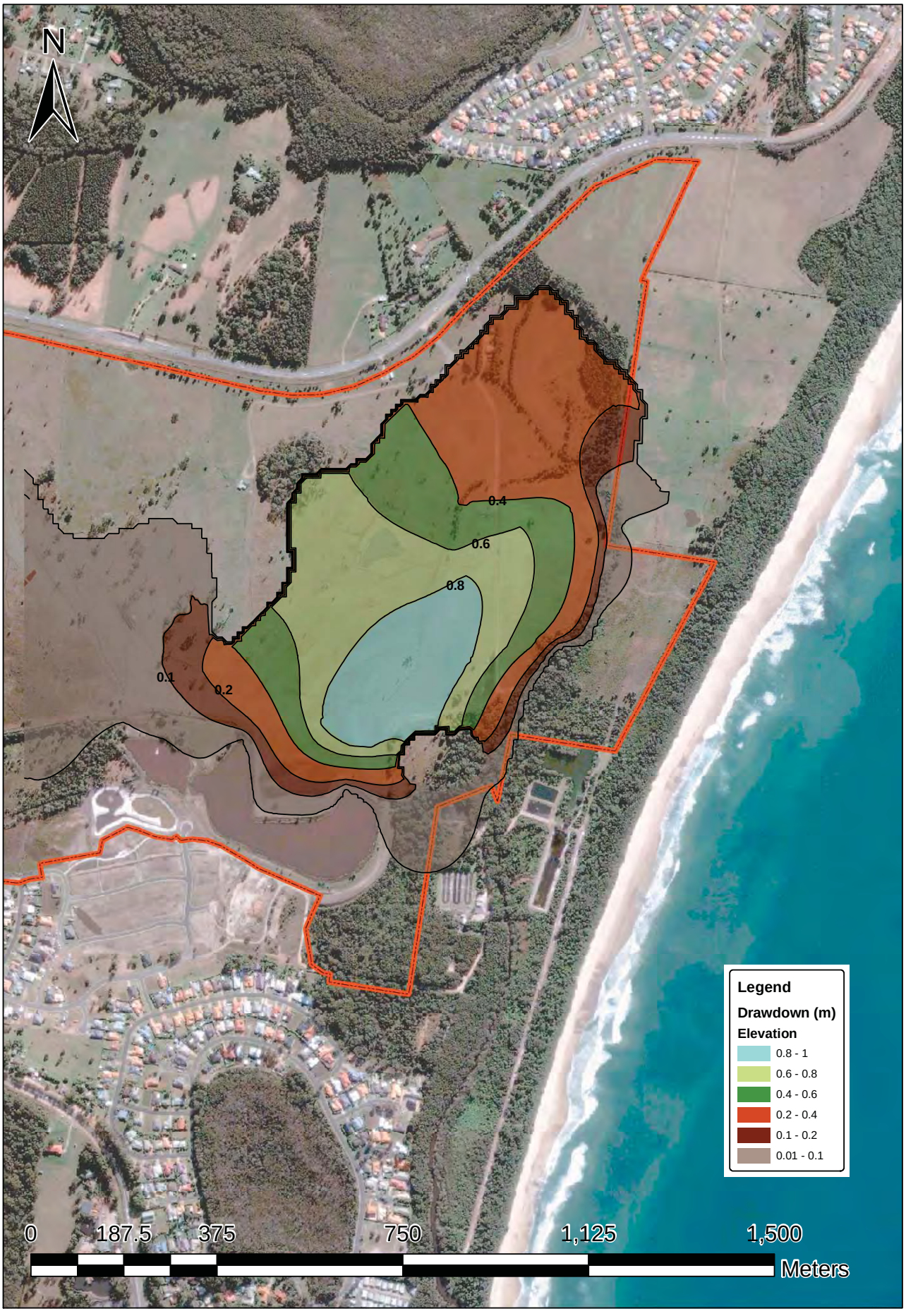
In summary, it is considered by WRL that the proposed changes to Watebody W1 cause a slightly reduced impact over the site as compared to the previous design. However, as the changes are so slight, they do not alter the recommendations previously given in WRL Technical Report 2009/32.

Please contact Steven Pells (8071 9847) or myself (8071 9800) should you require further information.

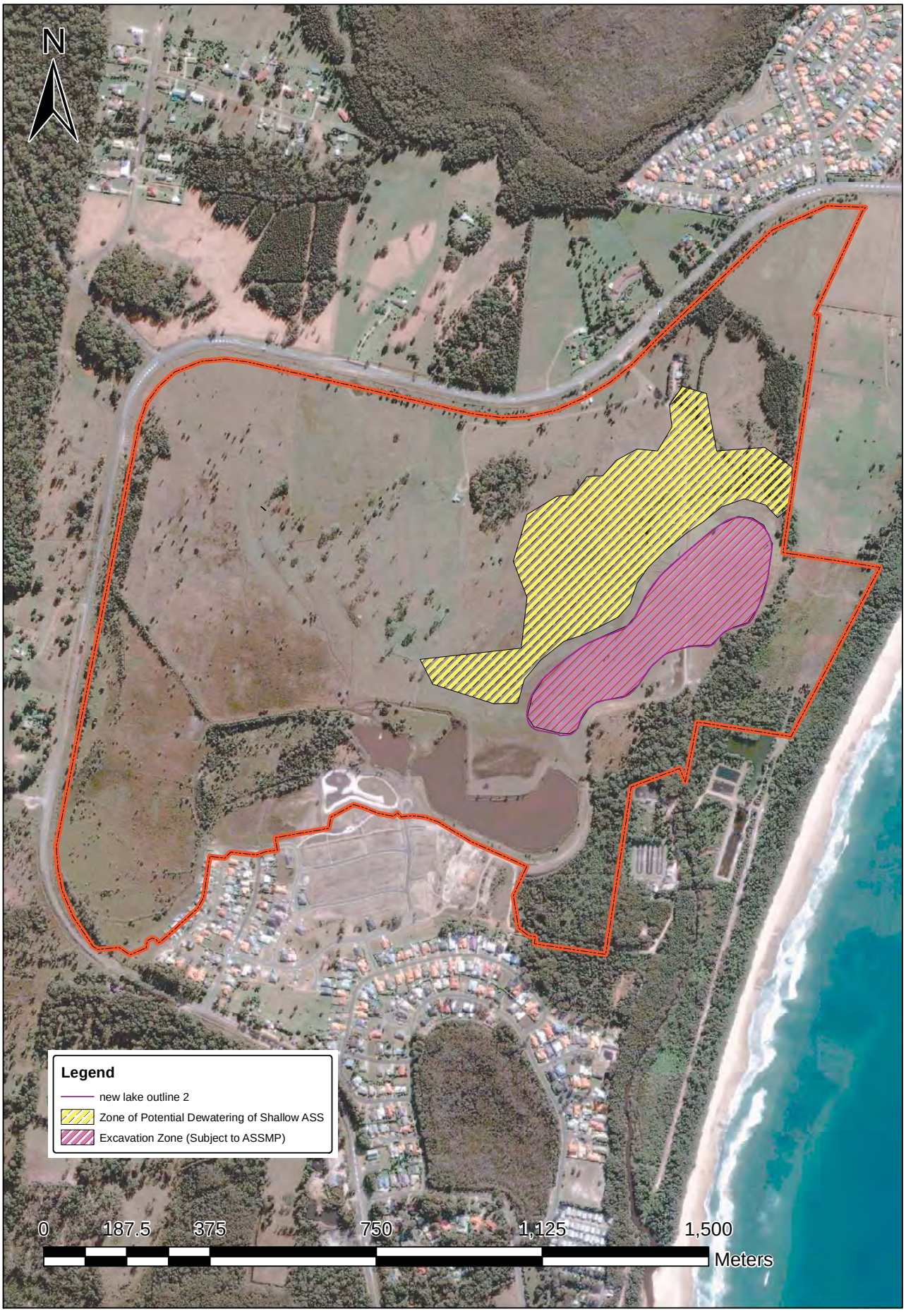
Yours sincerely,

B M Miller
Manager.

WRL L20110303	STEADY STATE SIMULATION OF POST DEVELOPMENT REPRESENTING MEDIAN GROUNDWATER LEVELS REVISED WATERBODY W1- MARCH 2011	Figure 1 insert filename



WRL L20110303	GROUNDWATER DRAWDOWN PRE MINUS POST DEVELOPMENT, AVERAGE ANNUAL LEVELS REVISED WATERBODY W1 - MARCH 2011	Figure 2 insert filename



WRL L20110303	ACID SULFATE SOIL POTENTIAL RISK ZONES DUE TO PROPOSED LAKE REVISED WATERBODY W1 - MARCH 2011	Figure 3 insert filename

Appendix F

Groundwater response to submissions

Appendix F Groundwater response to submissions

THE UNIVERSITY OF
NEW SOUTH WALES

Water Research
Laboratory

School of Civil and
Environmental Engineering

21st February 2011

Our Ref: WRL 09056:SEP:L110221

COMMERCIAL IN CONFIDENCE

St Vincent's Foundation Pty Ltd
C/- Tierney Property Services Pty Ltd
PO Box 493
PORT MACQUARIE NSW 2444

Attention: James Dunn / Brian Tierney

Dear James and Brian,

REVIEW OF DATA AND RESPONSE TO SUBMISSIONS

Environmental assessments for the proposed Rainbow Beach Estate development at Bonny Hills have recently been through a public exhibit process. Following this review, there have been a number of submissions from stakeholders. WRL was provided with a spreadsheet in which submissions were collated. WRL were requested to respond to Items 2.7, 2.25, 4.2, 4.3, 4.11, 4.14 and 4.22. Responses to these items by WRL are provided in Table 1 below.

Routine monitoring of groundwater levels and quality around the site has been ongoing since August 2009. Data recorded up to February 2010 was reviewed by WRL and was used as a basis for characterisation of baseline groundwater conditions and establishment of a numerical groundwater model. A review of the additional data that has been gained since that time has been presented in Section 2.0 of this letter.

1.0 Response to Submissions

Responses to submissions are provided in Table 1 below.

Table 1
Responses to Comments

Reference	WRL Comment
2.7	It is understood that the "assessment of wetting and drying" refers to Section 2.6.3 in "Water Engineering and Environment DGR Assessments" (WEDGRA), in which an analysis was undertaken to examine the risk and frequency of low water levels within the proposed lake. Groundwater investigations at the site show that groundwater levels are typically above the level of the proposed lake, inferring net inward seepage to the lake under typical conditions. The "wetting and drying assessment" presented in the WEDGRA adopted a conservative assumption of seepage flowing the other way - outward from the lake. This assumption is consistent with a period of drought in which water levels in the aquifer were depleted well below their typical levels. This conservative assumption is

	understood to be selected simply to test an extreme scenario and it is not invalidated by subsequent studies. The fact that seepage is typically toward the lake helps to limit further the risk of 'drying' of the lake.
2.25	While the heavy metals that were examined are technically listed as toxins, it should be noted that they each can be found naturally occurring in groundwater. Hence guidelines do not universally prohibit their exchange (or 'disposal' as referred). The proposed development maintains existing groundwater-surface exchange processes, including the currently existing exchange of toxins that have been measured in the groundwater. The proposed development does not manufacture these toxins, or establish a new and foreign 'disposal' mechanism for these toxins. The contaminants measured in the soil are typical of oxidised ASS, which occurs throughout coastal NSW. The ASS Management Plan has been developed to ensure the ASS conditions are managed across the site. Maintaining the lake pH > 5.5 will ensure that the majority of the metals with remain in insoluble form, and the limit risk to aquatic organisms. The existing lake is considered to be a good indicator of the future water quality of the proposed lake and, as discussed in previous studies, has provided favourable indications. Duchess Gully is groundwater fed, and is expected to be currently receiving natural and anthropogenic contaminants, none of which could be attributed to the proposed development. The proposed development does not necessarily promote a higher concentration of contaminants to be delivered to Duchess Gully than current conditions, and the redirection of the surface water flow path to the northern end of Duchess Gully is expected to promote flushing. Arsenic levels were measured in water samples taken from bores GW1 to GW9, with a mean value of 0.019 mg/L, which is less than the trigger concentration of 0.024 mg/L for impacted aquatic ecosystems (ANZECC, 2000). Measurements ranged from 0.005 mg/L (limit of detection) to 0.24 mg/L recorded at GW2, although subsequent measurements of 0.005 mg/L were later recorded at the same location. These concentrations fulfil criteria for irrigation and stock watering. Measured mercury levels were less than 0.001 mg/L, fulfilling the criteria for drinking water. The average recorded values of Mercury were less that aquatic trigger values of 0.0004 mg/L in 4 of the 11 samples, and less than 0.0006 mg/L (for freshwater systems) in 6 samples. Levels of Mercury in the groundwater were therefore marginal for release, although it is not known if these concentrations are higher or lower than the existing surface water characteristics. In summary, measurement of toxins was included in the groundwater monitoring plan to characterise existing groundwater conditions. A dynamic exchange of surface and groundwater will be maintained on the site, including the pre-existing exchange of toxins. Based on the available data, the observed concentrations and the implementation of the ASS Management Plan, the risk of increase of delivery of toxins to receiving waters is considered by WRL to be low.
4.2	A request by the NSW Office of Water (NOW) was made that an impermeable liner should be installed on each of the water treatment ponds (Ponds W1A, W1B, W1C, W1D, W1E, W2, W3, W4A and W4B). The rationale given was that the ponds are expected to receive runoff carrying urban contaminants and, due to their close

	proximity to the groundwater table, the possibility of transfer of these contaminants into the groundwater system was identified. The requirement for a hydraulic barrier between the ponds and the groundwater is only invoked if the surface water quality is shown to be of poorer quality than the groundwater, such that a reduction of the quality of the groundwater from its existing 'beneficial usage characteristic' may be incurred. A comparison of the modelled surface water quality against the measured groundwater quality adjacent to each of these ponds may be undertaken to check the requirement for a hydraulic barrier. A document which is commonly cited for the requirements of hydraulic barriers around treatment ponds is: • *Guidelines for Wastewater and Evaporation Lagoon Construction*, prepared by Environmental Protection Authority South Australia EPA 509/04—March 2004. The EPA 509/04 document has been recently updated with EPA 509/10, a 2010 issue, which can be found here: http://www.epa.sa.gov.au/xstd_files/Corporate/Public%20consultation/wastewater_lagoons.pdf WRL are not aware of any Australian statutory document which is used to provide more authoritative specification of these barrier layers. In the EPA509/10 document, specifications on lining materials are given. The usage of the natural geology as the hydraulic barrier is also allowed where the natural materials can be shown to provide an effective barrier to flow. At the Rainbow Beach Estate, it is possible that the clay materials adjacent to proposed wetlands W1A, W1B, W2, W3, W4A and W4B may provide a sufficient hydraulic barrier. To verify this, laboratory tests of the permeability of samples of the *in-situ* material will be required. It may be necessary to verify that the rate of groundwater flow through the *in-situ* materials is less than the rate of flow through a comparable constructed lining material with thickness of 300 mm and co-efficient of permeability of 1×10^{-9} m/s. If the *in-situ* material is shown to provide an effective barrier, there will still be a requirement for appropriate preparation of the pond base for construction of the ponds.
4.3	In review of the Environmental Assessment, NOW have maintained that there is potential for the groundwater quality in the locality to be affected due the risk of contamination from Acid Sulfate Soils (ASS). The statement by NOW that a low to medium risk of ASS contamination exists follows WRL's recommendations in WRL Technical Report 2009/32. WRL therefore acknowledge this risk. This risk has been addressed through the required implementation of a groundwater monitoring and response plan as presented in Appendix B to WRL Technical Report 2009/32.
4.11	See comment for Item 4.2
4.14	WRL were responsible for supervision of installation of monitoring bores GW1, GW2, GW3, GW4, GW5, GW6, GW7A, GW7B, GW8 and GW9. An application for groundwater licenses for installation of monitoring bores at the Rainbow Beach site was sent by fax to NOW on the 7th June 2009, prior to installation. The same application was resent by email along with the drilling and well construction details and surveyed locations to Information@water.nsw.gov.au, and a reply confirmation (from

	nizerah.elniz@water.nsw.gov.au) was received, stating that the application would be processed by the licensing office in Grafton.
4.22	See comment for Item 4.2

2.0 Review of Monitoring Data

Routine groundwater level monitoring has been undertaken since August 2009, and there is now data covering a period of 16 months of data. At the time of preparation of the groundwater characterisation study (WRL Technical Report 2009/32) and Groundwater Management Plan (ibid) for the site, there was only 5 months of data available. WRL have reviewed the currently available water level data and have presented it clearly in Figure 1, below. Based on review of this data, WRL's previous advice regarding water levels remains relevant.

The 'beneficial usage' of the groundwater, based on water quality, is characterised in WRL Technical Report 2009/32. Additional groundwater monitoring undertaken since the date of the WRL Report has been reviewed and is summarised in Tables 2 and 3 below. The additional groundwater data do not alter the recommendations previously given by WRL.

Please do not hesitate to contact myself or Steven Pells on ph. 8071 9847 should you wish to discuss or clarify any matters.

Yours sincerely,

Brett Miller
Manager.

Groundwater Levels and Daily Rainfall
July 2009 to December 2010

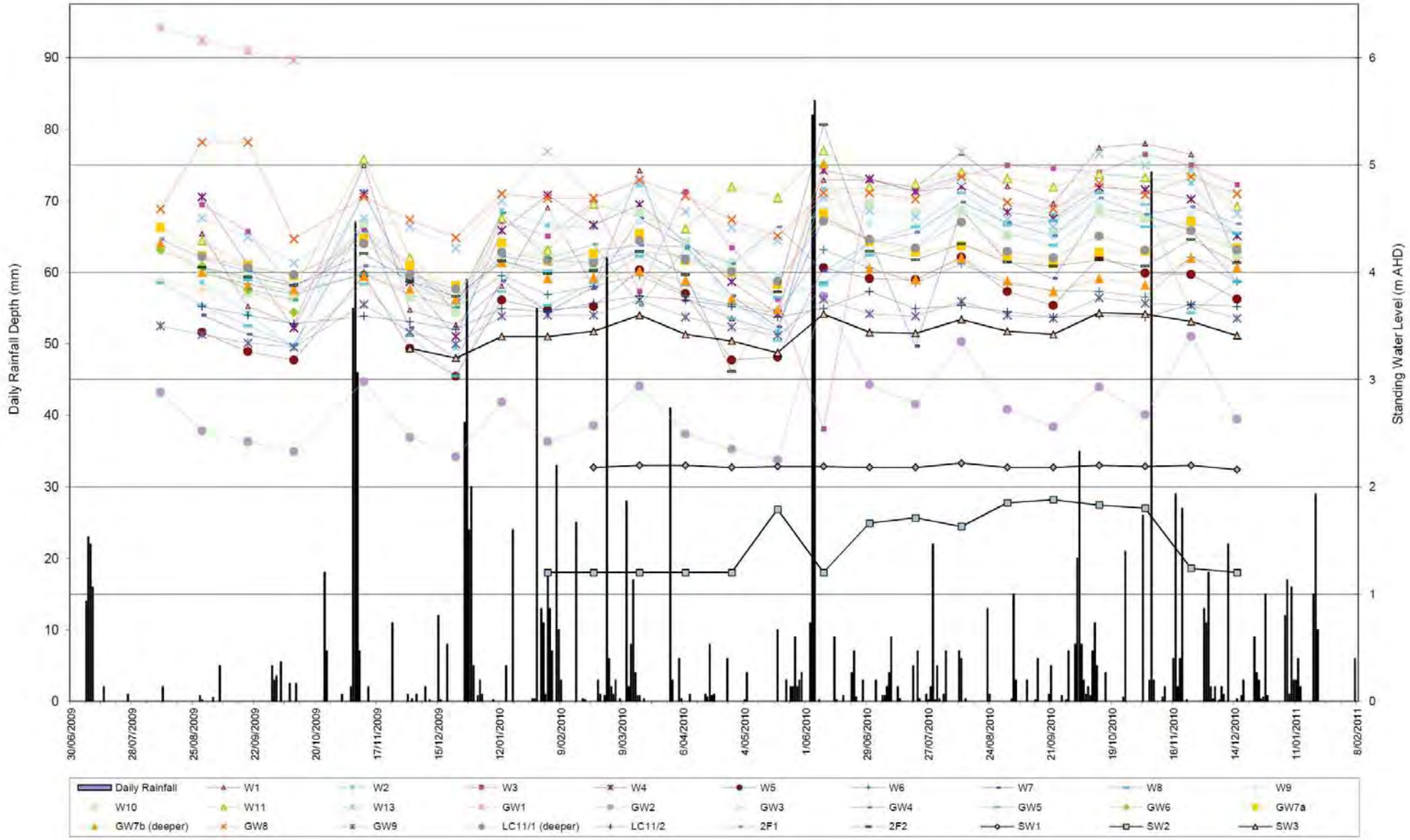


Table 2
Mean Water Quality Values for 2009 Sampling

Constituent	Mean Values Up Until End 2009																											
	Mean Measured Value (mg/L) At Monitoring Locations																											
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W13	GW1	GW2	GW3	GW4	GW5	GW6	GW7a	GW7b	GW8	GW9	LC11/1	LC11/2	2F1	2F2	SW1	SW2	SW3
Temp.	18.98	18.73	17.24	17.35	17.09	16.72	16.89	18.38	16.33	17.23	17.56	16.96	18.08	17.60	17.52	17.95	18.42	17.30	18.70	19.07	17.53	17.37	16.66	17.60	18.61	17.02	15.24	17.94	20.71
Cond	622	1803	1638	2138	3153	62	930	15333	211	177	573	1402	319	258	166	9900	6871	1169	115	167	1271	2373	190	517	542	84	437	3641	178
Salin	0.34	1.01	0.90	1.20	1.81	0.04	0.51	8.93	0.11	0.11	0.32	0.78	0.18	0.12	0.09	5.58	4.16	0.64	0.04	0.09	1.10	1.33	0.08	0.26	0.30	0.05	0.22	2.09	0.08
pH	5.75	5.59	6.83	5.77	5.10	4.57	4.93	5.58	5.79	4.94	5.50	7.16	4.75	5.67	6.25	7.15	5.71	5.98	5.42	6.36	7.16	6.42	5.44	7.05	6.02	5.83	6.72	6.48	7.51
DO %Sat	48.67	64.07	58.87	38.20	36.23	27.40	54.30	26.60	31.70	23.23	37.93	24.83	22.20	22.83	17.93	24.13	39.53	24.30	32.23	38.30	36.40	30.47	38.90	29.67	47.73	40.80	32.20	54.60	93.33
DO mg/L	4.47	5.93	5.63	3.63	3.47	2.63	5.23	2.37	3.13	2.27	3.63	2.40	2.13	2.17	1.70	2.23	3.60	2.33	3.03	3.53	3.50	2.93	3.80	2.80	4.47	3.93	3.20	5.10	8.33
Turb.	600	543	438	446	600	479	547	600	424	600	600	501	600	213	600	382	413	389	376	461	460	452	14	16	600	600	222	15	11
Chloride	142	520	373	673	960	24	313	4900	50	36	160	335	84	64	31	2743	2103	267	29	25	407	617	43	94	133	31	96	1127	48
Sulphate	27.33	103.67	43.00	71.67	145.00	5.33	36.00	930.00	5.67	24.33	26.67	171.00	10.33	21.67	5.33	256.67	720.00	126.33	6.00	20.33	175.00	231.67	6.67	4.67	6.67	13.67	3.67	133.33	12.67
Fe (total)	47.00	40.00	13.03	66.00	69.67	0.44	69.33	76.67	16.67	24.00	57.67	14.57	0.96	121.67	127.33	376.67	109.33	476.67	20.00	15.70	48.87	45.67	1.70	6.67	24.76	8.23	9.57	2.73	1.73
Fe (sol)	2180	935	1223	220	15300	320	2407	34667	3367	3847	395	2317	510	4567	35100	207	2400	6230	6333	1767	17752	20800	1600	5000	3357	2040	3767	1570	1567
Al (total)	41.67	108.00	24.33	54.53	46.33	3.80	58.33	79.00	18.00	41.00	55.67	29.80	1.77	500.00	231.00	436.67	260.00	300.00	310.00	94.13	90.00	12.53	2.57	0.51	43.34	20.33	0.42	0.25	1.51
Al (sol)	5553	3917	5537	513	1343	1090	73	35	577	433	1257	7520	677	8533	8733	610	347	241	27667	4833	30136	102	2400	503	97	3493	293	180	1520
Ca													5.47	4.60	5.10	83.67	121.67	17.67	7.17	6.20	13.33	29.67	3.07						
Na													52.33	41.33	21.33	1490.00	1120.00	166.67	17.67	37.00	406.67	400.00	32.67						
K													0.80	2.93	7.13	2.67	2.07	1.57	5.20	2.17	0.90	2.13	2.73						
Mg													7.23	6.73	4.87	406.67	278.33	29.67	4.17	4.57	34.00	59.00	4.83						
As													5.00	172.33	80.67	5.90	24.00	43.00	5.97	25.00	6.33	7.17	5.00						
Cd													0.70	1.60	1.03	0.70	0.70	2.73	0.70	1.23	0.70	0.70	0.70						
Co													1.00	159.67	59.00	1156.67	98.67	1143.33	18.00	13.53	21.20	3.13	1.00						
Pb													14.07	246.67	123.67	120.33	261.33	536.67	175.33	164.67	255.67	242.67	3.93						
Mn													6.80	733.33	560.00	3173.33	1333.33	3600.00	161.67	63.33	376.67	153.33	29.33						
Hg													0.13	0.93	0.47	0.83	1.33	1.37	1.80	0.77	0.83	0.13	1.40						
Zn													53.67	736.67	217.00	1796.67	130.33	606.67	490.00	123.00	96.67	87.67	361.57						
FCB													3.00	0.33	1.00	2.00	0.67	1.67	4.00	2.00	1.00	2.00		1.33					
NH4-N													0.25	0.39	0.36	0.16	0.15	0.30	0.52	0.36	0.21	0.20		0.55					
Org-N													1.37	0.78	1.33	0.28	1.18	0.88	1.27	1.21	0.50	0.62		1.78					
NOx-N													0.24	0.43	0.39	0.02	0.08	0.09	0.10	0.12	0.05	0.24		0.09					
Total-N													1.87	1.60	2.03	0.46	1.41	1.16	1.90	1.69	0.67	1.06		2.42					
Ortho-P													0.04	0.01	0.03	0.01	0.01	0.01	0.06	0.06	0.01	0.01		0.04					
Total-P													0.06	0.23	0.58	0.12	0.03	0.03	0.16	0.13	0.04	0.02		0.07					

.

Table 3
Mean Water Quality Values for 2009 and 2010 Sampling

Mean Values 2009 and 2010																													
Constituent	Mean Measured Value (mg/L) At Monitoring Locations																												
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W13	GW1	GW2	GW3	GW4	GW5	GW6	GW7a	GW7b	GW8	GW9	LC11/1	LC11/2	2F1	2F2	SW1	SW2	SW3
Temp.	19.67	19.44	18.52	18.65	18.51	18.66	18.54	19.65	18.05	18.68	19.80	18.17	19.26	18.69	18.94	19.12	19.26	18.48	20.37	20.72	18.89	18.57	18.47	19.03	19.47	18.92	16.91	18.83	21.36
Cond	580	1397	1665	1776	2858	84	1131	12157	221	219	1019	1000	191	297	192	9887	6535	1321	112	122	1664	2358	191	528	1193	100	508	2351	217
Salin	0.30	0.75	0.89	0.95	1.59	0.05	0.60	7.81	0.11	0.11	0.55	0.53	0.10	0.14	0.10	5.56	3.84	1.43	0.05	0.06	1.05	1.28	0.08	0.26	0.65	0.05	0.25	1.31	0.10
pH	5.63	5.83	6.87	5.90	5.16	4.28	5.06	5.25	5.63	5.51	6.12	6.60	4.45	5.32	5.79	6.95	5.65	5.77	5.26	5.65	6.88	6.05	5.21	6.71	6.19	5.57	6.39	6.26	7.39
DO %Sat	51.87	59.21	58.60	52.14	45.11	33.97	56.37	43.66	43.74	36.39	45.70	35.41	30.67	34.93	30.74	39.86	49.60	42.46	37.13	34.14	38.20	38.99	34.34	25.07	51.82	40.79	43.74	59.89	99.91
DO mg/L	4.73	5.40	5.46	4.81	4.16	3.09	5.24	3.77	4.07	3.27	4.15	3.29	2.77	3.17	2.76	3.50	4.44	3.96	3.34	3.03	3.51	3.60	3.19	2.30	4.74	3.74	4.19	5.57	8.89
Turb.	438	576	236	272	600	548	485	465	422	454	456	404	544	434	468	466	491	446	504	380	328	389	9	13	585	600	116	11	11
Chloride	136	391	367	533	856	24	344	4243	58	42	157	232	50	76	49	2683	1914	316	25	22	394	600	43	98	316	28	131	717	55
Sulphate	24.29	73.86	40.43	51.57	108.43	4.71	42.14	791.43	8.57	22.57	26.00	100.86	6.14	21.43	9.00	255.71	660.00	124.14	6.00	10.86	173.57	227.86	6.71	3.57	49.60	10.57	5.14	81.00	13.71
Fe (total)	21.14	23.03	6.46	29.57	40.70	0.40	35.23	57.86	12.33	14.21	37.83	8.06	0.64	56.26	67.66	161.77	50.33	214.64	10.19	8.29	21.12	26.04	1.59	7.37	18.31	5.43	6.07	1.62	1.31
Fe (sol)	1153	5815	1030	532	15957	404	5660	39429	4829	3817	7864	2593	477	3743	20614	155	4331	12813	3596	1704	7634	20200	1529	6200	3274	1476	2893	994	1061
Al (total)	19.56	62.57	12.65	23.70	24.71	2.61	25.27	33.95	10.27	18.37	31.33	19.54	1.48	226.59	120.86	187.40	111.59	128.71	144.69	43.07	39.06	16.54	2.99	0.50	29.24	14.94	0.42	0.21	0.85
Al (sol)	2849	15736	3756	366	1650	1381	126	51	1319	841	2635	9109	834	6714	6586	339	196	177	15686	3131	12981	64	2814	669	2978	3591	261	176	933
Ca													3.96	4.11	5.27	82.29	111.00	17.43	6.01	4.59	12.57	26.86	3.07						5.03
Na													30.71	45.29	25.71	1528.57	988.57	187.14	17.14	23.00	370.71	400.71	34.29						
K													0.94	3.00	5.69	2.63	1.79	1.57	2.79	1.14	1.66	2.19	2.66						
Mg													5.01	6.73	7.03	385.71	247.14	32.43	3.61	3.33	28.29	48.89	5.01						
As													5.00	81.39	45.34	5.39	13.33	21.29	5.41	16.34	5.57	5.93	5.00						
Cd													0.70	1.09	1.17	0.84	0.70	1.57	0.70	0.93	0.70	0.70	0.70						
Co													1.00	71.23	30.39	498.47	59.86	493.70	8.61	8.43	9.66	1.91	1.00						
Pb													9.33	110.94	65.43	52.64	112.67	230.57	87.13	77.89	111.06	104.74	2.89						
Mn													5.93	387.14	312.29	1500.29	1074.29	1978.57	87.57	41.66	195.57	140.00	22.00						
Hg													0.33	0.61	0.36	0.50	0.69	0.70	0.99	0.40	0.47	0.16	0.73						
Zn													81.71	359.71	151.14	795.57	110.43	313.00	280.86	96.71	87.57	75.71	197.39						
FCB													2.29	0.17	10.00	1.29	62.71	1.57	2.14	1.57	143.29	1.57		0.86					76.25
NH4-N													0.20	0.27	0.48	0.14	0.11	0.22	0.33	0.24	0.15	0.18		0.47			0.14	0.06	0.10
Org-N													1.40	0.81	1.45	0.65	1.29	0.90	1.74	1.18	0.62	0.84		1.90			1.31	1.45	1.09
NOx-N													0.13	0.21	0.50	0.12	0.08	0.07	0.07	0.08	0.17	0.14		0.06			0.02	0.01	0.03
Total-N													1.73	1.29	2.41	0.91	1.48	1.14	2.14	1.49	0.63	1.15		2.46			1.48	1.52	1.22
Ortho-P													0.03	0.01	0.13	0.04	0.01	0.01	0.08	0.05	0.14	0.13		0.07			0.01	0.01	0.01
Total-P													0.08	0.17	0.46	0.10	0.11	0.06	0.30	0.19	0.06	0.18		0.17			0.07	0.07	0.07

Appendix G

Stormwater response to submissions

Appendix G Stormwater response to submissions

AECOM Australia Pty Ltd
Level 8, 17 York Street
Sydney NSW 2000
Australia
www.aecom.com

+61 2 8023 9333 tel
+61 7 8023 9399 fax
ABN 20 093 846 925

22 March 2011

Commercial-in-Confidence

James Dunn / Brian Tierney
Tierney Property Services Pty Ltd
PO Box 493
PORT MACQUARIE NSW 2444

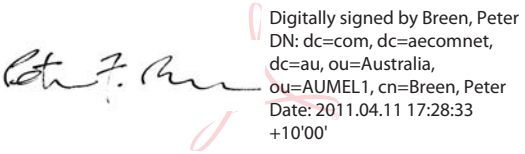
Dear James and Brian

Response to Submissions

Environmental assessments for the proposed Rainbow Beach Estate development at Bonny Hills have recently been through public exhibition. Subsequently, there were a number of submissions from stakeholders. AECOM was provided with a spreadsheet in which submissions were collated and were requested to respond to Items 2.10 - 2.18, 2.22, 4.1 - 4.3, 4.6 - 4.10, 4.22, 6.3, 11.0 and 11.2.

AECOM's responses to these items are provided in Attachment 1.

Kind regards



Dr Courtney Henderson
Senior Ecologist, Design + Planning
Courtney.Henderson@aecom.com

Peter Breen
Director, Design + Planning
Peter.Breen@aecom.com

AECOM Australia Pty Ltd
Level 8, 17 York Street
Sydney NSW 2000
Australia
www.aecom.com

+61 2 8023 9333 tel
+61 7 8023 9399 fax
ABN 20 093 846 925

Attachment 1 - Responses to Comments

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
2.10	1.13.2	**Issue:** Key aspects of the stormwater treatment system concept design are not documented. Appendix M includes updated MUSIC water quality work by AECOM. AECOM's revised MUSIC models show the extensive reliance on vegetated buffers, swales and bioretention however the location and extent of these treatment measures is not shown on a Concept Plan. Reliance on a computer model and broad statements noting an intention to use vegetated buffers, swales and bioretention in addition to end of line stormwater treatment wetlands do not constitute a concept design. **AECOM Response:** Aside from the placement of fill and beach access, the Project Application seeks approval for works located within the central corridor, which excludes future works within in the proposed residential areas delineated by the Concept Plan. The location of the vegetated buffers, swales and bioretention systems proposed as part of the future urban development cannot be determined until such time as detailed urban design of the site is undertaken. This urban design is not included within the scope of the Project Application. The exact location of these elements will be devised as part of a separate project or development application for urban components of the Concept Plan. While the exact location of these elements cannot be determined at this time, the treatment areas required for these elements are clearly stated in Section 4.2.9 of Appendix M (AECOM).
2.11	1.13.3	**Issue:** Appendix M fails to document critical assumptions with respect to vegetated buffers including location, widths, construction materials, potential impacts on road cross sections and potential impacts on the drainage plan. **AECOM Response:** Appendix M (AECOM) relates specifically to stormwater quality treatment, and was produced to supersede aspects of Appendix N (Cardno, WEEDGRA) as the development design evolved and needed resolution. The critical assumptions are documented in Section 3.4.3.2 of Appendix N (Cardno, WEEDGRA), and will be adopted except where stated in Section 4.2.4 in Appendix M (AECOM). The impacts on road cross sections and proposed drainage plan cannot be identified until the urban design and earthworks modelling are done.
2.12	1.13.4	**Issue:** Appendix M notes that proposed end of line constructed wetlands are to have 500mm extended detention depth. Figure 13B shows that only 200mm extended detention depth is proposed for Wetland 1 which is the largest of the proposed wetlands. Confirm whether the provision of 500mm extended detention is available on the other proposed stormwater treatment wetlands. If not available, modelling and resizing of the wetlands is to be undertaken so that all modelling is consistent with the proposal and ensure that what is modelled and what is proposed is actually viable to construct. **AECOM Response:** Extended detention is to be 500mm as stated in Section 4.2.5 of Appendix M (AECOM). Figure 13 B is a conceptual diagram in the WEEDGRA provided to Cardno earlier in the design phase to illustrate several concepts of wetland design.

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
2.13	1.13.5	**Issue:** Appendix N, Figure 13B shows a proposed stormwater treatment wetland which is to be hydraulically separated from the open water wetland via bentonite clay slurry. The extent of the lining is not clear. Concern raised that if the whole of the proposed constructed wetlands are not lined that they will dry out. The wetting and drying analysis reported in Appendix M fails to document wetland exfiltration assumptions and this is critical. The proposed wetlands are to be constructed partly on marine sands and are likely to be hydraulically connected with the proposed lake. When the lake level drops during dry periods so will the level in the proposed treatment wetlands – unless they are to be lined. Conversely if a liner is proposed and the wetting and drying analysis did assume zero exfiltration from the wetland then a cross section clearly showing key components such as a liner must be documented. The liner must be able to withstand drying out (clay cracks when dry) unless a revised wetting and drying analysis shows that it will never dry out. The liner must also be able to withstand hydraulic uplift pressures from groundwater beneath it especially because the MHL report identified that groundwater will flow into the wetland largely from the direction of Wetland W1. If the proponent intends (or partly intend) to rely on naturally occurring clay to line the base of any proposed wetlands then a plan showing the prevailing soil type overlain with the proposed extent of constructed wetlands needs to be provided. **AECOM Response:** 1) Cracking liner - Some of the stormwater treatment wetlands are to be built into clay soils and will not require lining. If wetlands are located above sandy soils, they will need to be lined. Water level drawdown analyses were undertaken to ensure the health of the wetland vegetation and these analyses identified that the treatment wetlands are unlikely to drawn down sufficiently to allow the wetlands to dry out. Therefore, the clay liners are also unlikely to dry out sufficiently to crack or leak. 2) Hydraulic lift - This is considered unlikely as the groundwater occurs at depths lower than the treatment wetlands. Hydraulic lift is only likely to occur if the stormwater treatment wetland was empty and the groundwater was unusually high. The occurrence of dry wetland and high groundwater is not likely to coincide. Every time it rains, the urban catchments provide water to the wetland earlier than it would be able to reach the groundwater, therefore drying in these treatment wetlands is less frequent than in natural catchments.
2.14	1.13.6	**Issue:** The Continually Stirred Tank Reactor (CSTR) number adopted for wetland modelling in MUSIC has not been documented. Concern about short circuiting of the proposed wetlands and poor wetland hydraulic efficiency. Proposed drainage plan shows stormwater pipes discharging to what is assumed to be the outlet end of the constructed wetlands. While no objection is raised to this in principle, the proponent is to ensure that the poor hydraulic efficiency proposed has been adequately accounted for in the MUSIC models and that the wetlands are of adequate size. **AECOM Response:** The default values for CSTRs ("continually stirred tank reactors" - an assumption used in the modelling to determine hydrologic efficiency) were used in the modelling in MUSIC. The assumption that the drainage plan shows stormwater pipes discharging to the outlet end of the constructed wetlands is incorrect. As outlined in the Landscape Master Plan attached to the end of Appendix M (AECOM), the plan shows inlets and outlets at opposite ends of the wetlands and the expected hydrologic efficiency provided is very high (high length to width ratios, >3:1).

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
2.15	1.13.7	**Issue:** Appendix M: Rainfall used in the MUSIC analysis (about 1150mm) is significantly lower than average local rainfall (1440mm). The proponent is to use an appropriate time series or demonstrate that the impact of using lower than average rainfall is negligible. **AECOM Response:** Background: MUSIC, the Stormwater modelling software, requires rainfall data in 6 minute time steps to accurately model pollutant runoff and stormwater treatment. There are often gaps in 6 minute datasets. To ensure that the model is as accurate as possible, modellers usually try to choose a 6 minute time series without any gaps for stormwater treatment modelling. Available Data: Cardno analysed the available 6 minute data from nearby meteorological stations. Six minute rainfall data was selected from the Port Macquarie Region. Monthly evapo-transpiration data for the Port Macquarie was also used. Complete data sets were available for the periods: - 1966-1970 (5 years) – Average annual rainfall: 1124 mm - 1980-1991 (10 years) – Average annual rainfall: 1054 mm Cardno and AECOM chose to use the 1966 to 1970 data set because the average annual rainfall of that period was 1124mm, and this was the closest to the long term average of 1440 mm for Bonny Hills. Thus, this dataset was the best available local data for stormwater treatment modelling. This was the most appropriate (i.e. local) time series available. We acknowledge that the rainfall data set used for the original MUSIC modelling was below the mean annual rainfall for the Bonny Hills site. This was due to the absence of better consecutive continuous data for this region (i.e. missing data in the other rainfall records). In order to confirm the performance of the wetland, a sensitivity analysis of the model has been undertaken by modifying the rainfall data in the model. To determine a suitable rainfall data set we examined records from coastal regions north to Queensland and south to Sydney with respect to two critical factors: 1) Absolute rainfall (i.e. mean annual rainfall); and 2) Seasonal pattern (i.e. mean monthly rainfall). Note consecutive continuous data had to be available from the examined sites and this immediately ruled out several potential weather stations. A range of stations were examined (see attachment "Rainfall Analysis.pdf - pasted in the column to the right as a .jpg) and Elanora Water Treatment Plant (station # 40609, Gold Coast, Queensland) was identified as having a reasonably similar long term average annual rainfall to Bonny Hills with suitable pluviograph data. However, seasonal distribution of rainfall for Elanora generally showed wetter summers and drier winters compared to Bonny Hills. The original MUSIC model was re-run with Elanora data providing results as follows:

<table>
<tr><th>Control Spreadsheet Item Number</th><th>Submissions Report Item Number</th><th>Issues (summarised for inclusion in Submissions Report) and AECOM Responses</th></tr>
<tr><td></td><td></td><td>
Original Model (Bonny Hills SILO rainfall data) vs. Elanora rainfall data
<table>
<tr><th>Pollutant</th><th>Bonny Hills % reduction</th><th>Elanora % reduction</th></tr>
<tr><td>TSS</td><td>79.7</td><td>77.1</td></tr>
<tr><td>TP</td><td>69.4</td><td>65.5</td></tr>
<tr><td>TN</td><td>46.6</td><td>42.8</td></tr>
</table>
The results show slightly lower percentage load reductions compared to the original modelling. We believe the sensitivity to the change in rainfall seasonality is as important as the increase in total annual rainfall. We believe the differences in treatment are primarily due to the more extreme seasonal patterns associated with the Elanora rainfall data and this testing is therefore considered conservative.
In summary, the meteorological data used in the modelling of stormwater treatment at Bonny Hills uses the closest station we could find that contained suitable data required to run a continuous simulation that was as close as possible to the long term mean annual rainfall average of the site. Although the sensitivity testing using Elanora Water Treatment Plant showed a reduced performance of the wetland, it is considered to be within the range of accuracy of the model.
Another consequence of using a lower than average rainfall can be a greater wetland drawdown than average conditions being represented in modelling. The water level drawdown of all of the wetlands were modelled to ensure that the wetlands would not draw down too far, which is visually unappealing and can threaten the viability of the wetland plants. Since this modelling was done using a lower than average rainfall, it was conservative i.e. there is a low risk of wetland water levels being drawn down unacceptably low.
</td></tr>
<tr><td>2.16</td><td>1.13.8</td><td>
Issue: Appendix N: Drainage Concept Plan D1 shows a piped drainage network planned for the site which is not consistent with the road cross falls necessary to affect the use of a vegetated buffer strip adopted for modelling purposes in Appendix M.
AECOM Response: As noted in 1.13.2 above, further work will be undertaken in subsequent project or development application(s) following detailed urban design of the residential components of the Concept Plan. It is expected that the drainage plan will evolve with the urban design and will be designed to accommodate the required treatment devices.
</td></tr>
<tr><td>2.17</td><td>1.13.9</td><td>
Issue: Appendix N: Based on Drainage Concept Plan D1, the catchment draining to Wetland W4A is not shown and the purpose of the wetland is unclear. It is not known if W4A is on line or off line or what arrangement is proposed.
AECOM Response: It is correct that the catchment was not shown on the Drainage Concept Plan D1 of Appendix N. The Drainage for the north-eastern corner of the site was not indicated. An indication of the approximate flow paths is provided in the image of the treatment train that was modelled in MUSIC in Figure 27, page 29 of Appendix M, (AECOM). The wetland is offline and it is purpose is to treat water from the upstream catchment.
</td></tr>
</table>

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
2.18	1.13.10	**Issue:** Appendix N: Wetland W4B shown on Drainage Concept Plan D1 seems to serve two catchments of roughly equal size with short circuiting or poor hydraulic efficiency likely. There is no indication this has been accounted for and no indication of the ability to achieve 500mm extended depth. **AECOM Response:** It is acknowledged that Wetland 4B as shown in the Drainage Concept Plan D1 (WEEDGRA, Appendix N) is confusing because the connection of the catchment to Wetland 4B is not clearly indicated. However, the design of drainage infrastructure is expected to evolve with further urban design of urban components, and wetland will be then designed to accommodate efficient routing of flows. Based on our experience of the site, it is expected that there will be sufficient grade to achieve the design extended detention.
2.22	1.13.14	**Issue:** Appendix M identifies a number of proposed bioretention systems. A plan is required showing where these bioretention systems are to be constructed. This plan should show that it will be viable to construct the bioretention systems in that location such that modelled storage depths and volumes and an ability to drain the devices are achievable. **AECOM Response:** The design principles for bioretention systems to treat water quality to the required standards are listed in Section 4.2.9 of Appendix M (AECOM). The location of these systems will be defined as the urban design for the urban components of the Concept Plan evolves. However, in general, if bioretention systems are located within streetscapes they receive surface runoff. Their drainage outlet is typically a similar depth as the minor drainage system; as a result drainage can normally be achieved.
4.1	2.1.1	**Issue:** NoW previously raised concerns to the proponent about the proposed main groundwater excavation Open Water Wetlands being used as a stormwater detention basis. Request that the proponent provide further information on stormwater management and WSUD for the site in order to assess whether WSUD measures will adequately treat the point source prior to directing stormwater to the proposed excavation. **AECOM Response:** Section 4.2 of Appendix M (AECOM) provides detailed information on the treatment of stormwater required prior to discharge to the open water wetland (the proposed excavation). Section 5.1.3 of Appendix M (AECOM) provides a discussion of the expected water quality of the open water wetlands, and concludes that the water quality of the open water wetlands is adequately protected.

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
4.2	2.2.1	**Issue:** This application proposes a series of 9 or more pre treatment ponds prior to stormwater discharge to the main groundwater excavations. NoW recommends these pre treatment constructed wetland ponds be lined before water enters the two main groundwater excavations (W1A, W1B, W1C, W1d, W1E, W2, W3, W4A, W4B and any other constructed wetland treatment ponds). This is considered necessary as the ponds are in close proximity to the groundwater table and therefore there is not adequate material between the pond and the groundwater table to provide adequate treatment nor removal of the pollutants expected to be entering these pond. **AECOM Response:** AECOM recommends that the stormwater treatment wetlands should be lined to prevent leaks from the wetland and to protect the wetland hydrology. If the in-situ material surrounding and below the wetland allows a rate of groundwater flow through the in-situ materials less than the rate of flow through a comparable constructed lining material with thickness of 300 mm and co-efficient of permeability of 1 x 10^{-9} m/s, then in-situ materials can be used in place of a liner (as recommended by WRL, the application of the following reference - a document which is commonly cited for the requirements of hydraulic barriers around treatment ponds is: Guidelines for Wastewater and Evaporation Lagoon Construction, prepared by Environmental Protection Authority South Australia EPA 509/04—March 2004, updated and reissued in 2010 as EPA 509/10, 2010, which can be found here: http://www.epa.sa.gov.au/xstd_files/Corporate/Public%20consultation/wastewater_lagoons.pdf). Even if the in-situ material is shown to provide an effective barrier, there will still be a requirement for appropriate preparation of the pond base for construction of the ponds.
4.3	2.3.1	**Issue:** The water quality information provided in the EA uses the existing lagoon as a predictor of what the water quality in the proposed open water wetland will be like. The EA states there are no ASS conditions in the existing lagoon. However there is potential acid sulphate soil (PASS) contamination issues associated with the proposed open water wetland. The modelling presents ASS issues as a low to moderate risk, however the risk of ASS contamination is possible. Therefore, there is the potential for the groundwater quality in the locality to be affected. **AECOM Response:** Risk of ASS contamination has been acknowledged and addressed through the implementation of a groundwater monitoring and response plan as presented in Appendix B to WRL's report (Appendix L).
4.6	2.4.1	**Comment only:** The Project Application EA outlines stormwater management measures following the principles of WSUD as requested in previous correspondence by NoW with the proponent. NoW outlined the importance of treating the point source by appropriate WSUD measures prior to stormwater entering the excavation and potentially contaminating groundwater.
4.7	2.4.2	**Comment only:** The WSUD measures chosen have been influenced by the topography of the site with biofiltration systems suitable for the upper areas of the catchment and open water wetlands proposed for the flat areas. The stormwater treatment train also includes buffer strips and grassed swales.
4.8	2.4.3	**Comment only:** The Project Application EA outlines that the wetland system would incorporate 5 water treatment areas along the north eastern edge of the large wetland. The water treatment wetlands and treatment areas of open water wetlands would have the following elements:

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
		- An inlet zone (sediment bash); - Macrophyte zone (a heavily vegetated area of different water depths to remove fine particulates and take up soluble pollutants); and - A high flow bypass channel.
4.9	2.4.4	**Comment only:** The existing lagoon and the proposed open water wetland will be connected by a new outlet structure to enable flows from the older waterbody to enter the proposed open water wetland. The constructed wetland treatment ponds are proposed as buffers to the main excavation to drop out sediment and improve stormwater treatment prior to entering the excavation.
4.10	2.4.5	**Comment only:** The open water wetland was not modelled as part of the stormwater treatment train, as the wetland was considered to be the receiving environment. The surface water model shows that the proposed treatment trains can adequately meet or exceed quality target load reductions set by Council.
4.22	2.8.6	**Issue:** All water treatment ponds (W1A, W1B, W1C, W1D, W1E, W2, W3, W4A and W4B) must be appropriately lined with an impermeable liner. **AECOM Response:** AECOM recommends that the stormwater treatment wetlands should be lined if required to prevent leaks from the wetland and to protect the wetland hydrology. A discussion on the need for a liner is included in the response to Submissions Report Item Number 1.13.5 and 2.2.1.
6.3	11.2.2	**Issue:** While Council is satisfied that the detailed design of the water treatment wetlands will be able to meet its maintenance access and process requirements whilst achieving the specified water quality targets, the issue of the total number of facilities is of concern from a sustainability perspective. The Proposal includes nine treatment wetlands, with sizes ranging from 800-9000m^2 (in addition to three existing wetlands), plus an additional seven bioretention systems with sizes ranging from 150-850m^2 in the upper catchments. The Proposal will result in 16 different stormwater treatment systems for Council to monitor and maintain for the life of the development. Council requests that the number of treatment systems is rationalised on the basis that a reduced number of treatment systems will be more cost effective and simpler to monitor and maintain by Council. The Stormwater Treatment and Wetland Functionality Report (AECOM, 9 July 2010) makes reference to this concern and notes that consolidation of some of the wetlands may be possible during the detailed design phase. Council requests that the Concept Plan and Project Application be amended to address this concern prior to approval. However if this is not possible, Council requests the following additions to the statement of commitments: Commitment to consolidate the total number of treatment wetlands to reduce Council's future maintenance liability. Specific reference is made to combining W4A & B, W1A & W1B, W1D & W1E, Existing treatment wetlands with W2. Preliminary consolidation plans showing the amended layout shall be submitted to Council for review prior to the preparation of Construction Certificate Plans.

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
		AECOM Response: The number of treatment devices has already been rationalised in comparison to the initial stormwater management strategy, and limited further rationalisation may be possible with earthworks design. Further rationalisation will have several consequences that may not be beneficial for maintenance, namely: • Larger sedimentation basins - Larger wetlands require larger sedimentation basins. Larger sedimentation basins may require larger specialised equipment for desilting works. The maximum size should therefore be limited to the size of equipment locally available for sediment clean-out. • Need for longer pipes - If the number of wetlands is further consolidated, there will be a need for longer pipes. The length of pipe run is an important consideration. Longer pipes are a potential unnecessary asset in the ground, and in the long term, longer pipes will need to be renewed. The proposed catchment-based approach will make it easier to establish the wetlands, as once the catchment is completed - the treatment is optimally sized and not waiting for other catchments to come online before the wetland is fully operational. Therefore, it will be quicker to achieve the optimum catchment hydrology, which will in turn help the wetland establish more quickly. Furthermore, the proposed catchment-based approach allows weeds to be more easily contained if particular catchments prove to be a source of weed propagules. Most of the maintenance of the wetlands would be undertaken by a bush regeneration contractor. Since the area of the wetlands is not increased or decreased through consolidation, there would be very little difference in the maintenance effort required by the bush regeneration contractor. Fewer treatment wetlands would mean fewer pits that require inspection, but this is likely to amount to less than one hours work every three months. The maintenance required during de-silting operations would not increase significantly as the total volume of sediment to be removed would be similar, the total distance to be covered by excavation machinery would be similar and maintenance access for this machinery will be provided. Finally, distributed systems create a better landscape outcome by providing distributed water features.

Control Spreadsheet Item Number	Submissions Report Item Number	Issues (summarised for inclusion in Submissions Report) and AECOM Responses
11.0	8.1.1	**Issue:** The volume and quality of stormwater runoff to the proposed open water wetlands is a concern if not adequately addressed. The Project Application EA has confirmed that these water bodies alone will be insufficient in absorbing runoff from the proposed urban areas without the use of bioretention systems higher in the catchment, requiring a comprehensive monitoring and management system to avoid negative impacts. Further, the NRCMA disagrees with the contention that the current lack of significant aquatic weeds in the existing lagoon lowers the risk of future infestation as the site is transformed from a pastoral to a residential landscape. The quality and quantity of any runoff into the water bodies, both during and after construction of the development is to be adequately managed and appropriate measures are to be prescribed for the inevitable increase in aquatic weed propagules. It does not appear that the proponent has adequately addressed this requirement. **AECOM Response:** DGRPA4.3 states: "Address the potential for the constructed wetland to harbour aquatic weeds, and where necessary, identify measures for their management". Sections 4.2.4, 4.2.6, 5.1.4, and 5.4 of Appendix M (AECOM) provide specific recommendations to improve the site's resistance to weeds. These recommendations have been incorporated within the revised Statement of Commitments for the Project Application. As outlined in Section 2.6 of the Project Application EA, extensive weed management is currently taking place on the site and has been successful in weed control. Maintenance checklists have been provided as attachments to Appendix M (AECOM) and these have several items that specifically deal with weed monitoring and control.
11.2	8.3.1	**Issue:** The proposed Central Corridor fails to provide habitat connectivity as the constructed wetlands occupy the bulk of the Central Corridor, leaving effective terrestrial corridors less than 50m in width in some locations, with no buffering, for the movement of terrestrial fauna. **AECOM Response:** A redesign of the open water wetland has been undertaken to improve habitat corridor values. This redesign involves the widening of the corridor between the existing lagoon and proposed open water wetland from 50m to 100m.

Appendix H

Revised ELUMP

Appendix H Revised ELUMP

Environmental Land Use Management Plan

The Land Owner is proposing an integrated urban development on approximately 178 ha of land situated at Rainbow Beach, Bonny Hills NSW ("the site"). As part of the proposal approximately 81 ha of land (or 46 % of the site) will form the Open Space Corridor located in the southern portion of the site. The Land Owner is cognisant of the natural assets that exist in the Rainbow Beach area, and as such proposes to rehabilitate the majority of the Open Space Corridor in a manner that enhances the ecological values and features of the site. This Environmental Land Use Management Plan (ELUMP) forms part of the broader Open Space Management Strategy prepared by Cardno (QLD) Pty Ltd and provides specific details concerning:

- the conceptual layout of the proposed development and the location of the Open Space Corridor;
- the location, extent and objectives of the Environmental Land Use Categories (ELUCs) defined within the Open Space Corridor; and
- the manner in which each ELUC is to be rehabilitated in order to achieve the specific management intents outlined herein and within the Open Space Management Strategy.

Environmental Land Use Category (ELUC)			Existing Vegetation Type (Darkheart 2008; Biolink 2006)		Rehabilitation objective	Vegetation Management Elements			
Type	No.	Area (ha)	Description	Ecological Values		Selective Vegetation Clearance	Structures	Supplementary Planting	Weed Control
Terrestrial Features									
Biodiversity Protection	1	1.2	Blackbutt – Tallowwood – Needlebark	• Regrowth with some mature trees • Some areas of dense weed Infestation • Supports Koala food trees • Some corridor values	Preservation and enhancement of existing values	No	None	As required	Yes
	2	1.9	Dry Blackbutt	• Regrowth with some mature trees • Some areas of dense weed Infestation • Supports Koala food trees • Some corridor values	Preservation and enhancement of existing values	No	None	As required	Yes
	3.1	1.7	Grey Ironbark – Grey Gum (near Southern School Site)	• Relatively Intact canopy • Stepping-stone habitat only • Minor weed incursion • Supports Koala food trees	Preservation and enhancement of existing values	No	No	As required	Yes
	3.2	2.1	Grey Ironbark – Grey Gum (Pocket Woodland)	• Relatively Intact canopy • Stepping-stone habitat only • Minor weed incursion • Supports Koala food trees	Preservation and enhancement of existing values	No	No	As required	Yes
	4	8.8	Paperbark – Swamp Mahogany – Swamp She Oak	• Mostly regrowth, but contains elements of Swamp sclerophyll on coastal plains EEC* • Minor weed incursion • Supports Koala food trees • Some corridor values	Preservation of existing values and enhancement of EEC elements	No	None	As required	Yes
	5.1	2.6	Swamp Oak (Eastern Creek)	• Mostly regrowth, but contains elements of Swamp Oak Floodplain Forest on Coastal Floodplains EEC • Minor weed Infestations • Some corridor values	Preservation and enhancement of existing Swamp oak swamp forest values	No	None	As required	Yes
	5.2	0.8	Swamp Oak (Central Corridor)	• Mostly regrowth, but contains elements of Swamp Oak Floodplain Forest on Coastal Floodplains EEC • Minor weed Infestations • Some corridor values	Preservation and enhancement of existing Swamp oak swamp forest values	No	None	As required	Yes
	6	1.3	Wallum Froglet Habitat	• Subject to repeated slashing in the past • Minor weed Incursion • Supports Wallum froglet breeding habitat	Preservation and enhancement of existing habitat values	No	None	As required	Yes
	7	0.6	Disturbed Heathland	• Subject to repeated slashing in the past • Demonstrated resilience • Stepping-stone habitat • Minor weed Incursion	Preservation and enhancement of existing values	No	None	As required	Yes
Sub-Total Area		**21**							
Biodiversity Enrichment	8	0.6	Cleared Pasture / Pastoral Woodland adjoining Swamp Oak	· Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Enrichment of existing values by reinstating Swamp Oak Floodplain Forest on Coastal Floodplains EEC elements	No	None	As required	Yes
	9	8.0	Cleared Pasture/ Pastoral Woodland adjoining Dry Blackbutt Open Forest	· Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Enrichment of existing values by reinstating Dry Blackbutt Open Forest elements	No	Pathway	As required	Yes
	10	18	Cleared Pasture/ Pastoral Woodland Disturbed/Regrowth Paperbark – Swamp Mahogany – Swamp She Oak	· Highly disturbed and modified • Some areas of degraded elements of Swamp sclerophyll on coastal plains EEC • Some demonstrated resilience • Minor-moderate weed Incursion • Low corridor values	Enrichment of existing values by reinstating elements of EEC and connectivity values	Limited – establishment pathways	Pathways	As required	Yes
Sub-Total Area		**26.6**							
Urban Edge	11	6.5	Cleared Pasture/ Pastoral Woodland	· Highly disturbed and modified • Low corridor values • Moderate weed incursion	· Provision of recreation areas for future residents • Provision of buffer zones between residential development and BP and BE ELUCs	Limited – establishment of: • constructed wetland; • storm water detention basins and swales; and • pathways	· Storm water detention basins • Pathways • Drainage swales • Passive recreational facilities (e.g. benches, bbqs)	Limited	Yes
Sub-Total Area		**6.5**							
District Sporting Fields	12	7.7	Cleared Pasture/ Pastoral Woodland	· Highly disturbed and modified • Low corridor values • Moderate weed incursion	Establishment of district sporting fields	Limited	No	No	Yes
Sub-Total Area		**7.7**							
Aquatic Features									
Macrophyte Treatment Zones	13.1	2.5	Cleared Pasture / Pastoral Woodland adjoining Swamp Oak (Central Corridor)	· Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Establishment of macrophyte vegetation for treatment of storm water runoff	Limited	Storm water detention basins	Yes	Yes
	13.2	0.4	Cleared Pasture / Pastoral Woodland adjoining Swamp Oak (Eastern Creek)	· Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Establishment of macrophyte vegetation for treatment of storm water runoff	Limited	Storm water detention basins	Yes	Yes
Constructed Wetland	14	9.9	Cleared Pasture/ Pastoral Woodland	· Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Establishment of waterbodies for treatment and retention of stormwater	Limited	Safety fencing where required	As required	Yes
Existing Wetland	15	6.3	Waterbodies with aquatic vegetation	· Stepping stone habitat • Moderate levels of weed Invasion on some banks • Good water quality	Retention and enhancement of existing values and functions	No	Safety fencing where required	As required	Yes
Sub-Total Area		**19.1**							
TOTAL AREA		**80.9**							

LEGEND

- Site Boundary
- Central Corridor Boundary
- Proposed Urban Development
- Lot 5 on DP25886 (Not Included in this ELUC)

VEGETATION MANAGEMENT UNITS

- Vegetation Type Boundary
- 10 ELUC Number (refer Table)
- Biodiversity Protection (ELUC 1-7)
- Bioderversity Enrichment (ELUC 8-10)
- Urban Edge (ELUC 11)
- District Sporting Field (ELUC 12)

FAUNA MOVEMENT CORRIDORS

- East - West
- North - South

AQUATIC FEATURES

- Macrophyte Treatment Zone (ELUC 13)
- Constructed Wetlands (ELUC 14)
- Existing Wetlands (ELUC 15)

50 0 50 100 150 200 250m
SCALE @ A1 1:5000

* *EEC - Endangered Ecological Community* pursuant to the NSW *Threatened Species Act 1995.*

DATE PLOTTED: 21 March, 2011 - 2:19pm

Rv.	DATE	REVISIONS	REC.	APPR.
4	14/03/11	Revision 4		
3	18/06/10	Revision 3		
2	03/02/10	Revision 2		
1	22/02/08	Revision 1		

DESIGNED: KAG
DRAWN: JM
CHECKED: DMC
Horizontal Datum: ******
Projection: ******
A1
Vertical Datum: A.H.D.

CAD FILE: I:\7135-01\Acad\Environmental Land Uses Management Plan\713501-ELUMP-01_revised.dwg
XREF's:

Cardno (Qld) Pty Ltd
ACN: 051 074 992
Level 11, North Tower, 515 St Paul's Tce, Fortitude Valley
Locked Bag 4006, Fortitude Valley Qld 4006.
Email: cardno@cardno.com.au

OFFICES: TELEPHONE FAX
Brisbane (07) 3369 9822 (07) 3369 9722
Sydney (02) 9496 7700 (02) 9499 3902
Gold Coast (07) 5539 9333 (07) 5538 4647
Sunshine Coast (07) 5443 2555 (07) 5443 5642
Townsville (07) 4772 1166 (07) 4721 2508
Hervey Bay (07) 4124 5455 (07) 4124 5155
Central Coast (02) 4323 2558 (02) 4324 3251
Port Moresby (00116675) 325 2322 (00116675) 325 0951
Philippines (00116632) 910 5146 (00116632) 910 5146

ST VINCENT'S FOUNDATION
RAINBOW BEACH
BONNY HILLS
ENVIRONMENTAL LAND USE MANAGEMENT PLAN

DATE: 14/03/11
PLAN No: 713501-ELUMP-01
Rv. 4

Appendix I

LPMA owners consent

Appendix I LPMA owners consent

Land & Property Management Authority
Crown Lands

Doc. No:
File Ref: 07/2241
6 April 2011

Sebastian Tauni
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Dear Sir

Rainbow Beach Concept Plan (06_0085) and Project Application (07_0001)

Further to my letter of 22 October 2010, consent as the landowner is hereby granted for the inclusion (in the 3A Project Application) of the works proposed on the on the Crown reserve associated with the formalisation of the beach access track.

The applicant has undertaken to provide detailed plans of the proposed works which will be further reviewed by the Land and Property Management Authority at the development application stage.

If further information is required please contact the writer on 02 65913513.

Yours sincerely

Terry Hemmingway
A/G Group Leader
Natural Resources and Property Services
Taree.

TAREE OFFICE
98 Victoria Street
Taree NSW 2430

PO Box 440
Taree NSW 2430
T: 02 6591 3500 I F: 02 6552 2816
ABN 33 537 762 019 | www.lpma.nsw.gov.au