

Leda Manorstead Pty Ltd

# Long Nosed Potoroo Management Plan

June 2014

Project Name:	Cobaki Estate Development
Project Number:	3003773
Report for:	LEDA Manorstead PTY LTD

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#### ISSUE REGISTER

Distribution List	Date Issued	Number of Copies
LEDA Manorstead PTY LTD:	02/06/2012	2 x hard copy 1 x electronic
SMEC staff:		
Associates:		
Gold Coast Office Library (SMEC office location):		
<b>SMEC Project File: 3003773</b>		

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# 1 Introduction

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This Long-Nosed Potoroo Management Plan (LNPMP) has been prepared by SMEC Pty Ltd for LEDA Manorstead Pty Ltd for the proposed development of approximately 595 ha of land to be known as the Cobaki Estate (hereafter referred to as “the site”). The plan is written as a requirement of Condition 2 of EPBC 2010/5296, which states that a Management Plan for the Long-nosed Potoroo is to be submitted to the Minister of the Department of Environment (DoE) for approval.

The proposed development is located within Tweed Shire Council (TSC) and is a proposed new residential community with a mix of urban land uses integrated with open space and environmental protection areas.

The proposed development comprises:

- Town centre precinct with a mix of retail, commercial, community and multi-unit residential uses, with up to 9,500 m<sup>2</sup> of retail space and 200 multi-unit dwellings covering 18 ha of land
- Residential precincts with a mix of housing types including detached houses, townhouses and multi-unit housing up to 3 storeys with up to 5,300 dwellings covering approximately 283 ha of developable land, excluding major roads
- Community and education precincts including two schools over 7 ha of land
- Open space, lakes and environmental protection areas covering 267 ha of land
- Access network of roads, public transport routes, and pedestrian / cycle paths
- Landscaping and vegetation management
- Water management
- Utility services infrastructure.

## 1.1 Location

The site is located west of the Tugun Bypass and Gold Coast Airport within Tweed Heads, New South Wales.

The site consists of land described as Lot 46 on DP755740, Lot 54 on DP755740, Lot 55 on DP755740, Lot 199 on DP755740, Lot 200 on DP755740, Lot 201 on DP755740, Lot 202 on DP755740, Lot 205 on DP755740, Lot 206 on DP755740, Lot 209 on DP755740, Lot 228 on DP755740, Lot 305 on DP755740, Lot 1 on DP562222, Lot 2 on DP566529, Lot 1 on DP 570076, Lot 1 on DP570077 and Lot 1 on DP823679.

The proposed development is bound by the Queensland and New South Wales border to the north and west and Piggabeen Road to the south. The site adjoins Cobaki Creek and Cobaki Broadwater to the east. It is located approximately 6 km west of Tweed Heads/Coolangatta Town Centre and 1.5 km west of the Gold Coast Airport and the Gold Coast Highway, and 500 m west of the Pacific Motorway (Tugun Bypass). Access is currently off Piggabeen Road. Future access will be off Boyd Street from the north and linking to Piggabeen Road via the proposed Cobaki Parkway.

The site exists in its current state as a large portion of cleared land, which was previously cleared for agricultural purposes (cattle grazing), and scatterings of native vegetation communities. There are no mapped State Environmental Planning Policy (SEPP) areas on site; however, SEPP 14 wetlands (Cobaki Broadwater) are located directly east of the site.

The location of the project site is shown in Figure 1.

## 1.2 Project Description

Cobaki Estate is a proposed mix use residential development of approximately 593 ha of land within the Tweed Shire Council region. The proposed development is divided in to 17 precincts and will consist of a mix of residential, retail and commercial, educational and community facility, an associated infrastructure passage and significant open space areas that will include sporting and recreational facilities and liner open space and neighbourhood parks. In addition, the site will include environmental protection areas including fauna corridors and saltmarsh wetland, wallum froglet and freshwater wetland habitat area.

The proposed development is shown in Figure 2.

## 1.3 Previous Studies

A number of previous studies have been undertaken as part of the various stages of development approval for this proposed development.




Such studies reviewed as part of this report include, but are not limited to:

- Tugun Bypass Environmental Impact Statement Technical Paper 12 – Flora and Fauna Assessment (Parsons Brinckerhoff and TMR, 2004);
- Tugun Bypass Species Impact Statement (EcoPro, 2004);
- Volume 1 – Ecological Assessment (JWA, 2008);
- Environmental Assessment Report Part 3A Concept Plan (JBA Urban Planning, 2008);
- Environmental Assessment Report Part 3A Project Application (JBA Urban Planning, 2009);
- Integrated Plan of Management for The Endangered Long Nosed Potoroo (*Potorous tridactylus tridactylus*) Population at Cobaki (Lewis & Freestone, 2009);
- Fauna Management Plan (JWA, 2009);
- Revised Regeneration and Revegetation Plan (JWA, 2010); and
- Construction Environmental Management Plan – Statement of Intent (Yeats, 2010).



Figure 1: Site Locality



<b>COORDINATE SYSTEM</b> GDA 1994 MGA Zone 56				<b>FIGURE</b> 1 - Site Locality	<b>REVISION</b> A	<b>STATUS</b> DRAFT		
				<b>CREATED BY</b> AM11482	<b>DATE</b> 12/11/2011	<b>ISSUED FOR INFORMATION</b>		
<b>PROJECT NO.</b> 3003XXX	<b>PROJECT TITLE</b> Cobaki Estate Management Plans	<b>SOURCE</b> The State of Queensland (Department of Environment and Resource Management), Copyright 2010 Aerial Imagery from Nearmap Hypertiles, copyright 2011					<b>CLIENT</b> LEDA MANORSTEAD PTY LTD	<b>CONSULTANT</b> SMEC Australia Copyright SMEC Australia Pty Ltd. All Rights Reserved.



**Figure 2: Proposed Development Layout**



**LEGEND:**

- Residential Areas
- Commercial
- Reservoir
- Existing Water Body: 1.52ha
- Cultural Protected Area
- Stormwater Treatment and Delivery Area: 15.35ha
- Open Space: 14.17ha
- Environmental Protection Area: 28.28ha
- Covenant Protected Area: 2.41ha
- Salt Marsh Rehabilitation Area: 87.70ha
- 20m Buffer between Residential Areas and Central Activity Zone

**FIGURE** 2 - Proposed Development

**CREATED BY** AM11482

**REVISION** A

**DATE** 18/11/2011

**STATUS** DRAFT

**ISSUED FOR INFORMATION**

**PROJECT NO.** 3003773

**PROJECT TITLE**  
Cobaki Estate Management Plans

**SOURCE**

LEDA MANORSTEAD Pty Ltd



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**CLIENT** LEDA MANORSTEAD PTY LTD

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## 2 Purpose and Objectives

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### 2.1 LNPMP Context and Purpose

This LNPMP is written as a requirement of Condition 2 of EPBC 2010/5296 which states that a management plan for the Long-nosed Potoroo is to be submitted to the Minister of the Department of Environment (DoE) for approval. Specifically, the condition states that the plan must address the following requirements:

- a) The construction and maintenance of permanent fauna underpasses and associated infrastructure that will facilitate safe and effective movement of the Long-nosed potoroo under Cobaki Parkway;
- b) Provision for revegetation in areas around the underpasses to provide refuge habitat for the Long-nosed potoroos;
- c) The construction and maintenance of permanent fauna exclusion fencing that will restrict the Long-nosed potoroo from accessing Cobaki Parkway (including bike paths) and facilitate the use of fauna underpasses;
- d) Measures to manage and monitor the use of fauna crossings and the effectiveness of fencing for the Long-nosed potoroo. Thresholds for management intervention if monitoring indicates the crossings or fences are not effective;
- e) Outline commitments for:
  - Predator control (including fox, feral animals and domestic pets), including a description and justification for the design, location and maintenance of predator control fencing along the interface of the development site and Long-nosed potoroo habitat fencing;
  - Weed control;
  - Fire management; and
  - Controlling human access.
- f) A monitoring program designed to determine the impacts of all activities associated with the Cobaki Lakes Development on the adjacent Long-nosed potoroo population. Prior to submission of the management plan for approval the person taking the action must have the plan reviewed by a suitably qualified independent expert to ensure the design of the monitoring program is sound and has sufficient statistical power to measure significant changes in abundance of the Long-nosed potoroo attributable to the proposal. Any recommendations made by the reviewer must be implemented prior to submission and a copy of the review must be attached to the plan;
- g) A monitoring timeframe for five years, at which point the need for further monitoring will be reviewed;
- h) Clear key milestones, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the plan;
- i) Provisions for reporting, including the submission of progress reports to the Minister after one, three and five years from the date of approval (13<sup>th</sup> October 2011);

- j) Actions must be based on the “Integrated Plan of Management for the Endangered Long-Nosed Potoroo (*Potoroo tridactylus tridactylus*) Population at Cobaki” (Lewis & Freestone, 2009). Agreement must be reached with the Queensland Department of Transport and Main Roads (TMR) regarding the resourcing and undertaking of actions to ensure all actions required under the Integrated Plan are implemented; and
- k) Provision of offsets in the event that (a) monitoring undertaken consistent with 2(f) detects a statistically significant decline of the species each year, for three subsequent years that is attributable to the Cobaki Lakes Development or (b) the approved plan can not be fully implemented for any reason.

The purpose of this LNPMP is to provide a practical guide to managing the adverse impacts of the proposed development on the Long-nosed potoroo population adjacent to the site.

The independent review was conducted by Dr Steve Phillips, Principal Ecologist at Biolink Pty Ltd, and has been included in Appendix 1.

## 2.2 LNPMP Objectives

The main objective of this LNPMP is to ensure that the proposed development will not adversely impact on the Long-nosed Potoroo population adjacent to the site. Specific objectives include:

- To identify the potential impacts of the proposed development on the population;
- To detail mitigation measures to protect the population, including:
  - Fauna underpasses and fauna exclusion fencing to facilitate safe and effective movement of the Long-nosed potoroo under Cobaki Parkway;
  - Providing refuge habitat through revegetation;
  - Predator control;
  - Weed control;
  - Fire management; and
  - Controlling human access.
- To design a monitoring program that addresses the requirements listed within the conditions of approval;
- To identify key milestones, performance indicators, corrective actions and timeframes; and
- To identify offsets in the event that monitoring detects a significant decline of the species attributable to the Cobaki Lakes Development or the approved plan cannot be fully implemented.

## 3 Planning and Legislation

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### 3.1 Relevant Legislation

#### 3.1.1 Legislative Requirements

Key environmental legislation specifically relating to Long-nosed Potoroo management includes:

- **Commonwealth Legislation**
  - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- **New South Wales Legislation**
  - *Environment Planning and Assessment Act 1979* (EP&A Act)
  - *Threatened Species Conservation Act 1995* (TSC Act) and amendments
  - *National Parks and Wildlife Act 1974* (NPWA)
  - *Noxious Weeds Act 1993* (NW Act).

It is noted that the Cobaki Estate Development was assessed under Part 3A of the EP&A Act. Section 75U of the EP&A Act provides that a range of NSW legislative approvals are not required for projects approved under Part 3A. However, the relevant regulator will be consulted and where deemed necessary, inspections and ongoing advice will be sought during the course of the proposed development.

- **Other Statutory Instruments**
  - North Coast Regional Environmental Plan (1988)
  - Tweed Shire Local Environment Plan (Draft 2010)
  - Tweed Shire Council Development Control Plan (2008).

### 3.2 Compliance with Legislative Requirements

The Minister of DoE provided approval of the development on 13<sup>th</sup> October 2011, subject to a list of conditions, including Condition 2, which states that a Management Plan for the Long-nosed Potoroo is to be submitted to the Minister of DoE for approval. Table 1 (overleaf) specifies compliance details of relevant conditions of approval associated with the Long-nosed Potoroo and statements of commitment for the proposed development. The table also indicates where in this document further detail of compliance can be found.

**Table 1: EPBC Compliance summary of relevant conditions of approvals and statements**

Condition/ Commitment Reference	Details of Condition/Commitment	Details of Compliance
2 Long Nosed Potoroo	<p>The person taking the action must submit a Management Plan for the Long-nosed potoroo, to the Minister for approval. The plan must address the following requirements:</p> <ul style="list-style-type: none"> <li>a. The construction and maintenance of permanent fauna underpasses and associated infrastructure that will facilitate safe and effective movement of the Long-nosed Potoroo under the Cobaki Parkway;</li> <li>b. Provision for revegetation in areas around the underpasses to provide refuge habitat for the Long-nosed Potoroos. Specifically, dry heathland shrubs such as Midgen Berry and groundcovers, including <i>Lepidosperma</i>, must dominate plantings around the fauna underpasses. Additionally, species that are tolerant to periodic inundation, must be planted in those areas prone to inundation, that should include <i>Gahnia sp.</i> <i>Restio sp.</i> and <i>Lomandra sp.</i>;</li> <li>c. The construction and maintenance of permanent fauna exclusions fencing that will restrict the Long-nosed potoroo from accessing the Cobaki Parkway (including bike paths) and facilitate the use of fauna underpasses;</li> <li>d. Measures to manage and monitor the use of fauna crossings and the effectiveness of fencing for the Long-nosed potoroo. Thresholds for management intervention if monitoring indicates the crossings or fences are not effective;</li> <li>e. Outline commitments for: <ul style="list-style-type: none"> <li>– Predator control (Including for fox, feral animals and domestic pets). The plan must include a description and justification for the design, location and maintenance of predator control fencing along the interface of the development site and Long-nosed potoroo habitat fencing;</li> <li>– Weed control;</li> <li>– Fire management; and</li> <li>– Controlling human access.</li> </ul> </li> <li>f. A monitoring program designed to determine the impacts of all activities associated with the Cobaki Lakes Development on the adjacent Long-nosed Potoroo population. Prior to submission of the management plan for approval the person taking the action must have the plan reviewed by a suitably qualified independent expert to ensure the design of the monitoring program is sound and has sufficient statistical power to measure significant changes in abundance of the Long-nosed potoroo attributable to the proposal. Any recommendations made by the reviewer must be</li> </ul>	<p>Section 6.2.1 “Fauna Underpasses”</p> <p>Section 6.2.1 “Fauna Underpasses” and Section 6.3 “Revegetation and Habitat Augmentation Works”</p> <p>Section 6.2.2 “Fauna Exclusion Fencing”</p> <p>Section 7 “Monitoring” and Section 8 “Performance Indicators and Corrective Actions”</p> <p>Section 6.4 “Predator Control”</p> <p>Section 6.5 Weed Control</p> <p>Section 6.6 “Fire Management”</p> <p>Section 6.2 “Fauna Sensitive Road Design”</p> <p>Section 7 “Monitoring”</p>



Condition/ Commitment Reference	Details of Condition/Commitment	Details of Compliance
	<p>implemented prior to submission and a copy of the review must be attached to the plan;</p> <p>g. A timeframe for monitoring as outline in 2(f) for five years, at which point of time the need for further monitoring will be reviewed;</p> <p>h. The plan must include key milestones, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the plan;</p> <p>i. Provisions for reporting, including the submission of progress reports to the Minister after one, three and five years from the date of this approval;</p> <p>j. All actions must be based on the Integrated plan of Management for the Endangered Long-nosed Potoroo (<i>Potorous tridactylus tridactylus</i>) population at Cobaki (Lewis &amp; Freestone, 2009). Agreement must be reached with the QTMR regarding the resourcing and undertaking of actions to ensure all actions required under the Integrated Plan of Management for the Endangered Long-nosed Potoroo plan (2009) are implemented; and</p> <p>k. Provisions of offsets in the event that (a) monitoring undertaken consistent with 2(f) detects a statistically significant decline of the species each year, for three subsequent years that is attributable to the Cobaki Lakes Development or (b) the approved plan can not be fully implemented for any reason.</p> <p>The plan must be submitted for approval by the Minister within six months of the date of the approval. The submitted plan must satisfy the Minister.</p>	<p>Section 7 “Monitoring”</p> <p>Section 8 “Performance Indicators and Corrective Actions”</p> <p>Section 10 “Reporting”</p> <p>Section 9 “Offsets”</p>

### 3.3 Licences and Permits

There are a number of licenses and permits which may be necessary to undertake the various management actions detailed in this plan. Table 2 provides an indicative list of these authorities, the prescribing legislation and the administering body. Whilst this list is current at the time of writing it should not be considered an exhaustive list. The responsibility to determine the legislative requirements, particular to an activity, are the responsibility of the individual undertaking or coordinating the action.

**Table 2 – Licenses and Permits**

Action	License/ Permit	Legislation	Regulatory Body	Comments
Access to Crown land	License to Occupy	<i>Crown Lands Act 1989 – Section 34</i>	Department of Primary Industries (DPI) Crown Lands Division (CLD)	
Access to Freehold land	N/A	N/A	Registered Owner	Written authority to be obtained prior to work
Monitoring - NSW	Scientific License Section 132c	<i>National Parks and Wildlife Act 1974</i>	NSW Office of Environment and Heritage (OEH)/ National Parks and Wildlife Service (NPWS)	The Cobaki Development has been approved under Section 3A of the EP&A Act 1979. Section 75U provides a number of exemptions to the requirements to the NPWS Act 1974. In effect it is not an offence to undertake works which involve a threatened species, and as such a permit under Section 132c is not necessary for activities associated with the development.
Monitoring - NSW	Ethics Approval	<i>Animal Research Act 1995</i>	NSW Department of Primary Industries (DPI)	Approval through an approved Animal Care and Ethics Committee.
Predator Control	N/A	<i>Prevention of Cruelty to Animals Act 1979</i>	NSW DPI – Agriculture/ Livestock Health and Pest Authorities	<p>Predator control must be consistent with DPI's Humane Pest Animal Control Standard Operating Procedures:</p> <ul style="list-style-type: none"> <li>• FOX006 – trapping of foxes using cage traps</li> <li>• FOX004 Fumigation of fox dens using carbon monoxide</li> </ul> <p>Advice regarding den fumigation methods is to be sought from NSW DPI and LHPA.</p>
Fire Management	Bushfire Hazard Reduction Certificate	<i>Rural Fires Act 1997</i>	NSW Rural Fire Service (RFS)	Landowner may be able to self-certify in some instances.

## 4 Cobaki Estate Biophysical Characteristics

Cobaki Estate has been comprehensively studied over the last twenty-five years. The following significant ecological values have been recorded on the site:

- Twenty-two (22) vegetation communities;
- Six (6) Endangered Ecological Communities (EECs);
- Eight (8) Threatened flora species; and
- Twelve (12) Threatened fauna species.

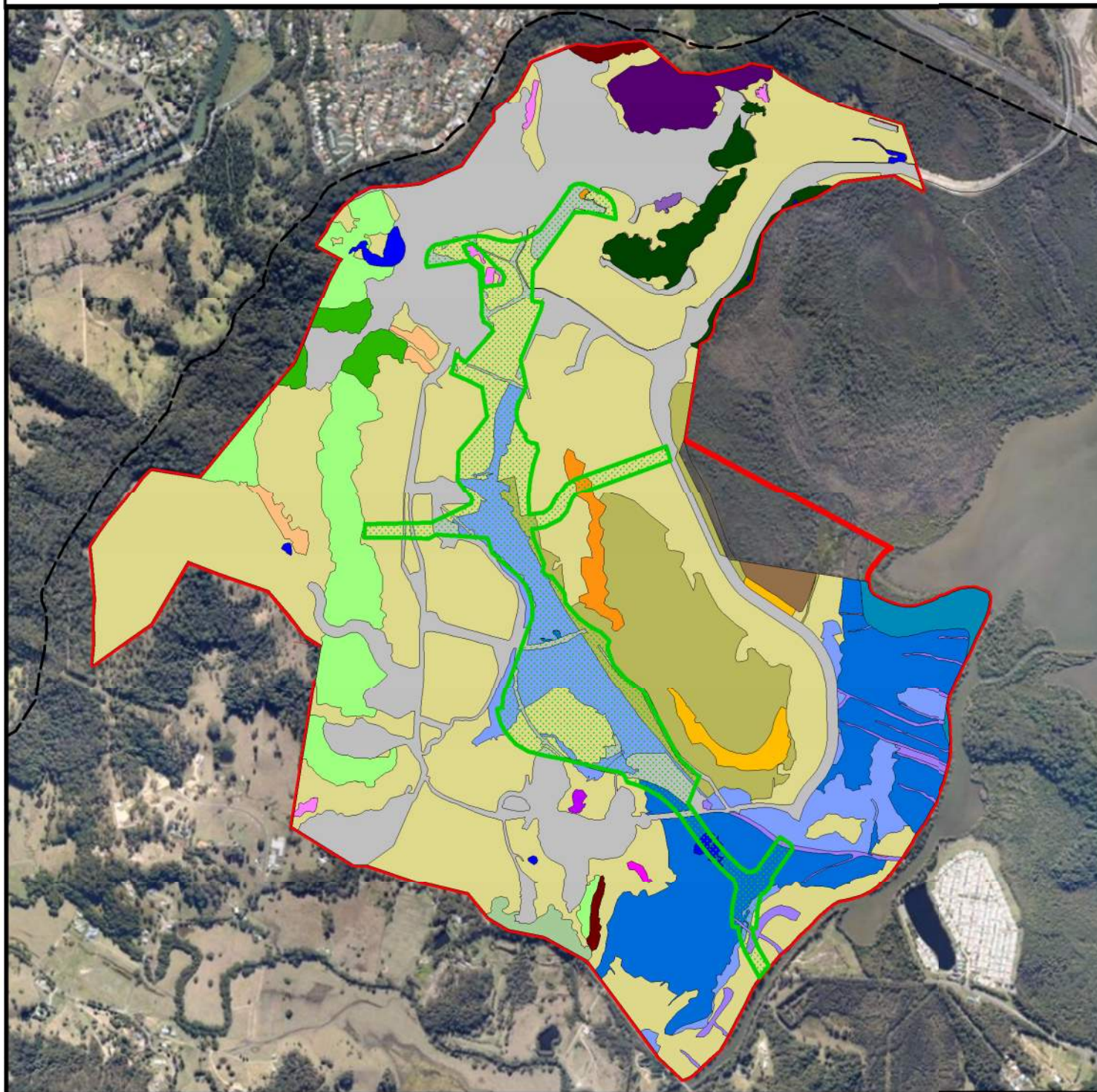
### 4.1 Vegetation Communities

Vegetation communities on site are shown in Figure 3 and are described as:

- 1(a) Very Tall Open/Closed Sclerophyll Forest (*Eucalyptus pilularis*, +/- *E. microcorys* +/- *E. propinqua*, +/- *Corymbia intermedia*)
- 1(b) Tall Open/Closed Sclerophyll Forest (*E. propinqua*)
- 1(c) Tall Open Sclerophyll Woodland (*E. pilularis*)
- 1(d) Tall Open Sclerophyll Forest (*E. pilularis*, +/- *E. siderophloia* +/- *E. tereticornis*)
- 2(a) Tall Closed Forest (*Lophostemon confertus*, +/- *Araucaria cunninghamii*).
- 2(b) Tall Open Forest (*Archontophoenix cunninghamiana*)
- 2(c) Very Tall Closed Forest (*Araucaria cunninghamii*)
- 2(d) Mid-high Open/Closed Forest (Riparian species +/- mixed species)
- 3 Tall/Very Tall Open/Closed Forest (*Lophostemon confertus* +/- Mixed rainforest species)
- 4 Closed Scrub (*Banksia aemula*, *E. racemosa* +/- *Leptospermum* spp.)
- 5 Mid-high Open Woodland (Mixed rainforest species)
- 6 Mid-high Open Woodland (*Eucalyptus robusta*)
- 7 Mid-high Open Woodland (*Eucalyptus racemosa*)
- 8 Mid-high Open Woodland (*Eucalyptus siderophloia*)
- 9 Low Closed Forest (Re-vegetation areas +/- Mixed *Eucalyptus* species)
- 10 Low Closed Grassland with Scattered Trees (Pastoral grasses +/- Mixed species)
- 11 Low Closed Grassland (*Sporobolus virginicus*, *Triglochin striata*, +/- *Casuarina glauca*)
- 12 Brackish Area (Mixed aquatic species)
- 13 Low to Mid-high Open Mangrove Forest (*Avicennia marina* var. *australasica* / *Aegiceras corniculatum* +/- *Casuarina glauca*)
- 14 Dam & Drainage Lines (Mixed aquatic species)
- 15 Low Open Forest/Woodland (*Casuarina glauca* +/- Mixed species)
- 16 Slashed Grassland/Heath Land/Sedgeland (Mixed species)



**Figure 3: Vegetation Communities**



**LEGEND:**

Community 1 - Dry sclerophyll communities Community 1a - Very tall open/closed sclerophyll forest ( <i>Eucalyptus pilularis</i> +/- <i>E. microcorys</i> +/- <i>E. propinqua</i> +/- <i>Corymbia intermedia</i> )	Community 2c - Very tall closed forest ( <i>A. cunninghamii</i> )	Community 8 - Mid-high open woodland ( <i>E. siderophloia</i> )	Community 14 - Dams & drainage lines (Mixed aquatic species)
Community 1b - Tall open/closed sclerophyll forest ( <i>E. propinqua</i> )	Community 2d - Mid-high open/closed forest (Riparian species +/- Mixed species)	Community 9 - Low closed forest (Revegetation areas +/- Mixed <i>Eucalyptus</i> species)	Community 15 - Low open forest/woodland ( <i>Casuarina glauca</i> +/- Mixed species)
Community 1c - Tall open sclerophyll woodland ( <i>E. pilularis</i> )	Community 3 - Tall/very tall open/closed forest ( <i>L. confertus</i> +/- Mixed rainforest species)	Community 10 - Low closed grassland with scattered trees (Pastoral grasses +/- Mixed species)	Community 16 - Slashed grassland/heathland/sedgeland (Mixed Species)
Community 1d - Tall open sclerophyll forest ( <i>E. pilularis</i> +/- <i>E. siderophloia</i> +/- <i>E. tereticornis</i> )	Community 4 - Low closed forest (Heathland)	Community 11 - Low closed grassland ( <i>Sporobolus virginicus</i> , <i>Triglochin striata</i> +/- <i>Casuarina glauca</i> )	Unvegetated land
Community 2 - Rainforest communities Community 2a - Tall closed forest ( <i>Lophostemon confertus</i> +/- <i>Araucaria cunninghamii</i> )	Community 5 - Mid-high open woodland (Mixed rainforest species)	Community 12 - Rushland/sedgeland/grassland (Mixed aquatic species)	Precinct Boundary
Community 2b - Tall open forest ( <i>Archontophoenix cunninghamiana</i> )	Community 6 - Mid-high open woodland ( <i>E. robusta</i> )	Community 13 - Low to mid-high open mangrove forest ( <i>Avicennia marina</i> var <i>australasica</i> / <i>Aegiceras corniculatum</i> +/- <i>Casuarina glauca</i> )	Open Space Zone
	Community 7 - Mid-high open woodland ( <i>E. racemosa</i> )		Site Boundary

**FIGURE 3 - Vegetation Communities**

**CREATED BY** AM11482

**PROJECT NO.** 3003773

**PROJECT TITLE**  
Cobaki Estate Management Plans

**REVISION** A

**DATE** 12/12/2011

**COORDINATE SYSTEM**  
GDA 1994 MGA Zone 56

**SOURCE**

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## 4.2 Endangered Ecological Communities

Six (6) Endangered Ecological Communities (EECs) occur on the site. These are as follows:

- Swamp sclerophyll forest on coastal floodplain – which occurs as an isolated clump of scattered Swamp mahogany in the central eastern portion of the site;
- Lowland rainforest on floodplain – occurring at various locations generally in association with drainage lines and depressions;
- Lowland rainforest – occurring on Mount Woodgee and on lower slopes in the northern portion of the site;
- Freshwater wetlands – occurring in the central and eastern portions of the site;
- Swamp oak floodplain forest – occurring in association with drainage lines in the south-east of the site; and
- Coastal saltmarsh in the NSW North Coast bioregion - in the south-east of the site.

## 4.3 Threatened Flora Species

Eight (8) Threatened flora species have been recorded on the site, including:

- White yiel yiel (*Grevillea hilliana*) – Endangered (TSC Act);
- Scented acronychia (*Acronychia littoralis*) – Endangered (TSC Act & EPBC Act);
- Fine-leaved tuckeroo (*Lepiderema pulchella*) – Vulnerable (TSC Act);
- Spiny gardenia (*Randia moorei*) – Endangered (TSC Act & EPBC Act);
- Marblewood (*Acacia bakeri*) – Vulnerable (TSC Act);
- Brush cassia (*Cassia brewsteri* var. *marksiana*) – Endangered (TSC Act);
- Coolamon (*Syzygium moorei*) – Vulnerable (TSC Act & EPBC Act); and
- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata*) – Endangered (TSC Act).

## 4.4 Threatened Fauna Species

Twelve (12) Threatened fauna species have been recorded from the subject site, including:

- Wallum froglet (*Crinia tinnula*) – Vulnerable (TSC Act 1995);
- Black-necked stork (*Xenorhynchus asiaticus*) – Endangered (TSC Act 1995);
- Powerful owl (*Ninox strenua*) – Vulnerable (TSC Act 1995);
- Masked owl – (*Tyto novaehollandiae*) – Vulnerable (TSC Act 1995);
- Osprey (*Pandion haliaetus*) – Vulnerable (TSC Act 1995);
- Koala (*Phascolarctos cinereus*) – Vulnerable (TSC Act 1995);
- Grey-headed flying-fox (*Pteropus poliocephalus*) – Vulnerable (EPBC Act 1999);
- Little bent-wing bat (*Miniopterus australis*) – Vulnerable (TSC Act 1995);
- Common bent-wing bat (*Miniopterus schreibersii*) – Vulnerable (TSC Act 1995);
- Eastern free-tail bat (*Mormopterus norfolkensis*) – Vulnerable (TSC Act 1995);
- Yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*) – Vulnerable (TSC Act 1995); and
- Greater broad-nosed bat (*Scoteanax rueppellii*) – Vulnerable (TSC Act 1995).

The Long-nosed Potoroo has not been recorded on site. However, there is the potential for the proposed development to indirectly impact on the population of Long-nosed Potoroos located east of the site.

## 5 Long-Nosed Potoroo – Species Information

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### 5.1 Distribution and Habitat

The Long-Nosed Potoroo occurs throughout south-eastern Australia, extending from near Gladstone, Queensland to south western Victoria. The species also occurs in Tasmania and on Bass Strait islands. In NSW and Queensland, it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm (Office of Environment and Heritage, 2005). In north eastern NSW its preferred habitat is dry and wet open shubland (Johnston, 2000).

The Cobaki Lakes and Tweed Heads West population of the Long-nosed Potoroo occupies approximately 108 ha of forest-heathland between the northern shore of Cobaki Broadwater and the NSW-Queensland border, extending east to the Gold Coast Airport land and west to Cobaki Estate (Figure 4). This population was last estimated at less than 100 individuals (Bali *et al.* 2003) and is completely isolated from other populations in the south and west. The nearest Long-nosed Potoroo records are found approximately 20 km south of the site, at Knights Forest adjacent to Cudgen Nature Reserve.

As stated within the Long-Nosed Potoroo Integrated Plan of Management (Lewis and Freestone, 2009), nine vegetation communities occur within the known habitat (Figure 4), including:

- Forest Red Gum Forest;
- Scribbly Gum Mallee Heathland;
- Paper Bark Forest;
- Swamp Mahogany/Paper Bark Forest;
- Scribbly Gum Forest;
- Tree Broom Heathland;
- Swamp Mahogany Forest;
- Swamp Mahogany Scribbly Gum; and
- Black She-oak Heathland.

The species has been recorded adjacent to the north-eastern corner of Cobaki Estate (Warren 1992, Woodward-Clyde 1997, EcoPro 2004). Numerous surveys on the site (Warren 1992, 1993, Woodward-Clyde 1997, Parker 1999, JWA 2000 – 2007) and within the border reserve to the north and north-west of the site (JWA 2000 – 2007), have failed to record this species.

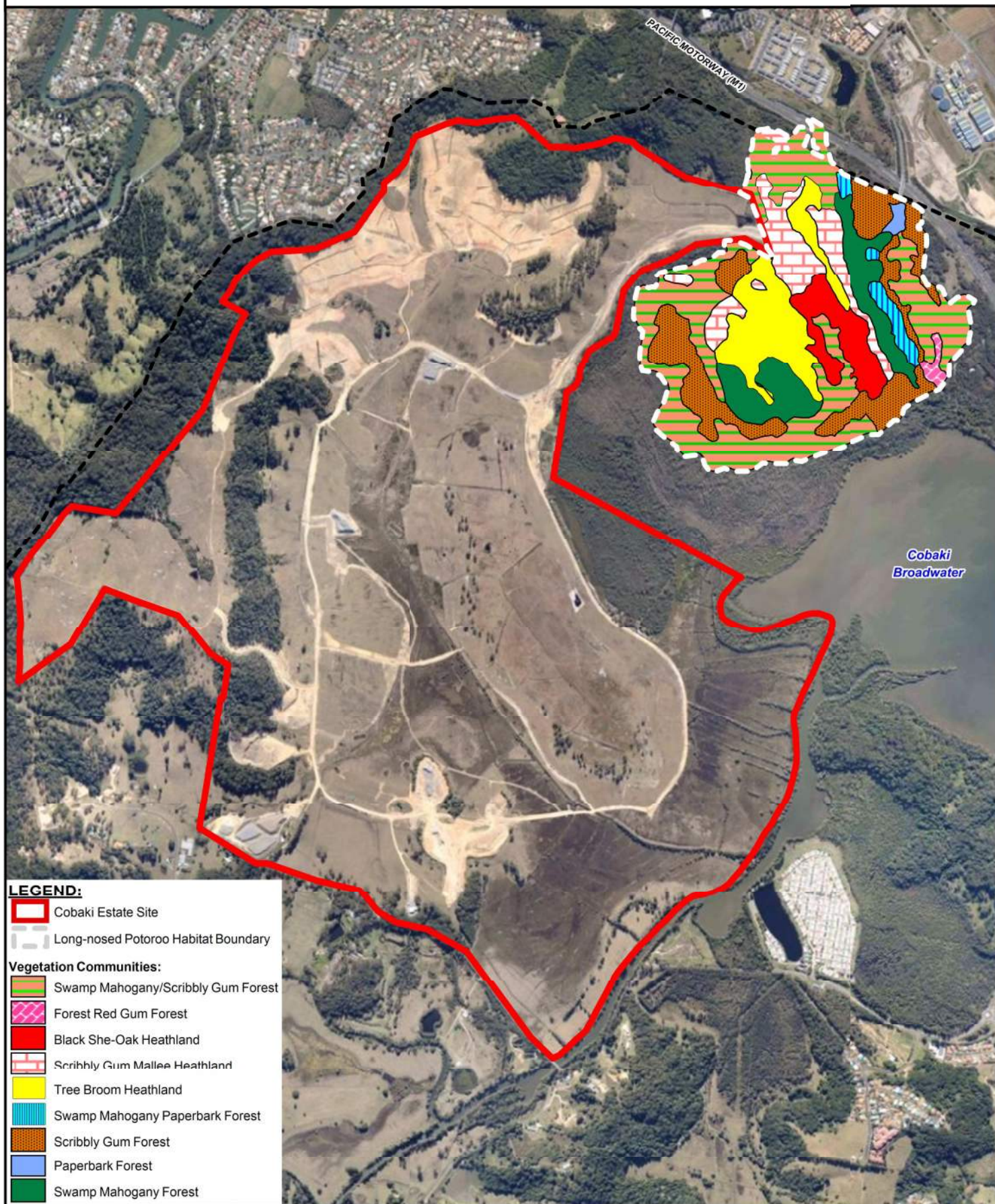
### 5.2 Conservation Status

In 2004, the Cobaki Lakes and Tweed Heads West population of the Long-nosed Potoroo was listed as an Endangered Population in Part 2 of Schedule 1 of the *NSW TSC Act 1995*.

The species is also listed as Vulnerable under the *NSW TSC Act 1995*, the *QLD Nature Conservation Act 1992* and the federal *EPBC Act 1999*.



**Figure 4: Long-Nosed Potoroo Habitat Area**



**FIGURE** 4 - Long-Nosed Potoroo Habitat Area

**CREATED BY** AM11482

**PROJECT NO.** 3003773

**PROJECT TITLE**  
Cobaki Estate Environmental Management Plans

**REVISION** 0

**DATE** 13/08/2012

**COORDINATE SYSTEM**  
GDA 1994 MGA Zone 56

**SOURCE**  
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**STATUS** FINAL

**ISSUED FOR INFORMATION**

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## 5.3 Ecology

The Long-Nosed Potoroo is mainly solitary and nocturnal, sheltering by day in dense low vegetation, where they form shallow depressions known as squats. This vegetation is generally comprised of Midgen Berry (*Austromyrtus dulcis*) and clumps of Flat-leaved *Lepidosperma* (*Lepidosperma laterale*) at Cobaki, but it may also use *Restio* spp. and *Lomandra* spp. (Lewis and Freestone, 2009).

The Long-Nosed Potoroo forages by digging small holes in search of roots, tubers, fungi and soft-bodied soil-dwelling animals. They are also known to feed on fruits, flowers, seeds and invertebrates (Claridge *et al.* 1993; Johnston 2000).

The species breeds throughout the year with peaks in late winter or early spring, and again in late summer. Females tend to become sexually mature at one year of age and a single pouch young is reared at a time.

## 5.4 Threatening Processes

Long-Nosed Potoroos are subject to a number of threats, including:

- Habitat loss and fragmentation from land clearing for development;
- Predation from exotic fauna including the red fox and feral and domestic dogs and cats;
- Frequent fires or grazing, reducing the density and diversity of understorey vegetation;
- Logging regimes or other disturbances that reduce the availability and abundance of food resources, particularly hypogeous fungi, and ground cover.

The primary existing threat to the Cobaki Lakes and Tweed Heads West population is the loss and fragmentation of habitat through the cumulative impacts of urban development and associated infrastructure. In recent years, Potoroo habitat has been removed and fragmented to accommodate the Tugun Bypass and Boyd Street overpass (Refer to Figure 1).

The Cobaki Lakes and Tweed Heads West Long-nosed Potoroo population is also currently threatened by predation from exotic predators such as the European red fox, *Vulpes vulpes*, and both feral and domestic cats, *Felis catus*. The species may also be forced to compete with feral pigs for food such as fungi and invertebrates (OEH NSW Scientific Committee, 2004).

Altered hydrological processes, causing surface ponding for extended periods after heavy rainfall events, particularly within the Tree Broom heathland on the northern side of the Boyd Street extension (refer to figure 4), is likely to result in reduced foraging and refuge habitat (Lewis and Freestone, 2009).

Although the Cobaki Estate site itself does not contain suitable habitat for the Long-nosed Potoroo, the proposed development has the potential to impact on the population through:

- Further habitat loss and fragmentation from the associated Boyd Street extension;
- Further edge effects on remaining habitat as a result of increased traffic and lighting;
- Road kills and injury;
- Further changes to hydrological processes from increased runoff;
- Human disturbance as a result of increased visitation; and
- Further predatory pressures, especially from domestic dogs and cats.



## 6 Management Actions

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As stated in the EPBC Approval Condition 2, management actions will be based on the “Integrated Plan of Management for the Endangered Long-nosed Potoroo (*Potoroo tridactylus*) Population at Cobaki” (Lewis & Freestone, 2009) (hereafter referred to as the “Integrated Plan”), which proposes a series of management actions for the Long-nosed Potoroo associated with development of the Tugun Bypass, Boyd Street Overpass and its extension to Cobaki Residential Estate.

In order to improve the long term conservation value of the Cobaki Long-nosed Potoroo population, the Integrated Plan proposes the design and implementation of a number of management actions including:

- General mitigation measures such as clearing guidelines and threatened species inductions;
- Fauna underpasses;
- Fauna exclusion fencing;
- Revegetation and habitat augmentation;
- Weed control;
- An exotic predator control program; and
- A fire management regime of mosaic burns.

Each management action relevant to the Cobaki Estate development is detailed below.

To ensure all actions required under the Integrated Plan are implemented, management procedures are to be coordinated between all responsible parties, including TMR, Gold Coast Airport and LEDA Manorstead. Responsible parties for each action are detailed in Section 11.

### 6.1 General Mitigation

The following general mitigation practices will be utilised during construction within the site:

- Prior to the commencement of clearing, a fauna survey will be completed by suitably qualified ecologists;
- Vegetation to be protected will be delineated prior to works, using coloured flagging tape or ‘parawebbing’;
- Fauna exclusion fencing will be erected along the interface of the site and the Potoroo habitat area prior to the commencement of clearing;
- Signs identifying the presence of a ‘Significant Environmental Area’ will be attached to the fauna exclusion fence on the site boundary at 100 m intervals;
- Prior to construction, large woody debris will be retained and stockpiled for use in the habitat augmentation program (see Appendix 2);
- Clearing works will be supervised by a suitably qualified fauna spotter/catcher;
- Site specific threatened species inductions will be undertaken for all site staff prior to commencing work. This ensures all staff are educated about their environmental responsibilities and foster a general awareness which encourages correct work practices.
- Induction will cover issues relating to threatened species, designated and restricted areas of access and waste disposal to minimise attraction of pest species; and

- Site staff will be educated on an ongoing basis through 'toolbox talks', ensuring important information relating to the protection of threatened species are reiterated regularly. These will be signed off by all attendees.

## 6.2 Fauna Sensitive Road Design

### 6.2.1 Fauna Underpasses

Construction and maintenance of fauna underpasses and associated infrastructure will facilitate safe and effective movement of the Long-nosed Potoroo. The Integrated Plan has proposed three (3) dedicated fauna underpass culverts, four (4) multiuse underpass culverts and one (1) drainage-fauna culvert along the Boyd Street overpass and extension. Of these, two (2) dedicated fauna underpasses and four (4) multiuse culverts are located on the Boyd Street Extension and construction and maintenance of these culverts are the responsibility of LEDA Manorstead (see section 11). An additional two (2) dedicated fauna underpasses (located approximately 80 m and 500 m west of the defined habitat area) have been designed along Cobaki Parkway since the Integrated Plan was written.

Refer to Appendix 3 for road designs showing culverts and Figure 5 for culvert locations.

#### ***Multiuse Culverts***

The four multiuse culverts (C1, C2, C4 and C5) are proposed at Chainages 25, 40, 140 and 200 m (Figure 5). Their objective is to facilitate wildlife movement via the raised 0.5 m ledge (1.0 m wide) with the remainder (1.4 m) acting as a drainage culvert. It is expected these culverts will be seasonally inundated for short periods of time but this is unlikely to significantly affect fauna movements and the viability of local wildlife populations. All four of these culverts have been designed at the same height and width dimensions (2.4 m wide x 1.2 m high) with lengths varying between 28.89 and 31.2 m.

The multiuse culverts have been designed not only to allow for the drainage features but have also been strategically placed in areas beneficial to the Long-nosed Potoroo. For example the drainage line in the vicinity of Chainage 30 is not proposed for burning so during a control burn this would act as a refuge area and the culvert would maintain connectivity with lands on the southern side of Boyd Street. It is at these times that multiuse culverts C1 and C2 are most likely to be used by potoroo. The area in which culverts C4 and C5 are located was also regularly used by Potoroos in 2003 (Bali et al. 2003).

#### ***Dedicated Fauna Underpasses:***

The two dedicated fauna underpasses within the Boyd Street Extension (C6 and C7) both measure 3 m in width and 1.2 m in height and lengths vary from 26.4 m to 28.8 m. The reduced height of the underpasses minimises human visitation (pedestrians and trail bike riders) and the increased width provides sufficient light levels for establishing vegetation and providing visibility for fauna. Monitoring at the Brunswick Heads Bypass (40km south) and Bulahdelah to Coolongolook deviation (500km south) has shown that Potoroos may have on several occasions used underpasses of similar dimensions (AMBS 2001a, b & c). Structure C6 is positioned in an area where several potoroo were known to have overlapping home ranges ( Bali *et al.* 2003) and C7 is strategically positioned to provide an entrance point during fire management and has been designed to link the area identified for regeneration (Lewis and Freestone, 2009).

A further two (2) dedicated fauna underpasses have been designed under Cobaki Parkway within the Cobaki Estate (C11 and C14). C11 is located approximately 150 m south of the proposed Cobaki Parkway-Precinct 3 Entry Road roundabout and C14 is located east of the Central Open Space corridor which transects Precinct 6. Both culverts measure 2.4 m in width, 1.8 m in height and approximately 28.8 m in length. The placement of structure C11 provides a link between the protected vegetation on site (particularly Rehabilitation and Management Areas 2 and 12) and the Long-Nosed Potoroo habitat area located approximately 30 m from the site boundary. Although not particularly beneficial to the Long-nosed Potoroo, C14 provides a link between the Cobaki Central Open Space and the environmental reserve east of the site.

### **Revegetation Near Culverts**

Revegetation and habitat augmentation within and adjacent to the underpass entrances will provide refuge habitat for the Long-nosed Potoroos and will facilitate the use of fauna underpasses. The planting schedule will be comprised of the shrub/ground cover species shown in Table 3 of Section 6.3. These will be planted up to the edge of the dedicated and multiuse culverts using two planting strategies:

1. Dry heathland shrubs such as Midgen Berry and groundcovers, including *Lepidosperma*, will dominate plantings around dedicated culverts.
2. *Gahnia sp.*, *Restio sp.* and *Lomandra sp.* will be used at the multiuse culverts as these are more tolerant to periodic inundation (Harden 1996).

These species were selected in the Integrated Plan as they are known to provide refuge habitat and therefore provide the most effective method of encouraging culvert utilisation. Further, this vegetation will provide fewer management issues with respect to culvert maintenance.

### **Culvert Floor and Substrate**

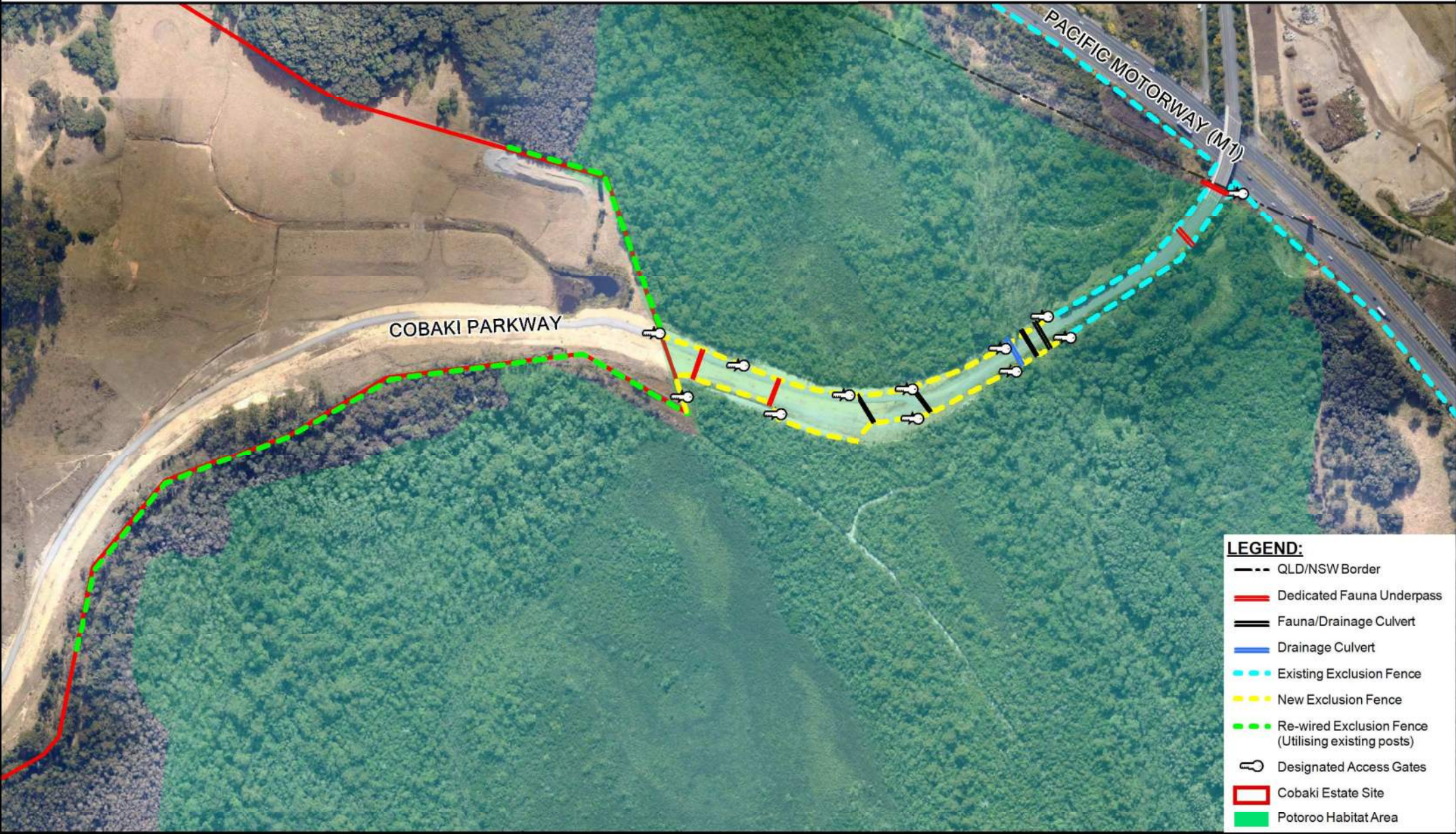
As specified in the Integrated Plan (Lewis and Freestone, 2009), sand mixed with a humus or mulch material at a 70:30 ratio will be placed to an approximate depth of 100 mm on the bottom of each dedicated culvert and on the ledges of the multiuse culverts. The ledge sections of the multiuse culverts will also be roughened with a broom finish. This will provide a familiar substrate to encourage the Long-nosed Potoroo to utilise the culverts.

### **Predator Control around Culverts**

Where necessary, and in the vicinity of potoroo habitat, drainage culverts running under Cobaki Parkway will be fitted with vertical grates. This will restrict use of these culverts by exotic predators and humans as a means of accessing potoroo habitat. Moreover, most of these culverts are likely to contain surface water throughout the year making them largely unsuitable to most fauna.



Figure 5: Culverts and Fencing



<b>COORDINATE SYSTEM</b> GDA 1994 MGA Zone 56				<b>FIGURE</b> 5 - Culverts & Fencing <b>REVISION</b> 0 <b>STATUS</b> FINAL				
<b>PROJECT NO.</b> 3003773		<b>PROJECT TITLE</b> Cobaki Estate Management Plans		<b>CREATED BY</b> AM11482 <b>DATE</b> 13/08/2013 <b>ISSUED FOR INFORMATION</b>				
<b>SOURCE</b> The State of Queensland (Department of Environment and Resource Management), Copyright 2010 Aerial Imagery from Nearmap Hypertiles, copyright 2011				<b>CLIENT</b> LEDA MANORSTEAD PTY LTD		<b>CONSULTANT</b> SMEC Australia Copyright SMEC Australia Pty Ltd. All Rights Reserved.		



### 6.2.2 Fauna Exclusion Fencing

The construction and maintenance of permanent fauna exclusion fencing will restrict the Long-nosed Potoroo from accessing Cobaki Parkway (including bike paths) and will facilitate the use of fauna underpasses. Correct positioning and maintenance of this exclusion fence will considerably reduce the risk of vehicle strike. It is also effective in the management of impacts relating to human visitation and predators.

Fauna exclusion fencing will be erected along the boundary of Cobaki Parkway and the Long-nosed Potoroo habitat area to the site boundary (as per Figure 5). Secure designated access gates will be located along the fauna exclusion fencing to provide access for management and monitoring of Long-nosed Potoroos.

The Integrated Plan specifies the fauna exclusion fence is to consist of 1.8 m high chain mesh including floppy top overhang and 1.0 m of pinned ground mesh, to prevent animals from digging under the fence (refer to Appendix 3). The fence will connect to the Boyd Street overpass exclusion fencing and will continue to the site boundary. The exclusion fence will be constructed within a few metres of the 2.5 m--wide cycleway on the northern side of Cobaki Parkway and within 4 m of the pavement on the southern side of Cobaki Parkway in order to accommodate various road and utility infrastructure requirements. The exclusion fence will be fitted to the headwall of the culverts to funnel fauna movements into the underpass. Where the fence culminates, fence returns of 5-10 m will be used to restrict and discourage fauna movement around the fence.

Signage will be displayed at 100 m intervals along the fauna fence identifying the presence of a 'Significant Environmental Area'. The signs will notify persons intending to carry out work in that area to ring the displayed phone number prior to commencing work. The signs will also provide instruction for reporting fence damage, with a contact number for either LEDA or TMR being provided. Fence damage will also be monitored, as detailed in Section 7.

The adoption of this fauna exclusion fence design, in association with the design along the Boyd Street Overpass and Tugun Bypass, will:

- Reduce wildlife road strike;
- Reduce domestic (i.e. dogs, cats) and exotic (i.e. fox, feral cats) predator movements and human visitation in and around potoroo habitat;
- Improve the effectiveness of fauna underpasses by directing wildlife into culverts; and
- Control edge effects.

### 6.3 Revegetation and Habitat Augmentation Works

The objective of the revegetation works is to reduce edge effects, provide refuge habitat and encourage use of the fauna underpasses by Long-nosed Potoroos.

The Integrated Plan has identified approximately 3 ha of land for revegetation and habitat augmentation works. It includes the area surrounding Boyd Street Overpass and continues west along Cobaki Parkway, making allowances for plantings to within 2.5 m of the road verge and up to the entrance of the fauna underpasses.

Of the 3 ha of land prescribed for regeneration within the Integrated Plan, LEDA is responsible for revegetation of 10 m wide strips aligning each side of the Boyd Street Extension (Figure 6). Further revegetation will occur within and adjacent to the fauna underpasses, as discussed in Section 6.2.1.

During habitat augmentation, the area will be prepared using mulch from the clearing works (heathland, scribbly gum forest). Prior to landscaping, the large woody debris retained prior to clearing works (see Appendix 2) will be strategically placed among the plantings. This will provide refuge habitat at the early stage of the regeneration works and has the potential to benefit the Long-nosed Potoroo population by:

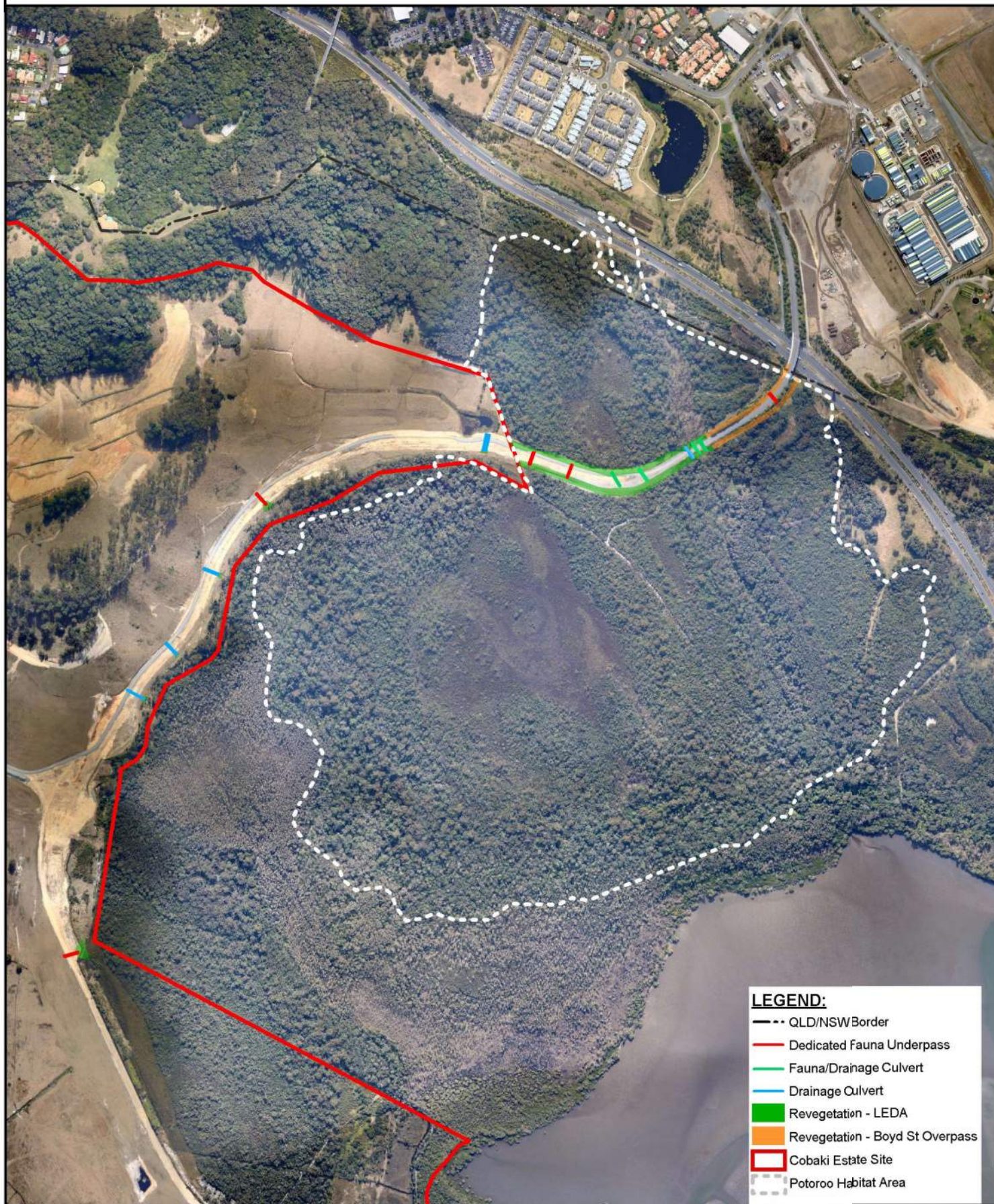
- Providing a range of microhabitats to stimulate mycorrhizal fungi;
- Encourage the use of fauna underpasses; and
- Reducing unauthorised access to these areas by trail bike riders.

The landscaping species list (Table 3), as proposed within the Integrated Plan, includes species known to provide both foraging and refuge habitat for the Long-nosed Potoroo. Planting densities will generally resemble the surrounding vegetation. Groundcover species will be planted at high densities adjacent to roads and fences in order to reduce weed invasion.

General rehabilitation of disturbed areas will be in accordance with the Site Regeneration and Revegetation Plan (JWA, 2010). Weed management, as per Section 6.5, will be undertaken during the construction and operational phase and where necessary will involve weed control before and after landscaping. Responsibility for ongoing maintenance of landscaping and revegetation is detailed in Section 11.



**Figure 6: Revegetation**



**FIGURE** 6. Revegetation

**CREATED BY** AM11482

**PROJECT NO.** 3003773

**PROJECT TITLE**  
Cobaki Estate Environmental Management Plans

**REVISION** B

**DATE** 21/01/2012

**COORDINATE SYSTEM**

GDA 1994 MGA Zone 56

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**Table 3: Revegetation species list**

Scribbly Gum Forest	Swamp Sclerophyll Forest
<b>Trees/Shrubs:</b>	
<i>Acacia fimbriata</i> <i>Aotus ericoides</i> <i>Austromyrtus dulcis</i> <i>Banksia aemula</i> <i>Banksia oblongifolia</i> <i>Banksia robur</i> <i>Callistemon pachyphyllus</i> <i>Dillwynia retorta</i> <i>Dodonaea triquetra</i> <i>Elaeocarpus reticulatus</i> <i>Eucalyptus racemosa</i> <i>Hibbertia scandens</i> <i>Hovea acutifolia</i> <i>Leptospermum juniperinum</i> <i>Leptospermum liversidgei</i> <i>Leucopogon leptospermoides</i> <i>Melaleuca nodosa</i>	<i>Acacia fimbriata</i> <i>Acacia obtusifolia</i> <i>Banksia oblongifolia</i> <i>Banksia robur</i> <i>Callistemon salignus</i> <i>Elaeocarpus reticulatus</i> <i>Leptospermum polygalifolium</i> <i>Leptospermum whitei</i>
<b>Groundcover:</b>	
<i>Balioskion tetraphyllum</i> <i>Caustis recurvata</i> <i>Dianella caerulea</i> <i>Lepidosperma laterale</i> <i>Xanthorrhoea johnsonii</i> <i>Xanthorrhoea macronema</i> <i>Zieria laevigata</i>	<i>Aristida spp. schizachryium</i> <i>Gahnia clarkei</i> <i>Gahnia sieberana</i> <i>Eriachne glabrata</i> <i>Melaleuca thymefolia</i> <i>Xanthorrhoea johnsonii</i>



## 6.4 Predator Control

The main predator of the Cobaki Lakes and Tweed Heads West Long-Nosed Potoroo population is currently the European Red Fox, *Vulpes vulpes*, although, without correct management, the proposed development could result in an increase in predation by domestic dogs and cats.

The predator management program will be undertaken twice per year. The program will consist of den fumigation and control baiting. If control baiting is not approved, this part of the program will be replaced with cage trapping and shooting. Coordination with all relevant stakeholders will be necessary in order to run the program concurrently with the existing fox control program at Gold Coast Airport, which will provide a higher success rate.

The program will run over a three week period comprising one week of pre-control monitoring and free-feeding and two weeks during which 1080 baiting and den fumigation will be undertaken. Monitoring will be ongoing throughout the 3 week period, thus providing constant assessment of the program. Clean baiting and predator monitoring will be discussed in Section 7. Installation and maintenance of fencing is also an important part of predator control. This was discussed in Section 6.2.2.

### 6.4.1 Control Baiting

Sixteen (16) bait stations will be established using FOXOFF® 1080 baits and left for a period of 14 days to allow sufficient time for uptake. During this time stations will be inspected every second day (see Section 7). All bait stations are to be constructed using a raised sand bed, with baits buried at a minimum depth of 100 mm. They are to be constructed with a rake to minimise the human scent transferred onto and near the bait station. Stations will be smoothed over to enable the detection of tracks made by the animal removing the bait. This approach will also enable an evaluation on the likelihood of non-target species such as Lace Monitor (*Varanus varius*) and Spotted-tailed Quoll (*Dasyurus maculatus*) accessing the bait stations.

The location of the bait stations is shown in Figure 7. The proposed location of bait stations aims to control exotic predators across four areas of potoroo habitat:

- Areas which would be subject to fauna exclusion fencing and underpasses (6 stations);
- Areas to the north of Boyd Street (4 stations);
- Areas to the south of Boyd Street (5 stations); and
- Peripheral habitat along Sandy Lane and near the GCA-Tweed Byron Aboriginal land boundary (1 station).

There are a number of restrictions associated with using 1080 in NSW, including:

- No baiting to occur within 150 to 500 m of residential premises;
- No baits allowed to contaminate water bodies; and
- Notification and signage to be utilised throughout the process.

The positioning of the bait stations has taken these considerations into account. In accordance with the *Pesticide Act 1999* all neighbouring landholders must be notified in writing informing them of the impending predator control program. Signage will also be displayed at the eight points identified in Figure 7. These signage points currently represent the main avenues for accessing the control zone.

### 6.4.2 Den Fumigation

Fumigation will be undertaken in November when fox cubs remain in their dens during the day. All dens occupied will be subject to fumigation using one of the following three methods depending upon advice from NSW DPI and LHPA:

- Chloropicrin (trichloronitromethane);
- Phosphine gas generated from aluminium phosphide; or
- Carbon monoxide cartridges, i.e. such as Den-Co-Fume®.

Those undertaking the fumigation will be appropriately trained and licensed, and are to consult with LHPA prior to fumigating. If den monitoring finds that sites are being reutilised following a fumigation session, a more permanent control method will be investigated.

### 6.4.3 Cage Trapping and Shooting

If 1080 baiting is not approved, cage trapping will be executed twice per year and is to be in accordance with the Humane Pest Animal Control Standard Operating Procedure – FOX006 – trapping of foxes using cage traps (NSW Department of Primary Industries, 2005). From an animal welfare perspective, cage traps are preferred over leg-hold traps as fewer injuries are sustained and non-target animals can be released unharmed (NSW DPI, 2005).

Sixteen (16) cage traps will be established in locations aimed to control predators across four areas of potoroo habitat (Figure 7):

- Areas that will be subject to fauna exclusion fencing and underpasses (6 stations);
- Areas to the north of Boyd Street (4 stations);
- Areas to the south of Boyd Street (5 stations); and
- Peripheral habitat along Sandy Lane and near the GCA-Tweed Byron Aboriginal land boundary (1 station).

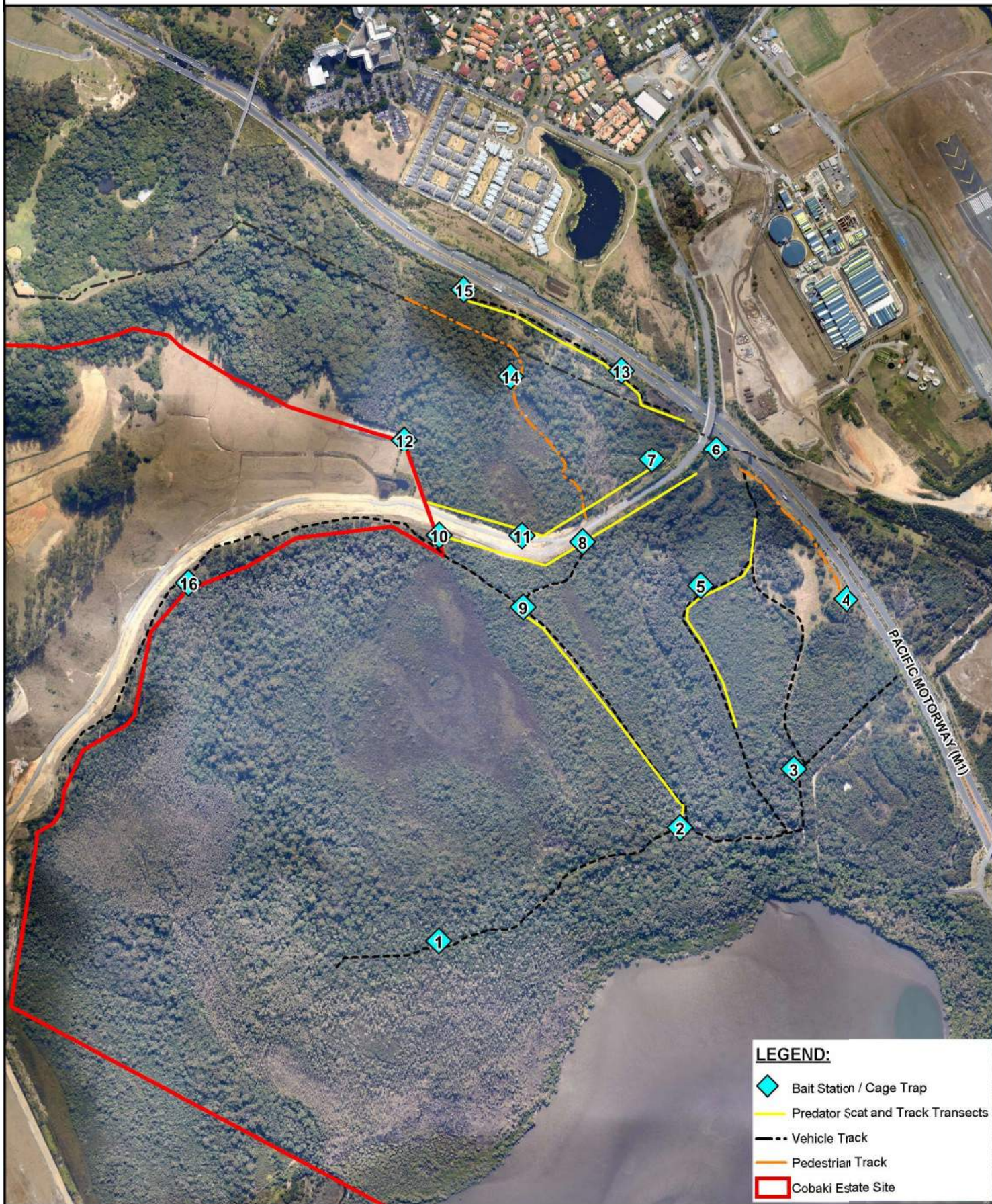
Wire mesh cage traps with 90 cm × 45 cm × 45 cm dimensions and made of 2.5 mm welded wire with a mesh size of 50 mm are to be used. Meat bait is to be placed inside the cage trap (i.e. Rabbit, lamb, chicken, or kangaroo) and the floor of the trap is to be covered with 3–5 cm of soil. The location of all trap sites will be accurately recorded with GPS devices.




Traps will be inspected daily to prevent suffering and possible death from exposure, thirst, starvation and/or shock. Trapped live foxes are to be destroyed by shooting whilst still inside the cage trap. Shooting of foxes is to be performed by skilled operators who hold the appropriate licences and accreditation. Storage and transportation of firearms and ammunition is to comply with relevant legislation requirements.

If a dog or a cat is caught in the trap, it is to be taken to the nearest council pound for assessment.



**Figure 7: Predator Control**



<b>FIGURE</b> 7. Predator Control	<b>REVISION</b> B	<b>STATUS</b> DRAFT		
<b>CREATED BY</b> AM11482	<b>DATE</b> 21/01/2012	<b>ISSUED FOR INFORMATION</b>		
<b>PROJECT NO.</b> 3003773	<b>COORDINATE SYSTEM</b> GDA 1994 MGA Zone 56			<b>CONSULTANT</b> SMEC Australia Copyright SMEC Australia Pty Ltd. All Rights Reserved.
<b>PROJECT TITLE</b> Cobaki Estate Environmental Management Plans	 Scale: 1: 10,000 @ A4			
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## 6.5 Weed control

The *NSW Noxious Weeds Act 1993*, species obligatory controls for certain noxious weeds in specific Local Government Areas. There are also a large number of “environmental weeds” that can invade bushland and waterways, causing degradation of vegetation communities and habitat if left unchecked.

A weed control program will be developed by the on-site environmental officer and implemented in stages prior to and during the earthworks phase. A visual inspection for weed species shall be conducted prior to the commencement of earthworks so that weed areas are identified. This will allow for key sites requiring weed management to be identified and a program developed that details timing and methods for eradication specific to each identified weed area. Once identified, the weed infested areas will be marked out prior to clearing using temporary paraweb fencing and signage. Re-usable topsoil that is weed free will be identified at this time.

The weed control program shall include the following measures:

- Weed control and hydroseeding of disturbed areas;
- Inspections shall be carried out on a six-monthly basis for weed species;
- Where possible, topsoil shall remain undisturbed;
- Noxious weeds will be managed in consultation with the local council;
- Weed infested topsoil will be stockpiled separately and disposed of if required; and
- Areas of significant or protected vegetation will be monitored to assess weed colonisation.

As per JWA (2010) weeds currently existing on site include:

- Camphor laurel (*Cinnamomum camphora*)
- Lantana (*Lantana camara*)
- Purple top (*Verbena bonariensis*)
- Wild tobacco tree (*Solanum mauritianum*)
- Black-berry nightshade (*Solanum nigrum*)
- Brazilian nightshade (*Solanum seaforthianum*)
- White passionflower (*Passiflora subpeltata*)
- Cork/Small passionfruit (*Passiflora suberosa*)
- Mickey mouse plant (*Ochna serrulata*)
- Large-leaved privet (*Ligustrum lucidum*)
- Small-leaved privet (*Ligustrum sinense*)
- Umbrella tree (*Scheffiera actinophylla*)
- Redhead cotton bush (*Asclepias curassavica*)
- Narrow leafed cotton bush (*Gomphocarpus fruticosus*)
- Balloon cotton bush (*Gomphocarpus physocarpus*)
- Crofton weed (*Ageratina adenophora*)
- Mistflower (*Ageratina riparia*)
- Blue billgoat weed (*Ageratm houstonianum*)
- Thickhead (*Crassocephalum crepidioides*)
- Brazilian fire weed (*Erechtites valerianifolia*)
- Flatweed (*Hypochoeris radicata*)
- Fireweed (*Senecio madagascariensis*)

## 6.6 Fire management

Fire management is in accordance with the Fire Management Plan as stipulated in the Integrated Plan. This Plan addresses mitigation and management of fire within and immediately adjacent to areas identified as potoroo habitat. The objectives for this plan are as follows:

- Objective 1: provide a mosaic landscape that contains areas with varying fire histories and therefore stages of regeneration;
- Objective 2: ensure suitable habitat for the potoroo without significantly impacting upon other flora and fauna species;
- Objective 3: minimise the potential for wildfire events by breaking up fuel loads; and
- Objective 4: ensure that between 50 and 70% of known habitat is suitable for the potoroo within 4 yrs post burn.

The plan nominated 11 fire precincts based on the vegetation types and existing control lines within the Potoroo habitat area (Figure 8). The objective of breaking the area into precincts is to ensure that at any one time there is sufficient and suitable habitat for Long-nosed Potoroos on either side of Boyd Street.

The main north-south drainage lines and the large Tree Broom Heathland depression have not been identified for prescribed burns for the following reasons:

- These vegetation communities generally possess low fuel loads and are often subject to inundation suggesting they pose little threat in supporting a wildfire;
- They provide a mosaic of long term residual habitat for potoroo unaffected by the proposed plan and may from time to time be of particular importance
- These areas comprise important habitat for the Wallum Froglet (*Crinia tinnula*), a fire sensitive species of wallum habitats (Lewis & Goldingay 2005).

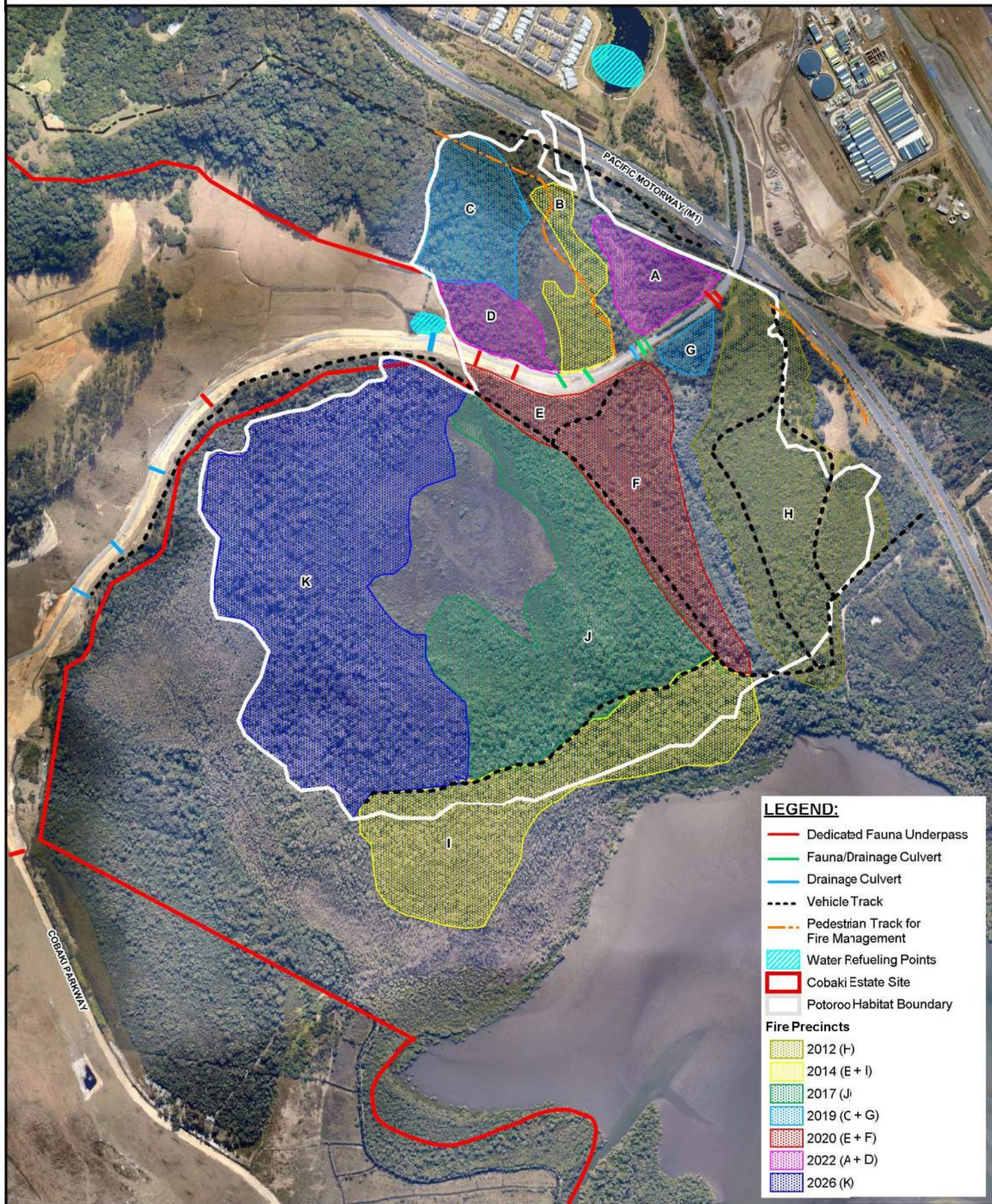
Prescribed burns are to be undertaken in autumn or early winter when conditions become favourable to low intensity fires, which is also subsequently compliant with the local NSW RFS burning schedule. Precinct A (2014), C (2012), E (2014), F (2014) and K (2012) are to be burnt during the first five years of the implementation. Burning H and B during the early stages of the plan aim to achieve two criteria:




- a) encourage the use of the culvert at Chainage 175 by burning both the north and south of the structure; and
- b) to reduce the fuel load and therefore risk of wildfire, in areas immediately adjacent to the overpass.

The remaining precincts are identified for burns in the proceeding 10 yrs (2016-2026). The schedule includes both years when multiple burns will be undertaken, as well as years when no burns will be undertaken, ensuring that more than 60% of known potoroo habitat remains suitable (i.e. >4 yrs post fire). Table 4 details the fire management guidelines for each precinct.



**Figure 8: Fire Management**



<b>FIGURE</b> 8 - Fire Management	<b>REVISION</b> A	<b>STATUS</b> DRAFT		
<b>CREATED BY</b> AM11482	<b>DATE</b> 04/01/2012	<b>ISSUED FOR INFORMATION</b>		
<b>PROJECT NO.</b> 3003773	<b>COORDINATE SYSTEM</b> GDA 1994 MGA Zone 56		 Scale: 1: 10,000 @ A4	
<b>PROJECT TITLE</b> Cobaki Estate Environmental Management Plans	<b>SOURCE</b> The State of Queensland (Department of Environment and Resource Management), Copyright 2010 Aerial Imagery by Nearmap Hypertiles, Copyright 2011			
			<b>CONSULTANT</b> SMEC Australia Copyright SMEC Australia Pty Ltd. All Rights Reserved.	
			<b>CLIENT</b> LEDA MANORSTEAD PTY LTD	



**Table 4 - Fire management prescriptions for each precinct identified in the Integrated Plan.**

Precinct	Area (ha)	Broad Vegetation Description	Proposed Burn	Guidelines
A	2.5	Scribbly Gum Forest – Heath Understorey	May-June 2014	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• No use of retardants</li> <li>• Patch work ignition from eastern management trail on state border</li> </ul>
B	2.6	Swamp Mahogany Scribbly Gum and Scribbly Gum Mallee Heathland	May-June 2021	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• No use of retardants</li> <li>• Patch work ignition from eastern management trail on state border and from central foot trail</li> </ul>
C	5.2	Swamp Mahogany Scribbly Gum and Scribbly Gum Mallee Heathland, Tree Broom Heathland	May-June 2012	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• No use of retardants</li> <li>• Patch work ignition from eastern management trail and northern open paperbark forest at base of Tugun Hill</li> </ul>
D	2.3	Swamp Mahogany Scribbly Gum and Scribbly Gum Mallee Heathland, Tree Broom Heathland	May-June 2018	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• No use of retardants</li> <li>• Patch work ignition from western boundary of Cobaki Lakes and on boundary of precinct C &amp; D.</li> </ul>
E	1.4	Scribbly Gum Mallee Heathland	May-June 2014	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• Vehicle use along sand management trail for containment.</li> <li>• No use of retardants</li> <li>• Patch work ignition from southern and western sand trails and southern side of Boyd Street.</li> </ul>
F	6.9	Black She-oak, Tree Broom Heathland, Scribbly Gum Mallee Heathland, Swamp Mahogany Forest	May-June 2014	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• Vehicle use along sand management trail for containment.</li> <li>• No use of retardants</li> <li>• Patch work ignition from main north south sand trail directing fire east into moist drainage line.</li> </ul>
G	0.9	Scribbly Gum Forest and Scribbly Gum Swamp Mahogany	May-June 2016	<ul style="list-style-type: none"> <li>• Fire interval of 10-15 yrs</li> <li>• No Use of Earth Moving Machinery</li> <li>• No use of retardants</li> </ul>

Precinct	Area (ha)	Broad Vegetation Description	Proposed Burn	Guidelines
		Forest		<ul style="list-style-type: none"> <li>Patch work ignition from Boyd Street and the north-south drainage line</li> </ul>
H	13	Scribbly Gum Forest and Scribbly Gum Swamp Mahogany Forest	May-June 2016	<ul style="list-style-type: none"> <li>Fire interval of 10-15 yrs</li> <li>No Use of Earth Moving Machinery</li> <li>No use of retardants</li> <li>Patchwork ignition from eastern management trails which can be accessed by vehicle burning west into drainage line</li> </ul>
I	13	Swamp Mahogany Forest, Scribbly Gum Forest	May-June 2018	<ul style="list-style-type: none"> <li>Fire interval of 10-15 yrs</li> <li>No Use of Earth Moving Machinery</li> <li>Vehicle access along east west management trail for containment</li> <li>No use of retardants</li> <li>Patch work ignition burning south toward</li> <li>Cobaki Broadwater</li> </ul>
J	13.7	Swamp Mahogany Forest, Black She-oak, Tree Broom Heathland, Scribbly Gum Mallee Heathland	May-June 2016	<ul style="list-style-type: none"> <li>Fire interval of 10-15 yrs</li> <li>No Use of Earth Moving Machinery</li> <li>Vehicle access along north-south and east-west trails used for ignition and containment</li> <li>No use of retardants Patchwork ignition initially from western side of precinct on east-west trail.</li> <li>Containment and further ignition along the north-south trail directing fire into wet Tree Broom Heathland</li> </ul>
K	32	Scribbly Gum Forest, Scribbly Gum/Swamp Mahogany, Scribbly Gum Mallee heathland	May-June 2012	<ul style="list-style-type: none"> <li>Fire interval of 10-15 yrs</li> <li>No Use of Earth Moving Machinery</li> <li>No use of retardants;</li> <li>Patchwork ignition from eastern Tree Broom</li> <li>Heathland and north western trail adjacent Cobaki Estate development.</li> </ul>

Adjustments to the proposed schedule are likely, as variables such as the success of revegetation (particularly around the culverts), success of predator control, and extent of previous burns, would all need to be taken into consideration prior to a burn.

All fire management procedures will require coordination between TMR, RMS and LEDA, in consultation with OEH, NPWS and QPWS and all activities are to follow the NSW RFS Standards for Low Intensity Bush Fire Hazard Reduction (2006).



## 7 Monitoring

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The monitoring program has been designed to determine the impacts of all activities associated with the Cobaki Estate Development on the adjacent Long-nosed potoroo population. The monitoring program timeframe will be at least five (5) years and is to be in accordance the Integrated Plan. Monitoring is to be coordinated between all responsible parties of the monitoring program, including TMR, Gold Coast Airport and LEDA Manorstead.

Monitoring techniques include:

### 1. Monitoring potoroo population size and structure

Biannual survey (May and November), including cage traps and hair tubes, will provide a comparable measure of potoroo extent, density and population structure to that of the baseline survey.

#### Hair Tube Survey:

A survey effort of 1000 trap nights per year is proposed in Year 1, with increased effort proposed for Years 2-5 in the absence of cage trapping. 100 hair tubes at 100 m centres are to be established within the habitat area (Refer to Figure 9). Hair tubes will be baited with rolled oats, peanut butter and honey to which 5% truffle oil will be added. The location of each hair tube will be GPS recorded and replicated at subsequent monitoring events.

Hairs collected from the hair tubes will be identified to species level. Analysis of the results will inform the following outputs:

- Extent of Occurrence (EoO): a Minimum Convex Polygon (MCP) with 50m buffer connecting outermost hair tubes that contained Long-nosed Potoroo hair.
- Area of Occupancy (AoO): number of hair tubes/100 in EoO that returned Long-nosed Potoroo hair  $\pm$  95% Confidence Interval (CI).

#### Cage trapping:

Cage trapping can impose considerable stress on the trapped individuals. Minimising cage trapping in favour of less intrusive survey techniques is therefore favourable. For this reason, cage trapping is recommended during Year 1 only. The results of the first year of cage trapping, when considered in conjunction with the work of Lewis (2010-2013), will provide a sufficient indication of population structure (i.e age structure, sex ratios, density, presence of breeding female etc.).

A survey effort of 800 trap nights per year is proposed. This will be conducted using a minimum of ten 5 x 2 configured trapping grids (i.e. 10 lots of traps at 25 m centres in two rows of 5), randomly selected from the 100 hair tube sites (refer to Figure 9). Traps will be baited with rolled oats, peanut butter and honey to which 5% truffle oil will be added.

Outputs from the live trap survey events include:

- Trap success per 100 trap nights  $\pm$  95% Confidence Interval (CI).
- Long-nosed Potoroo density (per hectare)  $\pm$  95% CI.
- Long-nosed Potoroo population estimate  $\pm$  95% CI.

If the hair tube monitoring results in subsequent years are below threshold (as detailed in Section 8), cage trapping may be reintroduced to assist in evaluating the potential issue.

## **2. Monitoring fauna underpasses**

Sand plots and infra-red cameras will be used to monitor the use of all nine fauna culverts and one bridge span.

Sand plots will be monitored twice per year in May and November for a minimum 5 years. The tracking material is to consist of a dry, loamy mix of sand, silt and clay laid on 2 m sections on either end of culverts as well as the middle section. Monitoring will consist of inspecting sand plots every two days and recording all fauna tracks to species (i.e. fox) or group level (i.e. bandicoot) before smoothing the plot over for the next sampling event. Human activity would also be recorded during each underpass visit in order to derive a relative disturbance measure.

Infrared cameras will be suspended from the roof and enclosed in a security cage in middle sections of the culverts. The cameras will run in continuous mode for 4 week periods in spring, summer, autumn and winter.

## **3. Monitoring the integrity of fauna exclusion fencing**

Fence breach monitoring will be undertaken quarterly during Year 1 and 6-monthly during subsequent years, as well as after major storm events. Fence breach locations will be recorded, which may facilitate in interpreting the road strike data.

## **4. Road strike**

The impact of the operation of Boyd Street, Cobaki Parkway and the Pacific Highway Tugun Bypass on road strike will be monitored. This will measure the effectiveness of fauna exclusion fencing and underpasses in reducing road strike. TMR (through Lend Lease are responsible for providing road strike data for the Tugun Bypass, and Leda will be responsible for Cobaki Parkway road strike data.

Initially two road strike transect surveys are to be undertaken following the opening of the road to vehicles with the first survey after 7 days of operation and the second survey one month later. Following these initial surveys, the road strike transect is to be undertaken concurrently with fauna fence integrity monitoring (i.e quarterly for 1 year and 6-monthly in the proceeding 4 years.

## **5. Habitat condition surveys**

Habitat condition surveys are to be undertaken across areas identified for revegetation, habitat in the immediate vicinity of the cage trap transects and within the broader area to determine revegetation and fire management success and monitor edge effects.

## **6. Exotic predator control monitoring**

Pre and post-control surveys are to be undertaken using non-control bait stations, predator scat and track transects and general traverses to locate den sites to determine population size and predator activity.

## **7. Fire Management Monitoring**

The fire management plan is to be reviewed on an ongoing basis once prescribed burns have commenced.

These techniques are detailed in Table 5.

TMR are currently conducting surveys on the Cobaki Lakes and Tweed Heads West Potoroo population (Lewis, 2010-2013). Once finalised, the results of this survey will be adopted as a baseline for comparison purposes, along with the survey results of the first year of the Cobaki Estate monitoring program detailed in this Plan.

In order to ensure the monitoring and the data collected is undertaken in a robust manner, the ecologists must have demonstrated ability in all aspects in which they are to be engaged. This

includes supervision by field staff with at least 10 years experience in vertebrate fauna surveys, experience in statistical analysis and the ability to interpret and translate meaningful relationships. The ecologists undertaking the work will also be endorsed by DoE.

**Note:** While it is proposed that the survey area captures the entire Long-nosed Potoroo habitat area shown in Figure 4, land access to some parts of this area may be limited. Significant areas of the Potoroo habitat are now under ownership of the Tweed Byron Aboriginal Land Council and due to the presence of culturally sensitive sites within this area, access is likely to be restricted.



**Table 5 – Monitoring Program**

Study	Timeframe	Description	Subject For Review
Population Size and structure	<ul style="list-style-type: none"> <li>Baseline - four nights of cage trapping and 5 nights of hair tubes conducted twice per year in May and November (i.e. 800 cage traps and 1000 hair tube nights per year)</li> <li>After one year this will be reviewed through annual reporting mechanisms as part of adaptive management.</li> <li>Minimum 5 year timeframe</li> </ul>	<p><b>Baseline Survey:</b></p> <ul style="list-style-type: none"> <li><b>Hair tube Monitoring:</b> <ul style="list-style-type: none"> <li>100 hair tubes at 100 m centres are to be established within the habitat area identified in Figure 4. Hair tubes will be baited with rolled oats, peanut butter and honey to which 5% truffle oil will be added. The location of each hair tube will be recorded by GPS and replicated at subsequent monitoring events.</li> <li>Outputs: <ul style="list-style-type: none"> <li>Extent of Occurrence (EoO): a Minimum Convex Polygon (MCP) with 50m buffer connecting outermost hair tubes that contained Long-nosed Potoroo hair.</li> <li>Area of Occupancy (AoO): number of hair tubes/100 in EoO that returned Long-nosed Potoroo hair <math>\pm</math> 95% Confidence Interval (CI).</li> </ul> </li> </ul> </li> <li><b>Cage trapping:</b> <ul style="list-style-type: none"> <li>A minimum of ten 5 x 2 configured trapping grids (i.e. 10 lots of traps at 25 m centres in two rows of 5), randomly selected from the 100 hair tube sites.</li> <li>Outputs: <ul style="list-style-type: none"> <li>Trap success per 100 trap nights <math>\pm</math> 95% Confidence Interval (CI).</li> <li>Long-nosed Potoroo density (per hectare) <math>\pm</math> 95% CI.</li> <li>Long-nosed Potoroo population estimate <math>\pm</math> 95% CI .Baseline survey (Year 1)</li> </ul> </li> </ul> </li> </ul> <p><b>Subsequent Surveys:</b> Additional hair tubes will be deployed to maintain the same level of survey effort of baseline surveys without the intrusive survey techniques involved in cage trapping (i.e 1800 Hair tubes per year).</p>	Review and compare population estimate, density, trap success, extent and area of occupancy with that of baseline study.
Fauna Underpass Use	<ul style="list-style-type: none"> <li><b>Sand Plots:</b> <ul style="list-style-type: none"> <li>Monitored twice per year in May and November.</li> <li>5 x 2 day monitoring events per season</li> <li>Minimum 5 year timeframe</li> </ul> </li> <li><b>Infrared Camera Systems:</b> <ul style="list-style-type: none"> <li>Run in continuous mode for 4 week periods in spring, summer, autumn and winter.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li><b>Sand Plots:</b> <ul style="list-style-type: none"> <li>The tracking material is to consist of a dry, loamy mix of sand, silt and clay laid on 2 m sections on either end of culverts as well as the middle section</li> <li>Monitoring will consist of inspecting sand plots every two days and recording all fauna tracks to species (i.e. fox) or group level (i.e. bandicoot) before smoothing the plot over for the next sampling event. Human activity would also be recorded during each underpass visit in order to derive a relative disturbance measure.</li> </ul> </li> <li><b>Infrared Camera Systems:</b> <ul style="list-style-type: none"> <li>Suspended from the roof and enclosed in a security cage in middle sections of culvert.</li> </ul> </li> </ul>	In the event that Infrared Cameras detect Potoroos using the culverts during the initial two years of monitoring, monitoring is to revert to sand plots only.
Fauna Fencing Integrity	<ul style="list-style-type: none"> <li>Quarterly during year 1 (February, May, August, November) and biannually (May and November) for years 2-5 as well as after major storm events.</li> </ul>	<ul style="list-style-type: none"> <li>Identify if and where any fence breaches have taken place and may facilitate in interpreting the road strike data.</li> <li>The type of fence breach is to be recorded (i.e. animal dug under fence, fence has been cut through vandalism).</li> </ul>	<ul style="list-style-type: none"> <li>Review for breaches and address as necessary.</li> </ul>
Road Strike	<ul style="list-style-type: none"> <li>Initially two surveys are to be undertaken following the opening of the road to vehicles with the first survey after 7 days of operation and the second survey one month later.</li> <li>Following these initial surveys, the road strike transect is to be undertaken concurrently with fauna fence integrity monitoring (i.e quarterly for 1 year and biannually in the proceeding 4 years.</li> <li>If road strike is identified as an ongoing</li> </ul>	<ul style="list-style-type: none"> <li>Walk transects are to be undertaken on either side of the Boyd Street overpass, Cobaki Parkway and again for 500 m north and south of the Boyd Street Overpass along the Pacific Highway. This will enable all road struck wildlife to be recorded in a format outlined in Appendix 4.</li> <li>In order to avoid the confounding effects of differing traffic volumes the data is to be recorded individually for Boyd Street, Cobaki Parkway and the Pacific Highway.</li> <li>In addition to the results obtained from road strike transects, information will also be collected from maintenance contractors and local wildlife rescue groups (i.e. Currumbin Valley Wildlife Carers and Currumbin Wildlife Hospital).</li> </ul>	<ul style="list-style-type: none"> <li>Review for breaches and address as necessary.</li> </ul>

Study	Timeframe	Description	Subject For Review
	problem in year 1, then monitoring in subsequent years is to be quarterly until the provided mitigation is shown to be effective. Surveys are to be undertaken at dawn on Sunday mornings (currently represents the period of lowest traffic flow).		
Habitat Survey	<ul style="list-style-type: none"> <li>Approximately 5 days in years 1, 3 and 5 of the plan.</li> </ul>	<ul style="list-style-type: none"> <li>Record cover and abundance of vascular plant species, assess vegetation density, canopy foliage projection cover, tree basal area, ground cover attributes of log, litter, bare soil using simple scaling system or absolute numbering system at each cage trap location, revegetation areas and underpasses and at 18 control points beyond the edge affected areas using a 4 x 4 m quadrat.</li> <li>Record the number of potoroo/bandicoot diggings within a 3 m radius of the trap sites.</li> <li>Each site marked with a steel picket and a north facing photo point established for future reference.</li> </ul>	<ul style="list-style-type: none"> <li>Review at years 1, 3 and 5 to assess progress of revegetation and regeneration of any burnt areas.</li> </ul>
Predation	<ul style="list-style-type: none"> <li>The predator management program monitoring is to be undertaken twice per year, comprising den fumigation and predator scat and track transects</li> <li>Predator scat and track transects are to be Minimum 5 year monitoring timeframe</li> <li>Fauna underpass use surveys will also record predator presence.</li> </ul>	<ul style="list-style-type: none"> <li><b>Den Fumigation:</b> <ul style="list-style-type: none"> <li>General traverse are to be undertaken in areas bordering roads, easements, clearings and excavations in order to adequately survey for fox dens. The location of each den will be recorded using a hand held GPS, notes taken on whether it represents an active or unoccupied den site and a picture taken.</li> <li>General traverses are also to be undertaken at the final day of the non-control baiting period, with any subsequent den fumigation occurring within the first two days of 1080 baiting.</li> <li>The number of active fox dens fumigated will be recorded and used as a relative index of fox activity. If monitoring results find that dens are being reutilised following a fumigation session, then permanent destruction of the den will be investigated.</li> </ul> </li> <li><b>Predator Scat and Track Transects:</b> <ul style="list-style-type: none"> <li>Surveys will be undertaken along five 500 m transects (shown in Figure 7).</li> <li>All predator scats observed during the transect surveys are to be collected and sent to an appropriate person for identification, to obtain data on prey item and to reduce recorder bias in subsequent surveys.</li> <li>Predator tracks will also be recorded during these transects using a simple measure of presence/absence.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Review for presence of other predator species following the completion of the Cobaki Estate, and resulting need to include other forms of control.</li> <li>Review of frequency of control, increasing or decreasing as necessary.</li> </ul>
Fire Management	<ul style="list-style-type: none"> <li>Immediately post-burn.</li> <li>15 year management timeframe.</li> </ul>	<ul style="list-style-type: none"> <li>Basic surveys of the area immediately post-burn will involve measuring the extent of burn patches using a handheld GPS, with representative photographs being taken from at least 4 positions to determine the percentage of the area burnt, and whether the fire was contained to the bounds of the precinct.</li> <li>Habitat monitoring techniques will also be used to ascertain the suitability of the habitat in a post fire state for Potoroos and incidentally for other species of fauna and flora.</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing review prior to each burn to ensure mosaic results being achieved, and sufficient regrowth occurring.</li> </ul>



**Figure 9: Proposed Long-nosed Potoroo Monitoring**



**LEGEND:**

- Hair Tubes (example)
- ◆ Cage Traps (example only - randomly selected)
- Predator Scat and Track Transects
- Vehicle Track
- Fauna Underpass Sand Plots and Infrared Cameras
- Cobaki Estate Site
- Potoroo Habitat Area

**COORDINATE SYSTEM**  
GDA 1994 MGA Zone 56

0 200 400 m  
Scale: 1: 10,000 @ A4

**FIGURE** 9 - Monitoring

**REVISION** 0

**STATUS** FINAL

**CREATED BY** AM11482

**DATE** 28/04/2014

**ISSUED FOR INFORMATION**



**PROJECT NO.** 30030009E **PROJECT TITLE** Cobaki Estate Management Plans

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**CLIENT**  
LEDA MANORSTEAD  
PTY LTD

**CONSULTANT** SMEC Australia  
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## 8 Performance Indicators and Corrective Actions

Performance indicators provide thresholds to indicate whether management actions are effective. Corrective actions are utilised if thresholds are not met within a certain timeframe and management intervention is required. Performance indicators, timeframes and corrective actions were set in accordance with the Integrated Plan and are detailed in Table 6.

**Table 6 – Performance Criteria and Corrective Actions**

Performance Criteria	Period	Below Threshold	Corrective Actions
<b>Cage Trap Surveys</b>			
<ul style="list-style-type: none"> <li>No statistically significant reduction in trap success</li> <li>No statistically significant reduction in population</li> </ul>	6 monthly (Year 1)	<ul style="list-style-type: none"> <li>A w%<sup>1</sup> reduction in trap success</li> <li>A x% or greater reduction in population estimate</li> </ul>	<ul style="list-style-type: none"> <li>Review cage trap survey methods if deemed necessary. Also consider the adequacy of survey timing and/or seasonal variation in the decision making process.</li> <li>Consider continuing cage trap surveys for another season.</li> </ul>
		<ul style="list-style-type: none"> <li>No signs of breeding (pouch young or sub adult) in north sub population (i.e. north of Boyd Street);</li> </ul>	<ul style="list-style-type: none"> <li>Review effectiveness of predator control and habitat condition; modify predator control and or fire management programs to improve habitat condition if required. Consult with government agencies and update plan accordingly.</li> <li>Review survey timing and prevailing seasonal conditions that could contribute to influencing breeding behaviour.</li> <li>Review male/female ratio; translocate required individuals in Year 5 if still no signs of breeding. Consult with government agencies and update plan accordingly.</li> <li>Consider continuing cage trap surveys for another season and amend the following: <ul style="list-style-type: none"> <li>Relocate trap locations if predator numbers, habitat condition and male/female ratio not of concern.</li> </ul> </li> </ul>
		<ul style="list-style-type: none"> <li>No sign of individuals moving between north and south sub population.</li> </ul>	<ul style="list-style-type: none"> <li>Review revegetation works around fauna underpasses effectiveness of predator control and potential edge effects along Boyd Street; reinstate vegetation around underpasses (as prescribed by the approved project landscape drawings), modify predator control and or fire management programs to improve habitat condition if required. Consult with government agencies (modifications only) and update plan accordingly.</li> </ul>

<sup>1</sup> Percent values will be added to performance criteria following baseline survey. Values will nominally be in the range of 25-50%, but are contingent upon new baseline data.

Performance Criteria	Period	Below Threshold	Corrective Actions
<ul style="list-style-type: none"> <li>No trap deaths of potoroo.</li> </ul>	Immediate	<ul style="list-style-type: none"> <li>One or more trap deaths of potoroo.</li> </ul>	<ul style="list-style-type: none"> <li>Cease trapping. Notify DoE and the National Parks and Wildlife Service within 24 hours of discovery.</li> <li>Review trap survey design and consult with agencies.</li> <li>Review and evaluate the importance for the need for cage trapping. Consult with agencies and update plan.</li> </ul>
<b>Hair Tube Surveys</b>			
<ul style="list-style-type: none"> <li>No statistically significant contraction in Long-nosed Potoroo Extent of Occurrence as compared to Year 1</li> </ul>	1 year between years 2 – 5	<ul style="list-style-type: none"> <li>A y% contraction in Extent of Occurrence</li> <li>An z% reduction of the associated Area of Occupancy<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>Review and amend hair tube survey methods if deemed necessary. Also consider the adequacy of survey timing and/or seasonal variation in the decision making process.</li> </ul>
<ul style="list-style-type: none"> <li>No statistically significant reduction of the Area of Occupancy as compared to Year 1</li> </ul>	2 consecutive years between Years 2-5.	<ul style="list-style-type: none"> <li>A y% contraction in Extent of Occurrence</li> <li>An z% reduction of the associated Area of Occupancy</li> </ul>	<ul style="list-style-type: none"> <li>Notify agencies within 28 days of 2nd annual monitoring event.</li> <li>Consider reintroduction of cage trapping surveys.</li> <li>Review effectiveness of predator control, drainage structures (Boyd Street) and habitat condition – relocate trap locations if predator numbers, culvert function and habitat condition is not of concern.</li> <li>Modify predator control, drainage and or fire management programs if required.</li> <li>Consult and develop contingency actions with government agencies and update plan accordingly.</li> </ul>
<b>Fauna Underpasses</b>			
<ul style="list-style-type: none"> <li>One or more potoroo make complete passage through an underpass.</li> <li>No evidence (fresh scats or tracks) of exotic</li> </ul>	1 year between years 2 – 5	<ul style="list-style-type: none"> <li>No potoroo pass through a constructed underpass.</li> <li>Fresh predator scats/tracks within fauna underpass culverts.</li> <li>Pedestrian/trail bike rider tracks</li> </ul>	<ul style="list-style-type: none"> <li>Review revegetation works around fauna underpasses, presence of vertical grates within underpasses and dry access to and through underpasses (the later only applying to dedicated fauna underpasses and not combination – drainage culverts).</li> <li>Reinstate vegetation/log hides around underpasses (as prescribed by the approved project landscape drawings), if required. Also ensure dry access to and or through culverts is</li> </ul>

<sup>2</sup> Based on analysis of log-likelihood ratios with alpha ( $\alpha$ ) set at 0.1

Performance Criteria	Period	Below Threshold	Corrective Actions
predators within fauna underpass culverts. • No sign of use (tracks) by pedestrians and trail bike riders	2 consecutive years between Years 2-5.	present within fauna underpass culverts.  • No potoroo pass through a constructed underpass. • Fresh predator scats/tracks within fauna underpass culverts. • Pedestrian/trail bike rider tracks present within fauna underpass culverts.	maintained. Earth material (sand/mulch) recommended for use. • Reinstate vertical grates within drainage culverts, if required.  • Review revegetation works around fauna underpasses, presence/suitability of vertical grates within underpasses and dry access to and through underpasses (the later only applying to dedicated fauna underpasses and not combination drainage culverts). • Reinstate vegetation/log hides around underpasses (as prescribed by the approved project landscape drawings), if required. Also ensure dry access to and or through culverts is maintained. Earth material (sand/mulch) recommended for use. • Modify predator control and or fire management programs if required. • Modify vertical grates, if required. • Consult with government agencies (modifications only) and update plan accordingly.
<b>Fauna Exclusion Fencing</b>			
• Potoroo not subject to road strike. • No visual signs of pedestrians and trail bike riders within potoroo habitat or underpasses.	Immediate	• Potoroo (1 or more individuals) struck by road vehicle.  • Visual signs of pedestrians and trail bike riders within potoroo habitat or underpasses.	• Fence to be inspected within 7 days of observation. Breaches (holes or lifted ground mesh) to be repaired/re-instated within 7 days of inspection. • Notify DoE  • Fence to be inspected within 7 days of observation. Breaches (holes or lifted ground mesh) to be repaired/re-instated within 7 days of inspection. • Review fence design if repeated/persistent intrusion occurs - structural integrity and or additional security features to be installed.
<b>Habitat Monitoring</b>			
• Cover/abundance of vascular species within remnant vegetation (impact zone) > 50% of remnant vegetation (non-impact zone).	2 consecutive years between Years 1-5	• Cover/abundance of vascular species within remnant vegetation (impact zone) < 50% of remnant vegetation (non-impact zone).	• Assess potential cause (natural and anthropogenic) and identify relevant corrective actions within 28 days of monitoring event (2nd consecutive year). Advise regulatory agencies.



Performance Criteria	Period	Below Threshold	Corrective Actions
<b>Regeneration Areas</b>			
<ul style="list-style-type: none"> <li>&gt;75% of landscaping plants viable and actively showing Signs of Growth (SoG) within regeneration and habitat augmentation areas.</li> </ul>	Years 1 – 5	<ul style="list-style-type: none"> <li>&lt;75% of landscaping plants viable and actively showing SoG within regeneration and habitat augmentation areas.</li> </ul>	<ul style="list-style-type: none"> <li>Maintenance period: Responsible party to determine cause of poor growth/absence. Re-instate/replace landscaping plants (as prescribed on the project drawings) if suitable and within 28 days of observation.</li> <li>Post maintenance period: Approval body/regulatory agency/landowner to determine cause of poor growth/absence. Re-instate/replace landscaping plants (as prescribed on the project drawings) if suitable and within 28 days of observation. If original species are considered not suitable, then substitute with recommended species at similar densities or at a rate that achieves required plant cover for potoroo. Undertake work within 28 days of observation.</li> </ul>
<b>Predator Control Program</b>			
<ul style="list-style-type: none"> <li>&gt;50% reduction in actively used fox dens between Year 1 and 5.</li> <li>&gt;50% reduction in exotic predator tracks or scats (between Year 2 and 5) within or immediately adjacent to dedicated underpass structures and fauna exclusion fences.</li> </ul>	Years 2 – 5	<ul style="list-style-type: none"> <li>&lt;50% reduction in actively used fox dens between Year 1 and 5.</li> <li>&lt;50% reduction in exotic predator tracks or scats (between Year 2 and 5) within or immediately adjacent to dedicated underpass structures and fauna exclusion fences.</li> </ul>	<ul style="list-style-type: none"> <li>Modify den fumigation agent and or application method.</li> <li>Add cage trap to entry and exit of each dedicated fauna underpasses (of which is subject to visitation by predators) and/or one bait station to associated fauna exclusion fence.</li> </ul>
<b>Fire Management Plan</b>			
<ul style="list-style-type: none"> <li>Precincts C and K burnt in Year 1 and A E and F burnt in Year 3 by low intensity fire.</li> <li>&gt;75% of precinct</li> </ul>	Years 1 – 5	<ul style="list-style-type: none"> <li>Precincts C,K,A,E,F not burnt within 1 year of required interval i.e. delay &lt;1 year.</li> </ul>	<ul style="list-style-type: none"> <li>Report on non-compliance to be provided to DoE within 13 months of the prescribed burn interval. Report must justify delay and detail when prescribed burns are to occur.</li> </ul>
		<ul style="list-style-type: none"> <li>&lt;75% of precinct (C,K,A,E,F) area burnt.</li> </ul>	<ul style="list-style-type: none"> <li>Burn remaining area within 8 weeks (weather depending) if burn &lt;50% of intended area. Burn remaining area in conjunction with next program burn (i.e. next programmed precinct).</li> </ul>

Performance Criteria	Period	Below Threshold	Corrective Actions
<p>(C,K,A,E,F) area burnt.</p> <ul style="list-style-type: none"> <li>• &gt;50% reduction in understorey fuel load of precinct.</li> <li>• &lt;25% of precinct canopy burnt.</li> <li>• &gt;50% of burnt precinct suitable for potoroo within 4 yrs of event (assessment will only apply to Precinct A,C,E,F in the life of this plan).</li> <li>• Dedicated firebreaks and access tracks maintained to pre-existing widths (as detailed within the plan) with variation <math>\leq \pm 1</math> m.</li> <li>• Prescribed burns do not extend (<math>&lt; 20</math> m) into precincts not programmed for burning.</li> </ul>		<ul style="list-style-type: none"> <li>• &lt;50% reduction in understorey fuel load of precinct.</li> </ul>	<ul style="list-style-type: none"> <li>• Burn remaining area within 8 weeks (weather depending).</li> </ul>
		<ul style="list-style-type: none"> <li>• &gt;25% of precinct canopy burnt.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify cause in consultation with RFS and or NPWS. Document and agree on measures to improve future performance. Notify regulatory agencies and amend plan within 28 days of event. Implement measures during next prescribed burn.</li> </ul>
		<ul style="list-style-type: none"> <li>• &lt;50% of burnt precinct suitable for potoroo within 4 yrs of event.</li> </ul>	<ul style="list-style-type: none"> <li>• Review the cause of slow regeneration rates and implement agreed corrective actions prior to next programmed burn.</li> <li>• Review process is to include notification/consultation with regulatory agencies and environmental specialists.</li> <li>• Consider increasing fire intervals (as to reduce fuel loads and thus fire intensity) or decreasing fire intervals (to allow vegetation a longer period to recover).</li> <li>• Modify and seek approval of plan if changes are required.</li> </ul>
		<ul style="list-style-type: none"> <li>• Errant fire (resulting from the programmed burns) extends into precincts other than C,K,A,E,F i.e. premature burn. 'Loss' of un-programmed precinct <math>&gt;15\%</math>.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify cause in consultation with RFS and or NPWS.</li> <li>• Document and agree on measures to improve future performance.</li> <li>• Notify regulatory agencies and amend plan within 28 days of event.</li> <li>• Implement measures during next prescribed burn.</li> </ul>
		<ul style="list-style-type: none"> <li>• Dedicated firebreaks and access tracks maintained to pre-existing widths (as detailed within the plan) with variation <math>&gt; \pm 1</math> m.</li> </ul>	<ul style="list-style-type: none"> <li>• Work to re-establish dedicated firebreaks and access tracks to be undertaken within 4 weeks of non-compliance.</li> </ul>

## 9 Provision of Offsets

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Offsets will be provided in the event that:

- a. Monitoring undertaken detects a statistically significant decline of the species each year, for three subsequent years that is attributable to the Cobaki Estate Development; or
- b. The approved plan cannot be fully implemented for any reason.

If required, offsetting will be in the form of off-site compensatory habitat. The nature of these off-site offsets has not been determined at the time of writing this report. As such when confirmed, an offsite specific Long Nosed Potoroo Compensatory Habitat Management Plan will be prepared.



## 10 Reporting

Reporting of all monitoring will be undertaken biannually, including a comprehensive annual report detailing and interpreting the results for each of the monitoring components and a 6-monthly summary (data only). The comprehensive report will be issued within 12 weeks of the completion of November monitoring and the 6-monthly summary issued within 8 weeks of the completion of May monitoring (Table 7). The annual report will be distributed to relevant stakeholders including but not limited to TSC and OEH. Progress reports will also be sent to the Minister of DoE 3 and 5 years from the date of approval (13<sup>th</sup> October 2011), i.e 13<sup>th</sup> October 2014 and 13<sup>th</sup> October 2016.

Review of monitoring results is to be undertaken in consideration of performance measures and used in an adaptive management process. At the end of the 5 year period, a summary report will be prepared and form the basis for public review.

Timing of some monitoring events will be subject to the commencement of construction of the fauna underpasses and fencing, and will rely on access agreements with the Tweed Byron Aboriginal Land Council.

**Table 7 Reporting requirements**

	Reporting Description	2014	2015	2016	2017	2018
Live Trapping	Cage trapping twice per year	✓				
Hair Tube Survey	Survey twice per year	✓	✓	✓	✓	✓
Culvert Monitoring	Sand plots and infrared cameras	✓*	✓*	✓*	✓*	✓*
Habitat Monitoring	Quantitative monitoring program	✓		✓		✓
Predator Control	Predator scat transects, culvert monitoring and den surveys, once per year	✓	✓	✓	✓	✓
Road Strike Monitoring	Transects of Boyd Street and adjoining Pacific Highway undertaken quarterly in year 1 and biannually in years 2-5.	✓	✓	✓	✓	✓
Fauna Fence Monitoring	Transects of Boyd Street and adjoining Pacific Highway undertaken quarterly in year 1 and biannually in years 2-5. Also undertaken following major storm events.	✓	✓	✓	✓	✓
Fire Management	Part of yearly report detailing and assessing prescribed and un-prescribed fires	✓		✓		
Progress Report to DoE	Progress Report to DoE	✓		✓		
Summary Report for Public Review	Collaborate on 5 years of management					✓

\* Monitoring and management actions to commence once the construction of all fauna underpasses, fauna exclusion fencing and revegetation is complete.

## 11 Responsibilities and Resources

### 11.1 LEDA Personnel Responsibilities

The responsibilities of key staff for the project, including the Construction Manager and on-site Environmental Officer will also be detailed in the CEMP.

The Proponent, Leda Manorstead Pty Ltd, will ensure that adequate resources are available to carry out and maintain all mitigation measures in accordance with relevant Acts and this plan.

Contact details for relevant personnel involved in the implementation of this LNP include:

Organisation/Position	Name	Contact Details
Project Manager	Reg Van Rijn (LEDA)	(07) 5570 5500
Construction Manager	Dennis Hughes	0417 797 099 Email: leda@hughesintermodal.com.au
Environmental on-site Officer	Jon Alexander (SMEC)	(07) 5578 0250, 0424 152 298, Jon.Alexander@smec.com
Veterinary Hospital (Billinudgel)		(02) 66803480
Wildlife Relocation and Management Services		(07) 5590 4301
Currumbin Sanctuary		(07) 5534 1266
DoE Representative	Alex Taylor	Email: Alex.Taylor@environment.gov.au
Office of Environment and Heritage (OEH) (DECC)	Chris Sayer	(02) 6640 2500 131 555
Fisheries	Pat Dwyer	(02) 6626 1397 1300 550 474
Tweed Shire Council	General Enquiries	(02) 6670 2400
	Mick Denny	Phone: (02) 6670 2602 Email: MDenny@tweed.nsw.gov.au
	Colleen Forbes	Phone: (02) 6670 2596 Email: cforbes@tweed.nsw.gov.au

### 11.2 Task Commitment

To ensure all actions required under the Integrated Plan are implemented, management procedures, monitoring and reporting are to be coordinated between all participants of the management plan, including TMR, Gold Coast Airport and LEDA Manorstead.

The proposed timing and commitment of relevant tasks is shown in Table 9 below. Timing of some management and monitoring events is subject to change based on construction start dates.

**Table 9 – Task Commitment**

Action	Commencement	Completion	Responsibility
<b>Development of Integrated Plan of Management</b>	<ul style="list-style-type: none"> <li>Approval of Tugun Bypass 21st Dec. 2006 – 16th Feb. 2007</li> </ul>	<ul style="list-style-type: none"> <li>5th June 2007</li> <li>Revised 9th April 2008 and August 2009</li> </ul>	<ul style="list-style-type: none"> <li>TMR has developed the Integrated Plan</li> </ul>
<b>Boyd Street Overpass:</b> <ul style="list-style-type: none"> <li>1 x dedicated fauna culvert</li> <li>1 x bridge span to reinstate drainage flow</li> </ul>	<ul style="list-style-type: none"> <li>Approval of Boyd Street Overpass (13th Feb. 2007)</li> </ul>	<ul style="list-style-type: none"> <li>June 2008</li> </ul>	<ul style="list-style-type: none"> <li>TMR – construct</li> <li>TSC to maintain</li> </ul>
<b>Boyd Street Extension Culverts :</b> <ul style="list-style-type: none"> <li>2 x dedicated fauna culvert</li> <li>4 x multiuse culverts</li> </ul>	<ul style="list-style-type: none"> <li>Anticipated 2015</li> </ul>	<ul style="list-style-type: none"> <li>Anticipated 2016</li> </ul>	<ul style="list-style-type: none"> <li>LEDA construct and maintain*</li> </ul>
<b>Cobaki Parkway Culverts:</b> <ul style="list-style-type: none"> <li>2 x dedicated fauna culverts</li> </ul>	<ul style="list-style-type: none"> <li>Anticipated 2015</li> </ul>	<ul style="list-style-type: none"> <li>Anticipated 2016</li> </ul>	<ul style="list-style-type: none"> <li>LEDA construct and maintain*</li> </ul>
<b>Fauna Exclusion Fencing :</b> <ul style="list-style-type: none"> <li>1600 m fauna exclusion fence along Pacific Highway</li> <li>480 m fauna exclusion fencing for Boyd Street overpass</li> <li>2300 m fauna exclusion fence along Boyd Street Extension (Cobaki Parkway) and around potoroo habitat</li> </ul>	<ul style="list-style-type: none"> <li>21st Dec 2006 – 16th Feb 2007</li> <li>Approval of Boyd Street Overpass (13th Feb. 2007)</li> <li>Anticipated 2014</li> </ul>	<ul style="list-style-type: none"> <li>June 2008</li> <li>June 2008</li> <li>Anticipated 2015</li> </ul>	<ul style="list-style-type: none"> <li>TMR - construct and maintain in NSW (10 years)</li> <li>TMR - construct</li> <li>TSC to maintain</li> <li>LEDA construct and maintain*</li> </ul>
<b>Relocate Bikeway:</b> <ul style="list-style-type: none"> <li>Relocate 650 m of bikeway along Boyd Street so that it abuts the roadway</li> </ul>	<ul style="list-style-type: none"> <li>Anticipated 2015</li> </ul>	<ul style="list-style-type: none"> <li>Anticipated 2016</li> </ul>	<ul style="list-style-type: none"> <li>LEDA construct and maintain*</li> </ul>



Action	Commencement	Completion	Responsibility
<b>Revegetation:</b> <ul style="list-style-type: none"> <li>Tugun Bypass Adjacent Known Potoroo habitat (as per planting schedule)</li> <li>Boyd Street Overpass (as per planting and habitat augmentation schedule)</li> <li>Boyd Street Extension (as per planting and habitat augmentation schedule)</li> <li>Cobaki Parkway Culverts</li> </ul>	<ul style="list-style-type: none"> <li>21st Dec 2006 – 16th Feb 2007</li> <li>Approval of Boyd Street Overpass (13th Feb. 2007)</li> <li>Anticipated 2015</li> <li>Anticipated 2015</li> </ul>	<ul style="list-style-type: none"> <li>June 2008</li> <li>June 2008</li> <li>Anticipated 2016</li> <li>Anticipated 2016</li> </ul>	<ul style="list-style-type: none"> <li>TMR (including 10 year maintenance)</li> <li>TMR – construct TSC to maintain</li> <li>LEDA construct and maintain*</li> <li>LEDA construct and maintain*</li> </ul>
<b>Implementation and Monitoring of Mitigation Measures:</b> <ul style="list-style-type: none"> <li>Implement baseline surveys for Potoroos</li> <li>Implement a biannual trapping survey (Year 1)</li> <li>Implement a biannual monitoring program</li> <li>Habitat surveys at years 1, 3 and 5.</li> <li>Implementation of fire management plan</li> </ul>	<ul style="list-style-type: none"> <li>2010 (TMR)</li> <li>2014<sup>(1)</sup></li> <li>2014<sup>(1)</sup></li> <li>Upon completion of ALL mitigation structures</li> <li>2010</li> </ul>	<ul style="list-style-type: none"> <li>2014 (LEDA &amp; TMR)</li> <li>2014</li> <li>Year 5 of plan</li> <li>Year 5 of plan</li> <li>Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>TMR and LEDA</li> <li>LEDA for duration of plan</li> <li>LEDA for duration of plan</li> <li>LEDA for duration of plan: 5yrs</li> <li>Coordinated by RMS and TMR in consultation with OEH NPWS and QPWS,</li> </ul>

Action	Commencement	Completion	Responsibility
			and undertaken by RFS (QLD/NSW) or NPWS
<ul style="list-style-type: none"> <li>Implement exotic predator control program</li> </ul>	<ul style="list-style-type: none"> <li>2014</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>TMR and LEDA for duration of plan – 5 yrs. Also RLPB</li> </ul>
<b>Reporting:</b> <ul style="list-style-type: none"> <li>6-monthly Summary Report</li> <li>Annual Report</li> </ul>	<ul style="list-style-type: none"> <li>Upon first monitoring season completion</li> </ul>	12 weeks after Year 5 of plan	<ul style="list-style-type: none"> <li>LEDA for duration of plan: 5yrs</li> <li>To be submitted to OEH NPWS and TSC annually</li> <li>To be submitted to DoE at end of year 1, 3 and 5.</li> </ul>
<b>Public Review:</b> <ul style="list-style-type: none"> <li>Provision for public review after 5 yrs</li> </ul>	<ul style="list-style-type: none"> <li>2018</li> </ul>	<ul style="list-style-type: none"> <li>Six months prior to end of year five</li> </ul>	<ul style="list-style-type: none"> <li>Coordinated by NSW Roads and Maritime Services (RMS) and TMR</li> </ul>

\* Maintenance handover from LEDA to TSC. TSC to confirm timeframe.

<sup>(1)</sup> Monitoring will commence upon the construction of all fauna underpasses and associated exclusion fencing and revegetation works.

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## Appendix 1 – Independent Review Letter

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LEDA Manorstead Pty Ltd  
Attn: Mr Grant Epple  
Suite 14, Level 1  
46 Cavill Avenue  
Surfers Paradise Qld 4217

17 October 2013

Dear Grant

Thank you for the opportunity to review the Long-nosed Potoroo (LNP) Plan of Management prepared by SMEC Pty. Ltd. on behalf of Leda Manorstead Pty. Ltd. I have now completed my review and offer the following information for your consideration.

***Background to this review***

In their decision dated 13<sup>th</sup> October, 2011 the Australian Government Department of Sustainability Environment, Water Population and Communities (DSEWPaC) approved construction of a residential development and ancillary commercial facilities over an area known as Cobaki Lakes in the Tweed LGA (ref: EPBC 2010/5296).

In so far as it relates to the LNP and amongst other things, the approval was conditioned to require as follows (underlining is my emphasis):

*"A monitoring program designed to determine the impacts of all activities associated with the Cobaki Lakes Development on the adjacent LNP population. Prior to submission of the management plan for approval the person taking the action must have the plan reviewed by a suitably qualified independent expert to ensure that the design of the monitoring program is sound and has sufficient statistical power to measure significant change in abundance of the LNP attributable to the proposal..."*

***Qualifications and Experience***

I am a Ph.D. qualified research scientist/landscape ecologist with over 30 years of professional experience in wildlife survey, threatened species and natural area management. My particular area of specialist expertise is with koalas, a species for which I have pioneered and developed a number of statistically sensitive habitat assessment, landscape-scale survey and monitoring techniques. However, I also serve in the capacity of an adjunct academic with links to a number of tertiary institutions in Australia which I assist in the supervision of higher degree research candidates.

***Experience with the focal species***

My experience with LNP covers a professional career of some 25 years commencing with targeted survey work on behalf of the NSW National Parks and Wildlife Service in the Upper Hastings River catchment on the mid-north coast of NSW during the early 1980's. In 1990 I was a co-supervisor of a LNP research program undertaken



by Richard Mason, the project requiring habitat assessments, capture and radio-tracking of LNP in the Tyagarah Nature Reserve approximately 45 kilometers to the south of the population now the subject of the aforementioned management plan. I was also part of the Griffith University survey team that in 2001 and as part of ecological investigations associated with the proposed Tugun by-pass, reported the presence of LNP on the Cobaki site for the first time following its initial discovery at that locality nearly a decade earlier.

More recently (2007 - 2009) I have undertaken targeted survey work for LNP in a number of localities, most notably an 18 month survey program on the Springbrook Plateau (Qld) some 25km to the west of the Cobaki site. This protracted program was undertaken with a view to establishing LNP conservation status on lands owned by Gold Coast City Council and advising on LNP-related habitat/fire management issues. This particular work included grid-based hair funnel sampling along with use of capture/recapture techniques and development of benign quantitative estimators of presence and abundance based on the density of digs.

### ***The Management Plan***

The management plan being the focus of this review is that of:

Marsden, A. 2013. *Long-nosed Potoroo Management Plan*. Version 3. Prepared by SMEC Pty. Ltd. for LEDA Manorstead Pty Ltd.

For the remainder of this correspondence the abovementioned document will be referred to as the LNPMP. The relative merits of the LNPMP cannot be assessed in isolation however, there being two preceding studies that have served to inform it and which need to be read in conjunction with the LNPMP before considering the basis of the proposed monitoring program. These two studies are as follows:

Bali, R., Lewis, B., and Brown, K. 2003. *The Status and Distribution of the Cobaki Long-nosed Potoroo Population*. Prepared for Parsons Brinckerhoff, and

Lewis, B.D and Freestone, C.Z. 2009. *Integrated Plan of Management for the Endangered Long-nosed Potoroo (Potorous tridactylus tridactylus) Population At Cobaki*. Prepared by Lewis Ecological Surveys for PacificLink Alliance.

In general terms, both Bali *et al.* (2003) and the work of Lewis and Freestone (2009) serve to provide a reasonable overview of the ecology of LNP, notwithstanding that there have been a number of relevant reports and peer-reviewed publications in recent years which might have been referred to in the LNPMP for the purposes of bringing the knowledge base up to speed. Perhaps the most significant element of these more recent studies is the switch from Pistachio oil to Truffle oil as an attractant and bait supplement for studies on LNP and other mycophagous mammals, the implications of which could be expected to have significant bearing on otherwise discounted aspects of survey design but also the cage-trapping component of the proposed monitoring program. This aside for the moment however and with particular regard to the earlier work of Bali *et al.* (2003) the previous studies provide a good foundation – subject to qualifications outlined in the following paragraph – upon which to develop a longer-term management strategy.

The DSWEPaC approval required all actions to be based on the work of Lewis and Freestone (2009). In considering this requirement there are three issues that become compounding and thus warrant some discussion. The first of these is what I perceive to be a perpetuated but false assertion in the LNPMP (page 14) that “... *no suitable habitat for the species exists on the site.*” In my experience this is certainly not the

case, by example my own work on the Springbrook Plateau taking place in elevated Wet Sclerophyll forest communities typical of those present on more elevated areas of the Cobaki site. Hence the habitat in this instance should be considered as non-limiting given that there is clearly potential – under optimal conditions – for LNP to occur outside of the habitat area identified in the LNPMP. Given the history of the species on the site, there must also be recognition that the work of Bali *et al.* (2003) may well have been sampling a LNP population in recovery mode and/or that population growth, distribution and abundance may well have changed over the intervening period. This brings me to my third point, that over 10 years have now passed since the work of Bali *et al.* (2003) and there is no guarantee that either numbers or density or distribution of the LNP on the site will be as it was in 2003. In a related context the issue of genetic bottlenecks arising from the fire and/or disturbance history on the site over time and the extent to which inbreeding may or may not increase the vulnerability of the population to disease and/or disturbance stressors arising from development. On this basis I consider there to be grounds for re-evaluating the DSEWPaC requirement, or perhaps qualifying it on the basis that additional/more recent information will be required to serve as baseline data against which outcomes from the envisaged monitoring program can meaningfully be compared.

Page 33 of the LNPMP summarises key elements of the monitoring techniques proposed to be employed over the envisaged 5 year time frame of the monitoring program. To this end and again in general terms I am comfortable that principles associated with proposals to monitor underpass use and the condition of exclusion fencing, road-strike and predator control/management are achievable. In this context I have also noted that proposals for fire management monitoring and habitat condition surveys are beyond the scope of the LNPMP to address in any meaningful way because they clearly extend beyond the envisaged 5 year timeframe of the monitoring program.

I have thus devoted the greater portion of this review to what I perceive as deficiencies in the design of the proposed LNP population size and structure component of the monitoring program. This particular aspect of the monitoring program is fundamental to its success or otherwise but in my opinion the current design is at odds with the clearly defined task of designing a statistically sensitive monitoring program that can measure significant change in LNP abundance.

As I currently understand Table 5 of the LNPMP, a key element of the proposed monitoring program is a cage trapping program comprised of 4 consecutive nights of trapping to be conducted twice a year in May and November along 4 closely aligned transects on either side of the Boyd Street access. Collectively, this represents a total survey effort of 320 trap nights (160 each in May and November). Section 7.1 of the LNPMP then envisages that performance of the potoroo population can be measured in four ways as follows:

- “1. Comparing the density and number of LNP captured along each transect with the baseline study (Bali et al. 2003). Captures of similar numbers of LNP in each of these areas would be regarded as a success;*
- 2. The capture of LNP at one or more cage trap locations along each transect would be considered a success. This would indicate LNP have some tolerance or become habituated to the changing abiotic and biotic influences on the landscape;*
- 3. Population structure of the LNP population on both the north and south of Boyd Street. Evidence of sub adult and/or pouch young would be considered a success; and*

4. *Individuals moving between the north and southern sides of Boyd Street would be considered a success and indicate that culverts are being utilised.*

Related to the above and amongst other more qualitative estimators the quantitative performance criteria threshold value that is proposed for purposes of the trapping component of the proposed monitoring program is 1.2% (i.e. 1.2 LNP captured / 100 trap nights) as follows:

Above threshold:-

*“Trap success (i.e. capture rate) and estimated population density\* > 70% of baseline data collected in Bali et al. (2003), i.e. > 1.2% trap success; or*

Below threshold:-

*Trap success (i.e. capture rate) and estimated population density\* < 70% of baseline data collected in Bali et al. (2003), i.e. < 1.2% trap success.”*

In my opinion the following considerations work against a notion that the preceding threshold values are capable of satisfying the DSEWPaC requirement that all activities associated with the Cobaki Lakes residential development be considered and that the proposed monitoring program have sufficient statistical power to measure significant change in abundance of LNP:

1. As currently presented in the LNPMP, the trapping component of the survey is focused exclusively on that area either side of Boyd Street near the underpasses and thus lacks the ability to yield data on LNP abundance elsewhere in the 100 – 150ha habitat area known to be occupied by the endangered population in 2003;
2. there is no knowledge of what influence a change in bait type will have on the threshold figure of 1.2%, thus in the event of an increase (in success) there is some potential for a false conclusion to be reached about changes in LNP abundance in the area being trapped and so extrapolated across the site, when in fact the opposite might be true.
3. On the basis of a total bi-annual trapping effort of 320 trap nights, application of the 1.2% threshold value implies that the difference between success and failure (and so the difference between a requirement for corrective action(s) or not) will come down to whether no more than 3 or more than 5 LNP are captured respectively. Notwithstanding bias arising from the localized focus of trapping effort alluded to above, it should also be clear that the differences between 3 - 5 LNP captures per annum will be non-informative because such variation is also well within the expected range of variance as can be evidenced by further analysis of the trap success data detailed in Bali et al. (2003) which indicates a standard error value approximating 25% of the estimated trap success [ $1.9 \pm 0.43$  (SE) LNP captures 100tn<sup>-1</sup>].

Given the above considerations I have little recourse but to conclude the cage trapping component that is otherwise intended to underpin the ability of the LNPMP to inform on issues of LNP abundance across the site is incapable of doing so. This is because the proposed survey effort of 160 trap nights at four localities will not be sufficient to detect change in LNP abundance, because of the localized survey effort and the central tendency measures associated with earlier trap success data.

For reasons I have already alluded to above I would strongly argue the need for new baseline survey data to subsequently inform the envisaged 5 year monitoring program. This is not intended to diminish the earlier work of Bali et al. (2003), rather



to see it as a valuable reference point in ecological time and space now transcended by one or more LNP generations. As with any sampling program the ability to detect change in a meaningful way will invariably be a function of both survey effort and replication. I have also borne in mind the need (if at all possible) to incorporate more than one survey technique. Ideally new baseline data should be collected in the 12 – 18 month period preceding intensive development works on the site. I would also be of the view that this period should involve 2 sampling events so as to clearly define the baseline data estimates and associated confidence intervals. Below I suggest a multi-faceted, more rigorous and statistically driven survey design that is capable of informing the issue of LNP abundance on the Cobaki Lakes site.

### **1. *Hairtube/funnel monitoring***

Bali *et al.* (2003) deployed a grid-based sampling regime based on the use of hair funnels at 50 – 80m. In general terms the hair funnel return (in terms of LNP hair samples) from this sampling technique was not informative and has been effectively discounted in the LNPMP. However, there is now clear evidence that LNP respond more positively to hairtube/funnel survey when the attractant contains truffle oil. Hence there is a need to re-evaluate the potential utility and value of this technique in terms of its ability to inform monitoring of the LNP population. More importantly perhaps is that the grid-based approach originally utilised by Bali *et al.* (2003) in principle also offers a less biased and more systematic approach to survey effort than is currently presented in the LNPMP.

To this end the following is proposed:

#### **(i) Methodology/Design**

One hundred hair funnels at 100m centres focussed and/or overlapping the LNP habitat area identified in Fig 4 of the LNPMP, to be baited with rolled oats, peanut butter and honey to which 5% truffle oil has been added. It is further proposed that these 100 sites become permanent monitoring points for purposes of the LNPMP.

#### **(ii) Minimum Survey Effort: 1000 hair funnel nights per annum.**

#### **(iii) Output:**

- LNP *Extent of Occurrence* (EoO): a MCP + 50m buffer connecting outermost hair funnels that contained LNP hair, and
- LNP *Area of Occupancy* (AoO): no of hair funnels/100 in EoO that returned LNP hair  $\pm$  95% Confidence Interval (CI).

### **2. *Annual Cage trapping***

#### **(i) Methodology/Design**

A minimum of 20 5 x 2 configured trapping grids (i.e. 10 traps at 25m centres in two rows of 5 so as to effectively survey an area of 0.625ha), the trapping program to run over a minimum of 4 consecutive nights with traps checked at 2200, 0200 and 0600 hrs nightly. The twenty sites selected for this component are to be randomly selected from the 100 sites identified by 1 above for each of the five years of the proposed monitoring program.

#### **(ii) Minimum Survey Effort: 800 Cage trap nights per annum<sup>1</sup>.**

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<sup>1</sup> Could be comprised of 2 x 400 trap-night sessions during both May and November in 10 of the 20 randomly selected sites for that year respectively.

(iii) Output:

- LNP trap success per 100 trap nights  $\pm$  95% CI
- LNP density (LNPha<sup>-1</sup>)  $\pm$  95% CI
- LNP population estimate  $\pm$  95% CI

**3. Thresholds for intervention**

The potential advantage of incorporating a number of different tools into the assessment of LNP distribution and abundance at the Cobaki site means that an appropriately informed series of checks and balances can be incorporated into monitoring program. Ideally the output from each of the two techniques being advocated herein will be the same for each monitoring event. However, until the current pre-development conservation status of the LNP population has been properly determined and new baseline data has been collected for consideration it remains problematical to set limits for intervention. Doing so would be a key requirement of the survey design outlined in the preceding pages, with likely intervention drivers envisaged to be of a form such as:

- (i) A  $w\%$  contraction in LNP Extent of Occurrence and/or reduction of  $x\%$  of the associated Area of Occupancy<sup>2</sup>, or
- (ii) A  $y\%$  reduction in trap success and/or  $z\%$  or greater reduction in population estimate.

[Note: realistically but entirely contingent upon data arising from the gathering of new baseline data, the values  $w - z$  above will nominally be in the range of 25 – 50%].

**Concluding comment**

The LNP population under consideration in this instance is also an endangered population for purposes of the NSW Government's *Threatened Species Conservation Act 1995*. It is a poor reflection on the work of many field ecologists that the work they do is not communicated to a broader audience so as to further advance management and monitoring techniques for threatened taxa such as LNP. I conclude this review with a comment that both the design and results of the monitoring program in this instance is worthy of publication in the peer-reviewed literature. Accordingly I would strongly advocate that any final report arising from the monitoring program be in a form suitable for immediate submission to a previously identified scientific journal and that the contractual arrangements relating to the undertaking of this monitoring program reflect this need.

Please do not hesitate to contact the undersigned if you require further information.

Yours sincerely



Steve Phillips B.Sc.(Hons), Ph.D.  
Managing Director/Principal Ecologist.

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<sup>2</sup> Based on analysis of log-likelihood ratios with alpha ( $\alpha$ ) set at 0.1.

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25/03/2014

Attn: Alex Taylor  
Assistant Director  
Approvals Monitoring North  
Environment Assessment and Compliance Division  
Department of the Environment

Dear Alex,

**RE: Independent Reviewer Comments regarding the Cobaki Estate Long Nosed Potoroo Management Plan (LNPMP)**

As you would be aware comments regarding the Cobaki Estate Long Nosed Potoroo Management Plan (LNPMP) were received by LEDA from the independent reviewer Dr Stephen Phillips (Biolink Pty Ltd) in Oct 2013. In those comments Dr Phillips puts forward a number of suggestions for modifications and additions to the current LNPMP. SMEC has evaluated these comments on behalf of LEDA and whilst broadly in agreement with the various points raised, would like to propose some amendments and seek agreement with proposed methods of integrating and implementing Dr Phillips recommendations.

The key recommendations raised are paraphrased in the following pages, with the SMEC response to each item immediately below.

**Comment/ recommendation:** The work of Bali et al. (2003) which has been used to establish a baseline for comparison purposes is now dated, and new, more current baseline data should form the basis comparison of future monitoring.

**Response:** This is accepted and it is proposed that the recent potoroo survey work of Lewis (2012 & 2013) conducted for Qld Dept of Transport and Main Roads on the "Cobaki" potoroo population be adopted as a baseline for comparison purposes, along with the survey results of the first year of the Cobaki Estate monitoring program. Once these results are available the LNPMP would be updated to reflect the new baseline comparison data.

**Note:** While it is accepted that a wider survey area more reflective of the historically recognised LNP habitat area is appropriate, it should be noted that SMEC is aware that land access to some parts of this area will be limited. Significant areas of the Potoroo habitat to the south of the proposed Cobaki Parkway are now under the ownership of the Tweed Byron Aboriginal Land Council and due to the presence of culturally sensitive sites within this area, access is likely to be restricted.



**Comment/recommendation:** Change the baits used as an attractant for Long Nosed potoroo through the inclusion of Truffle oil as per the reviewer's recommendations.

**Response:** Accepted and reflected in the revised plan.

**Comment/recommendation:** Dr Phillips proposes a monitoring program featuring substantially increased survey effort and increased use of hair tubes. This is generally accepted however some proposed modifications to the suggested regime are below.

**Response:** it is proposed that the monitoring program as suggested be adopted in the first year including both cage trapping and the use of hair tubes. Following the first year it is proposed that hair tubes only be used for monitoring. The rationale behind this is:

1/ The results of the first year cage trapping, when considered in conjunction with the work of Lewis (2012, 2013), will provide a good "snapshot" of the Potoroo population dynamics Male/Female, age class, presence of breeding females etc as well as informing the other outputs proposed by Dr Phillips. If hairtube only monitoring in future years triggers point (i) of the "thresholds for intervention" suggested, then cage trapping could be reintroduced to assist in evaluating any potential problem.

2/ Cage trapping imposes considerable stress on the animals involved. Minimising cage trapping in favour of less intrusive survey techniques whilst still capturing sufficient information to provide a robust evaluation of the population is considered a "win-win" situation.

3/ Following year one, additional hairtubes could be deployed during subsequent surveys to maintain the level of survey effort.

**Comment/recommendation:** it is recommended that the final report be prepared in such a way that it would be suitable for immediate submission to a peer reviewed scientific journal.

**Response:** whilst the idea of submitting the results of monitoring programs such as this for publication in the scientific literature is a laudable one, in SMEC's opinion this should be a separate activity from the submission of reports which finalise approval conditions.

The review and acceptance of papers into the scientific literature can be a protracted exercise, which if linked to approval conditions could produce unreasonable time delays to the project. Additionally, the project and site specific recommendations which form an important part of most monitoring finalisation reports may be of little relevance or value to a wider scientific audience.

If you require any clarification around any of the attached comments please don't hesitate to contact me directly.

Yours sincerely,

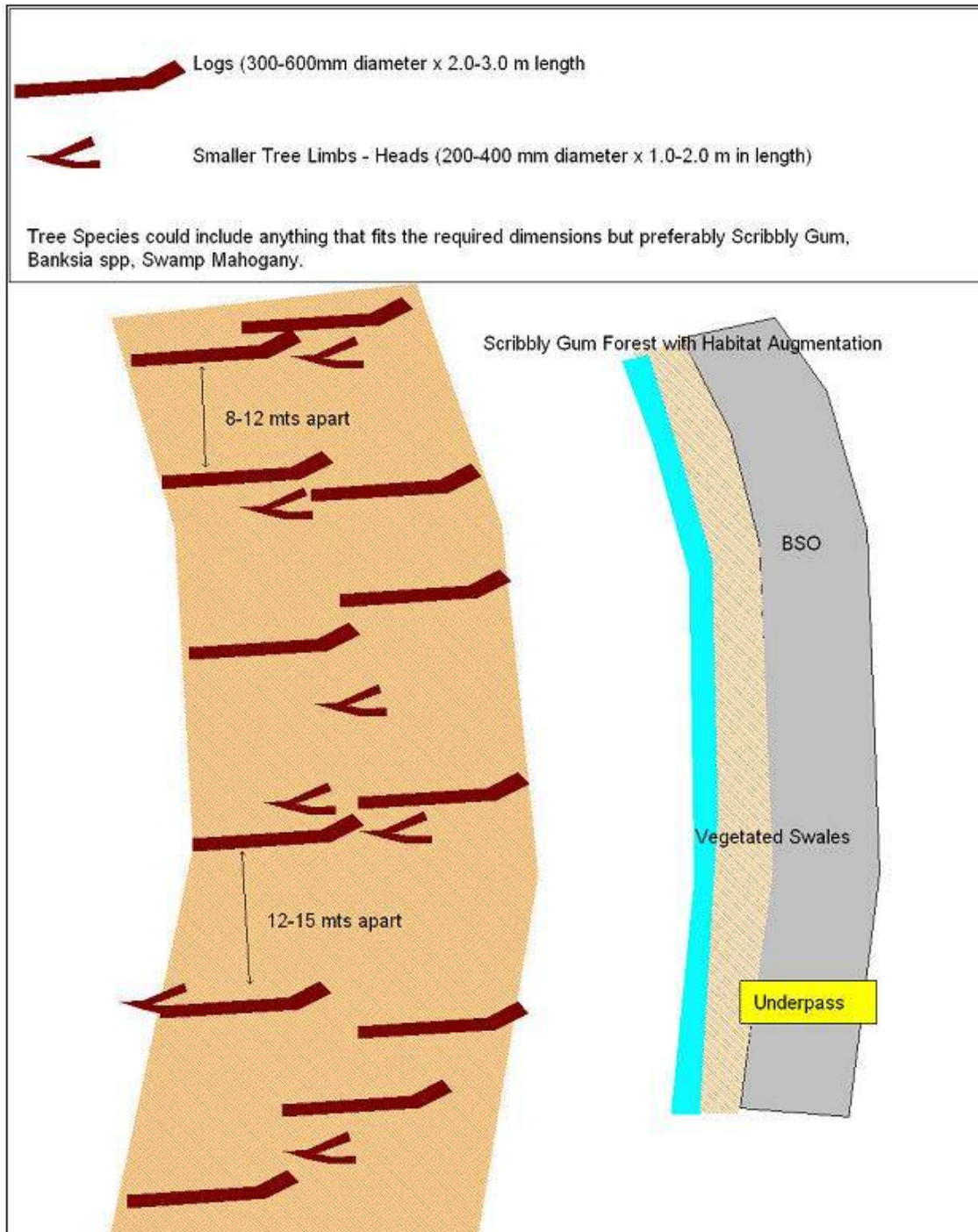


**Jon Alexander**  
Environment and Planning Manager

## Appendix 2 – Habitat Augmentation

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Below is habitat augmentation strategy for the revegetation areas adjacent to Boyd Street Overpass, Boyd Street Extension and Cobaki Parkway. The objective of this is to encourage cover dependant fauna including potoroo into the regeneration areas which will in turn encourage their use of other management actions including culverts. The use of large woody debris (200-600 mm diameter x 1.0-3.0 m) will also discourage the use of these areas by bikes and pedestrians and provide greater definition of maintenance areas to site staff (i.e. not likely to undertake vegetation management works in these areas). The density and arrangement of the material is shown below and allows for 12 logs and 6 tree limbs on either side of the Boyd Street Overpass at intervals of 8-15 m apart. This approach should be adopted for Boyd Street Extension.

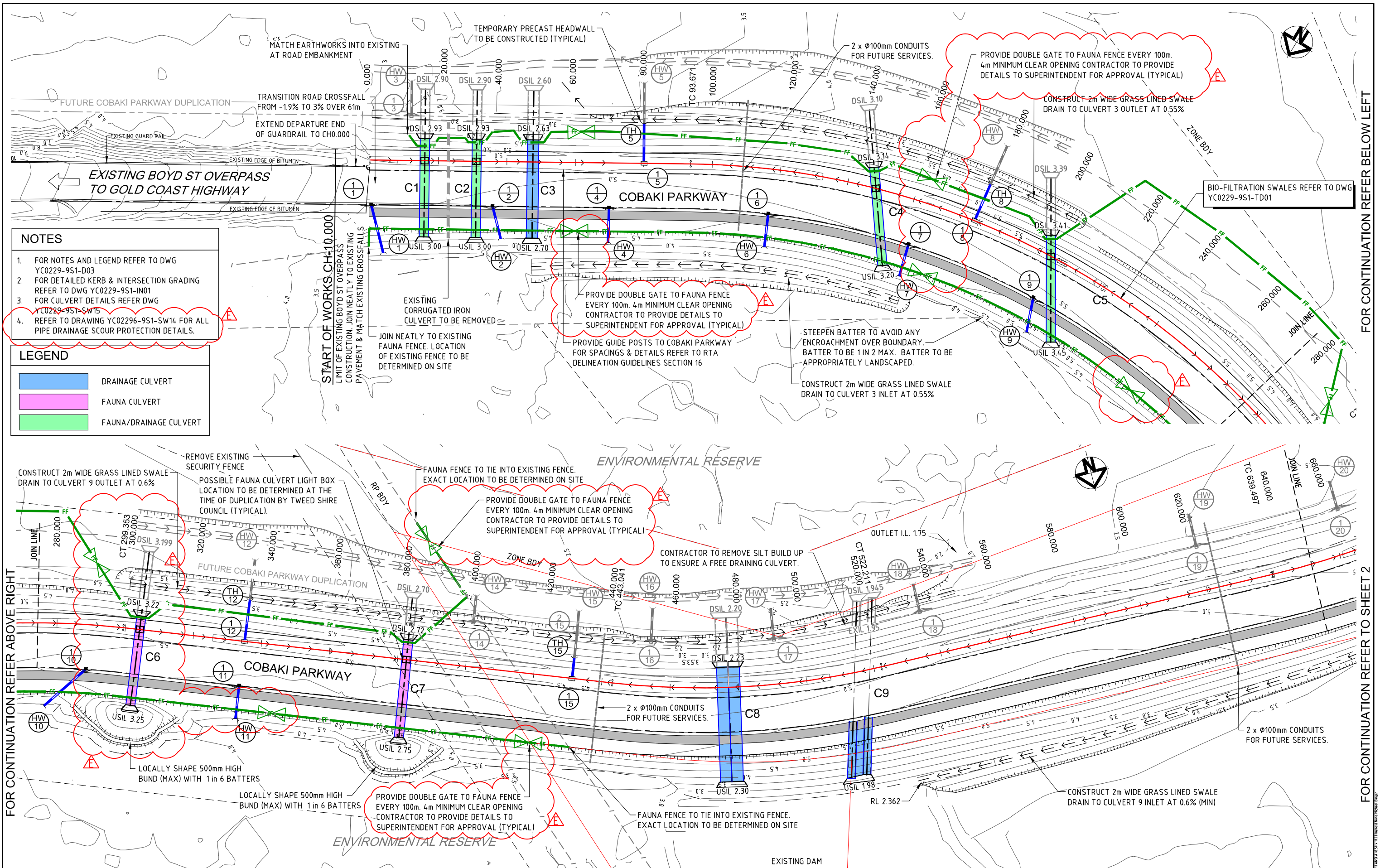



Source: Lewis and Freestone, 2009

## Appendix 3 – Boyd Street Extension and Cobaki Parkway Road Designs

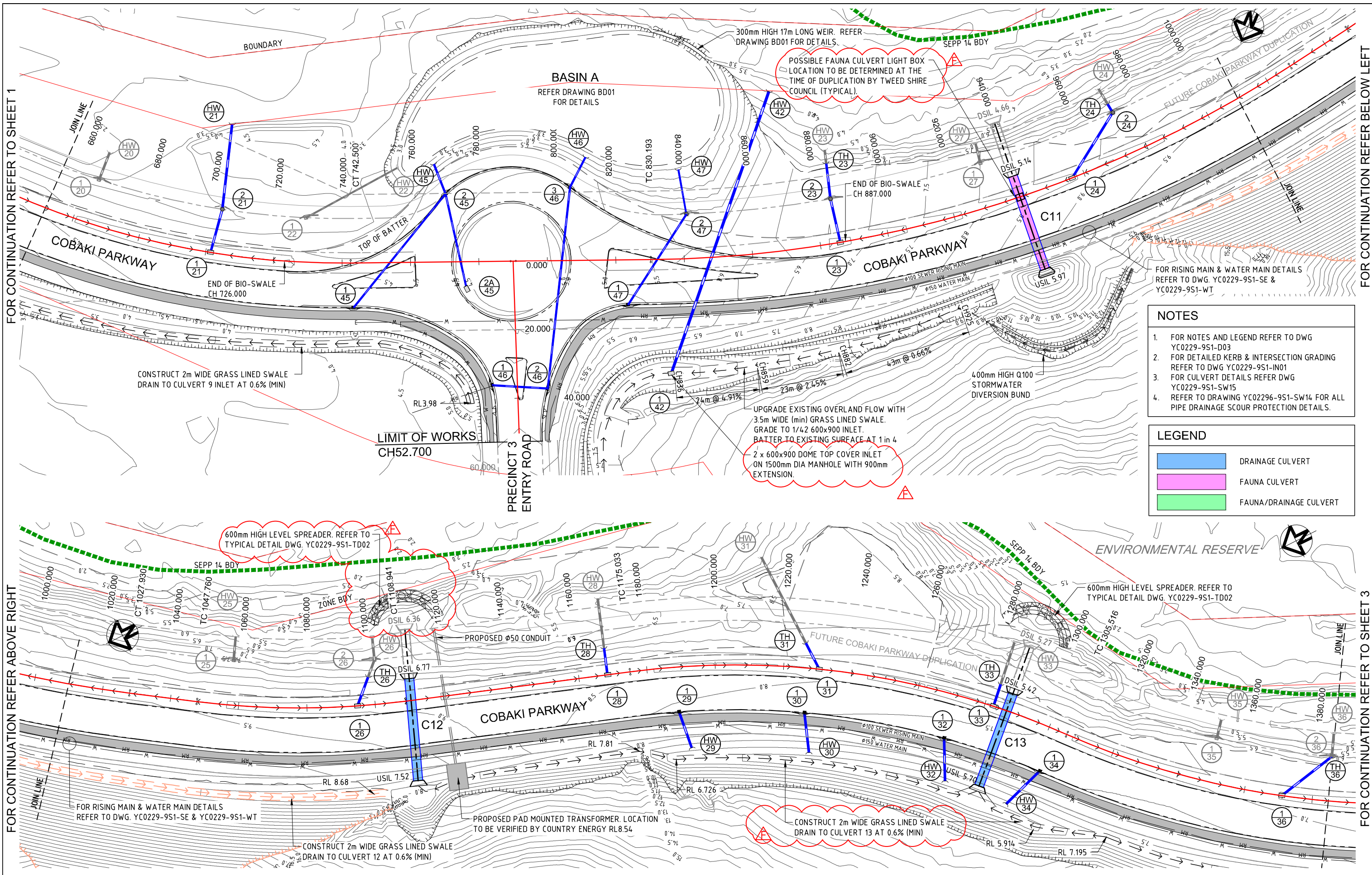
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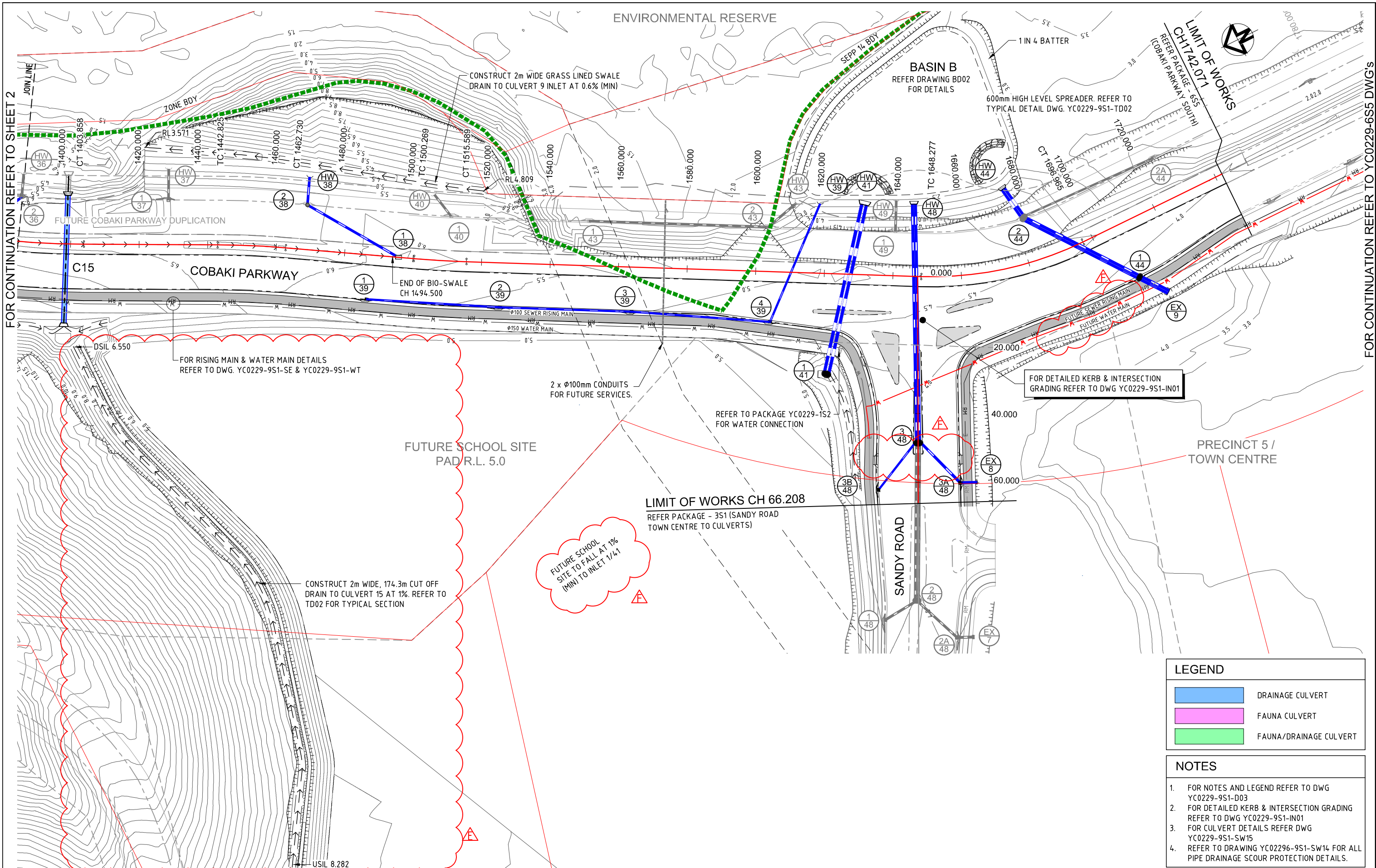
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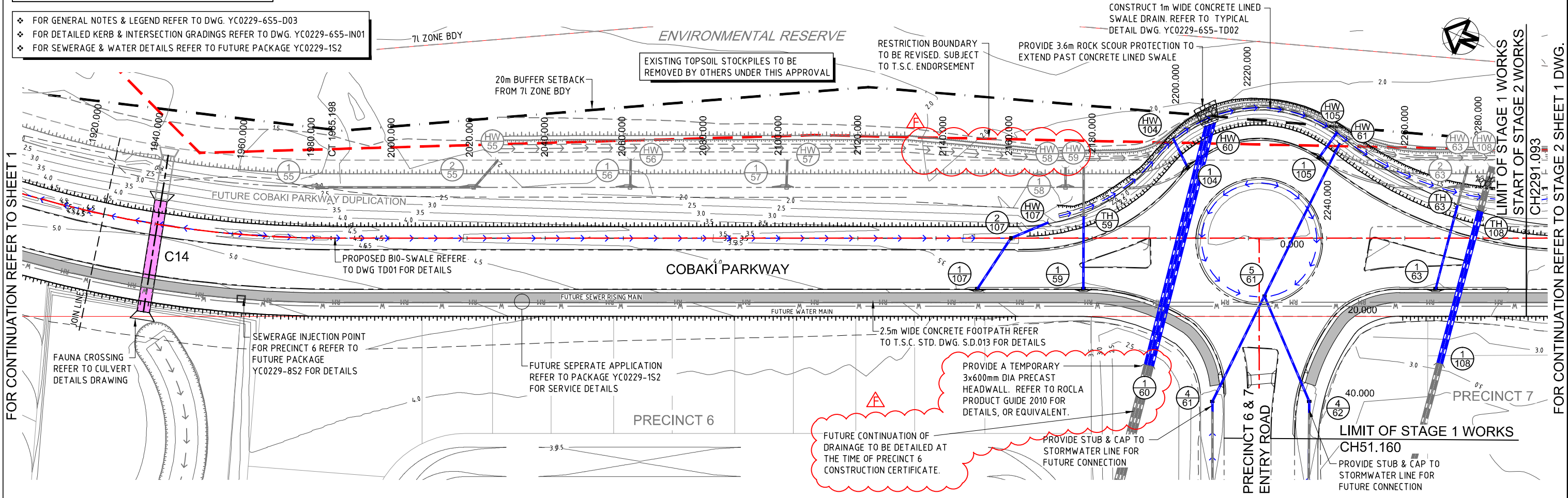
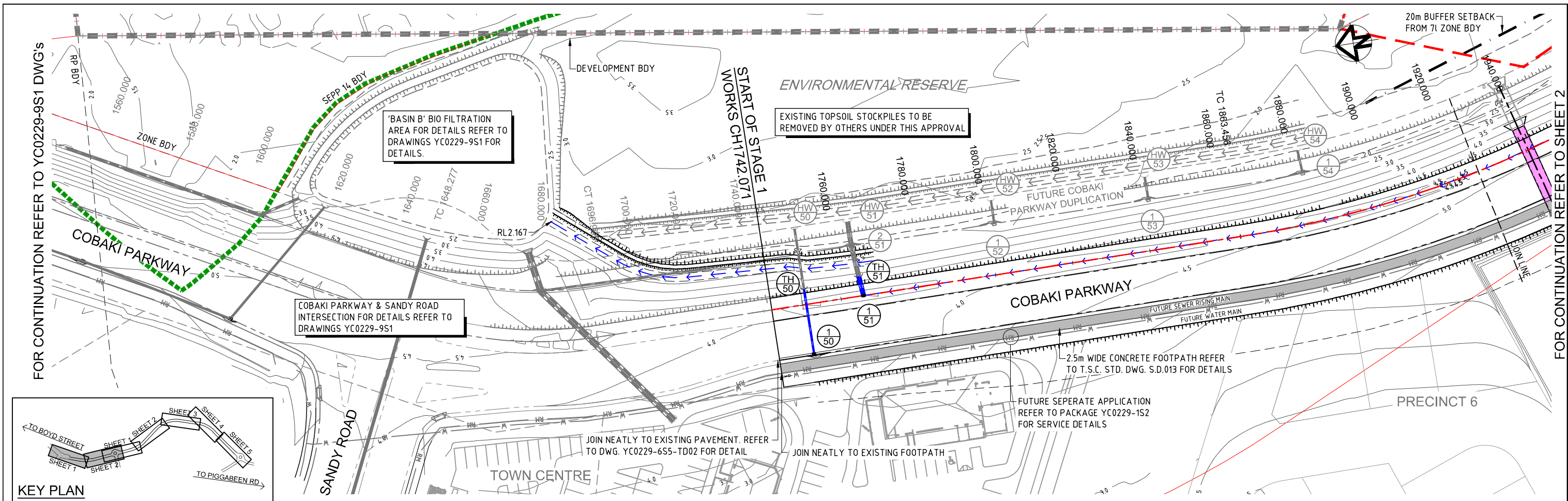
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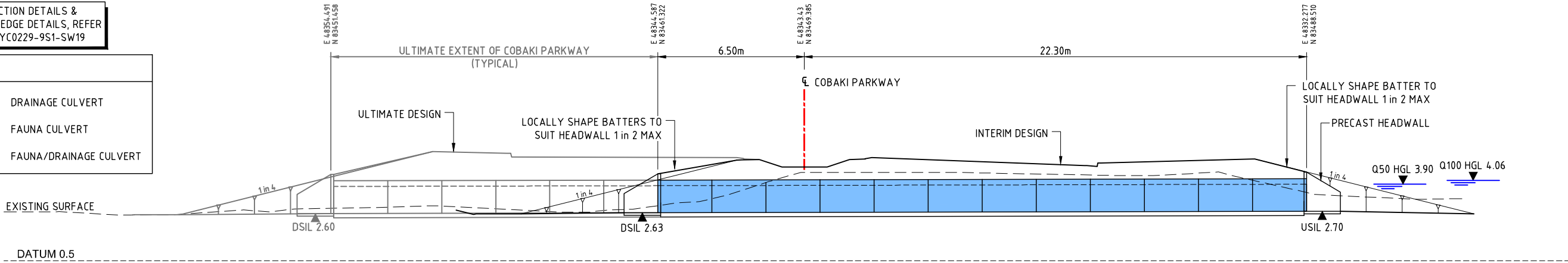
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\* FOR OUTLET PROTECTION DETAILS & FAUNA/DRAINAGE LEDGE DETAILS, REFER TO TABLE ON DWG. YC0229-9S1-SW19

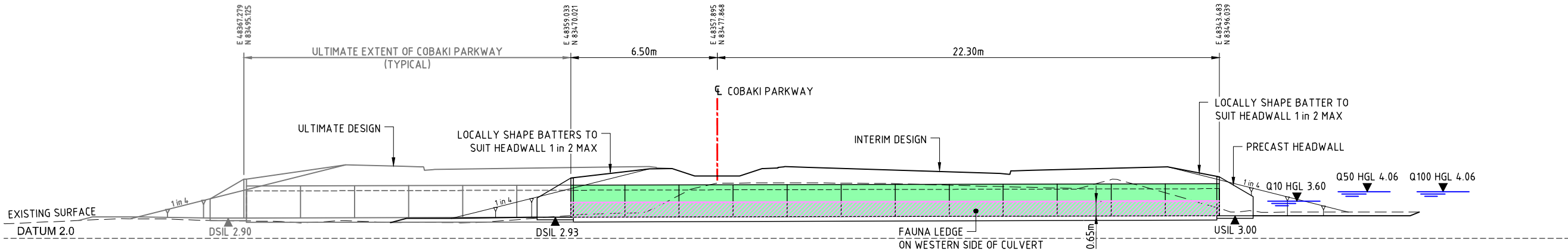
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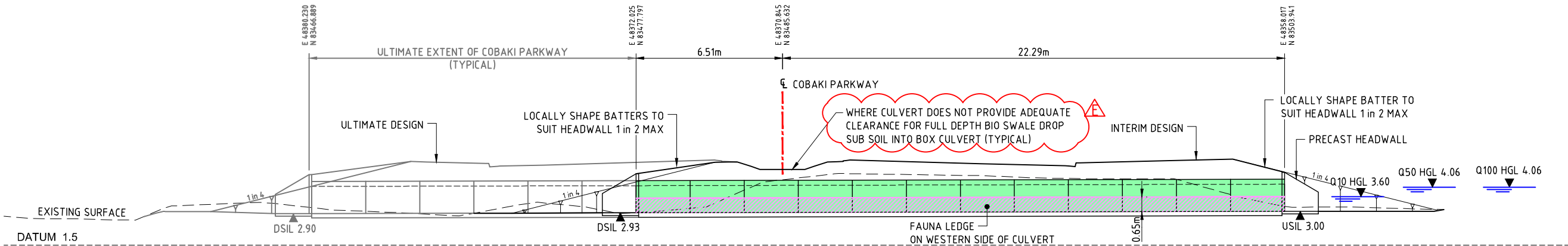
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USIL = 2.70  
DSIL = 2.63  
SKEW = 0° @ CENTRE



CULVERT 2 / 2400mm x 1200mm RCBC CULVERTS

28.8m - (12 LENGTHS @ 2.4m)  
GRADE = 0.24%  
USIL = 3.00  
DSIL = 2.93  
SKEW = 0° @ CENTRE



CULVERT 1 / 2400mm x 1200mm RCBC CULVERTS

28.8m - (12 LENGTHS @ 2.4m)  
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\* FOR OUTLET PROTECTION DETAILS & FAUNA/DRAINAGE LEDGE DETAILS, REFER TO TABLE ON DWG. YC0229-9S1-SW19

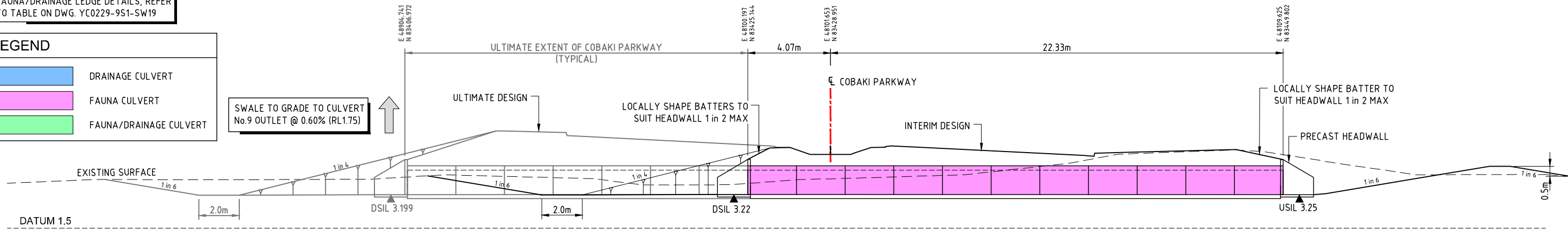
LEGEND

DRAINAGE CULVERT

FAUNA CULVERT

FAUNA/DRAINAGE CULVERT

SWALE TO GRADE TO CULVERT  
No.9 OUTLET @ 0.60% (RL1.75)



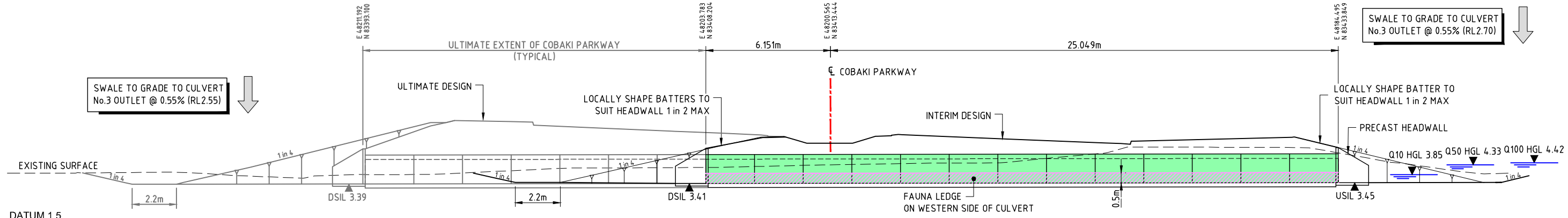
CULVERT 6 / 3000mm x 1200mm RCBC CULVERTS

26.4m - (11 LENGTHS @ 2.4m)  
GRADE = 0.11%  
USIL = 3.20  
DSIL = 3.18  
SKEW = 0° @ CENTRE

FOR OUTLET PROTECTION DETAILS & FAUNA/DRAINAGE LEDGE DETAILS, REFER TO TABLE ON DWG. YC0229-9S1-SW19

SWALE TO GRADE TO CULVERT  
No.3 OUTLET @ 0.55% (RL2.55)

SWALE TO GRADE TO CULVERT  
No.3 OUTLET @ 0.55% (RL2.70)

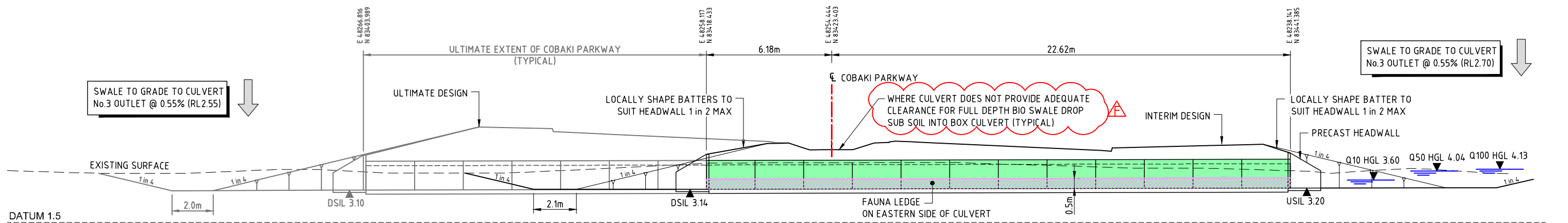


CULVERT 5 / 2400mm x 1200mm RCBC CULVERTS

31.2m - (13 LENGTHS @ 2.4m)  
GRADE = 0.13%  
USIL = 3.45  
DSIL = 3.41  
SKEW = 27°51'04" @ CENTRE

SWALE TO GRADE TO CULVERT  
No.3 OUTLET @ 0.55% (RL2.55)

SWALE TO GRADE TO CULVERT  
No.3 OUTLET @ 0.55% (RL2.70)



CULVERT 4 / 2400mm x 1200mm RCBC CULVERTS

28.8m - (12 LENGTHS @ 2.4m)  
GRADE = 0.21%  
USIL = 3.20  
DSIL = 3.14  
SKEW = 19°07'27" @ CENTRE

STATUS			
CONSTRUCTION ISSUE			
		FOR CONSTRUCTION	
F	SUB SOIL NOTE ADDED	G.S.	15.08.11
E	CULVERT 6 LEVELS AMENDED	G.S.	08.08.11
D	AMENDMENTS FOR COUNCIL APPROVAL	G.S.	26.07.11
C	RESPONSE TO COUNCILS INFORMATION REQUEST	G.S.	23.03.11
B	RESPONSE TO COUNCILS INFORMATION REQUEST	G.S.	25.02.11
A	ORIGINAL ISSUE	G.S.	15.10.10
REV	DESCRIPTION	DRAWN	DATE

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DRAWING IS NOT TO BE SCALED

SCALE (AT ORIGINAL SHEET SIZE)

SCALE 1 0 1 2 3 4 5 1:100

ORIGINAL SHEET SIZE

A1

CLIENT

LEDA MANORSTEAD Pty Ltd

LEDA

PROJECT

COBAKI PARKWAY NORTH  
CONSTRUCTION CERTIFICATE  
COBAKI, TWEED HEADS WEST  
CIVIL ENGINEERING DRAWINGS

YEATS CONSULTING ENGINEERS

LEVEL 1, 193 FERRY ROAD SOUTHPORT QLD 4215 AUSTRALIA  
T 07 5571 2232 F 07 5503 1672 info@yeats.com.au www.yeats.com.au

TITLE

CULVERT DETAILS  
SHEET 2 OF 5

TASK	BY	INITIAL	DATE	APPROVED	RPEQ No	7825
REVIEW	C.S.		15.10.10			
DESIGN	M.B.		15.10.10			
DRAWN	G.S.		15.10.10			

DRAWING NUMBER

YC0229-9S1-SW16

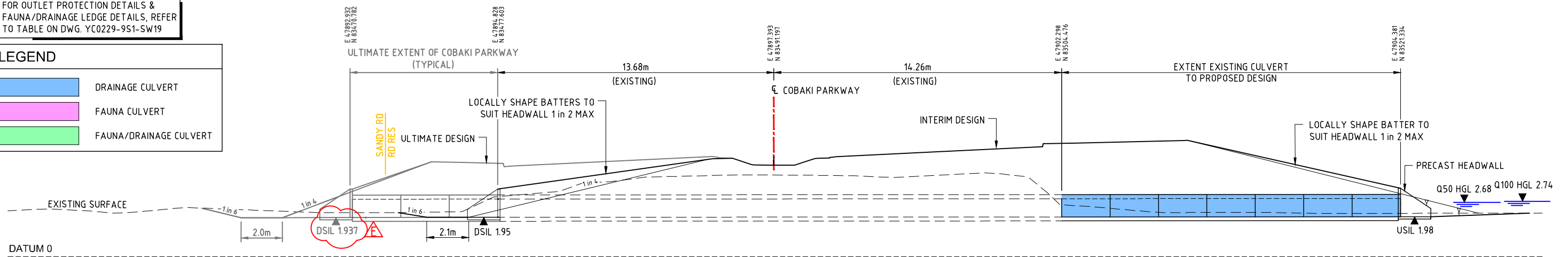
REVISION

F

\* FOR OUTLET PROTECTION DETAILS & FAUNA/DRAINAGE LEDGE DETAILS, REFER TO TABLE ON DWG. YC0229-9S1-SW19

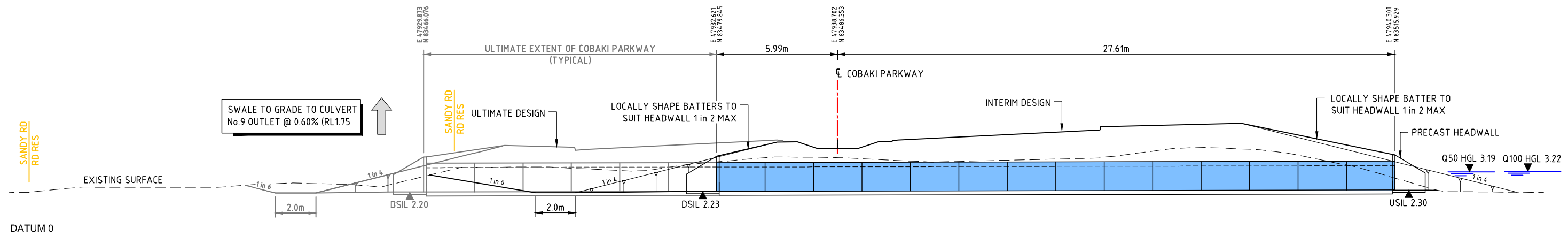
#### LEGEND

<span style="display:inline-block; width:20px; height:10px; background-color:blue; border:1px solid black;"></span>	DRAINAGE CULVERT
<span style="display:inline-block; width:20px; height:10px; background-color:magenta; border:1px solid black;"></span>	FAUNA CULVERT
<span style="display:inline-block; width:20px; height:10px; background-color:green; border:1px solid black;"></span>	FAUNA/DRAINAGE CULVERT



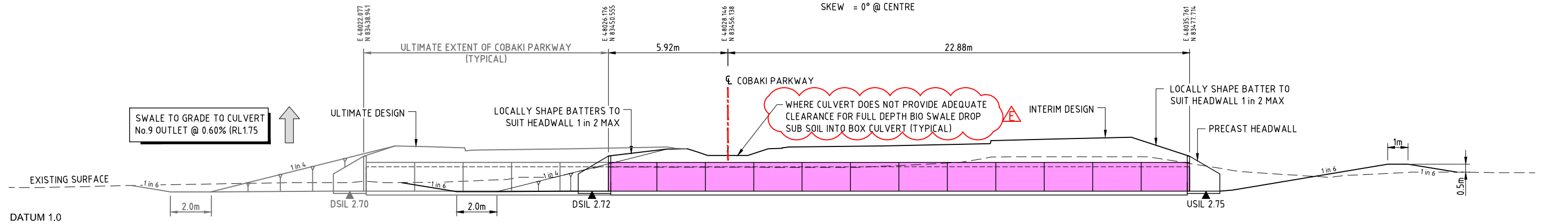
#### CULVERT 9 - 3 / 2100mm x 900mm RCBC CULVERTS

16.8m - (7 LENGTHS @ 2.4m)  
GRADE = 0.18%  
USIL = 1.98  
DSIL = 1.95  
SKEW = 13°31'39" @ CENTRE



#### CULVERT 8 - 2 / 2400 x 1200mm RCBC CULVERTS

33.6m - (14 LENGTHS @ 2.4m)  
GRADE = 0.21%  
USIL = 2.30  
DSIL = 2.23  
SKEW = 0° @ CENTRE



#### CULVERT 7 / 3000mm x 1200mm RCBC CULVERTS

28.8m - (12 LENGTHS @ 2.4m)  
GRADE = 0.10%  
USIL = 2.75  
DSIL = 2.72  
SKEW = 0° @ CENTRE


STATUS			
CONSTRUCTION ISSUE		FOR CONSTRUCTION	
E	SUB SOIL NOTE ADDED & CULVERT 9 ULTIMATE LEVEL AMENDED	G.S.	15.08.11
D	AMENDMENTS FOR COUNCIL APPROVAL	G.S.	26.07.11
C	RESPONSE TO COUNCIL'S INFORMATION REQUEST	G.S.	23.03.11
B	RESPONSE TO COUNCIL'S INFORMATION REQUEST	G.S.	25.02.11
A	ORIGINAL ISSUE	G.S.	15.10.10
REV	DESCRIPTION	DRAWN	DATE

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DRAWING IS NOT TO BE SCALED	
SCALE	(AT ORIGINAL SHEET SIZE)
SCALE	1 0 1 2 3 4 5 1:100
ORIGINAL SHEET SIZE	A1




CLIENT	LEDA MANORSTEAD Pty Ltd
<b>LEDA</b>	

PROJECT	COBAKI PARKWAY NORTH CONSTRUCTION CERTIFICATE COBAKI, TWEED HEADS WEST CIVIL ENGINEERING DRAWINGS
---------	--

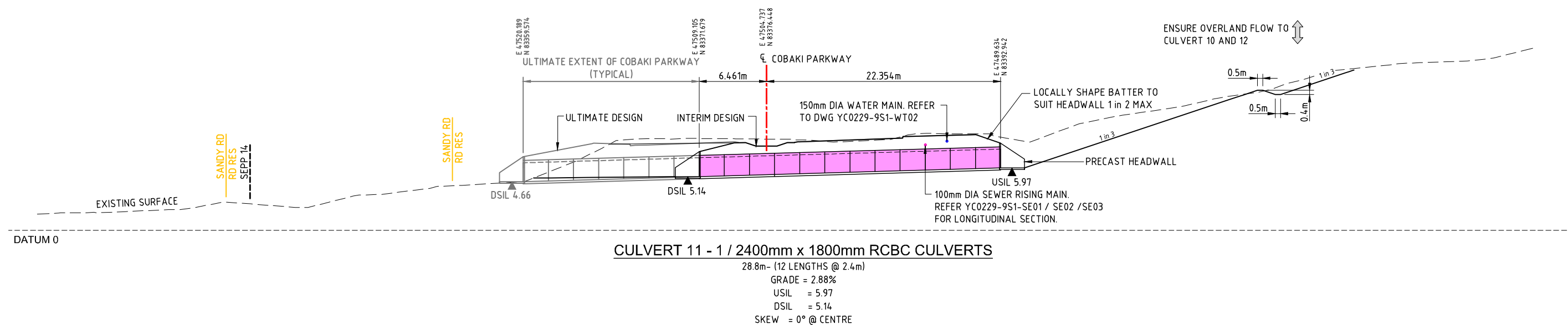
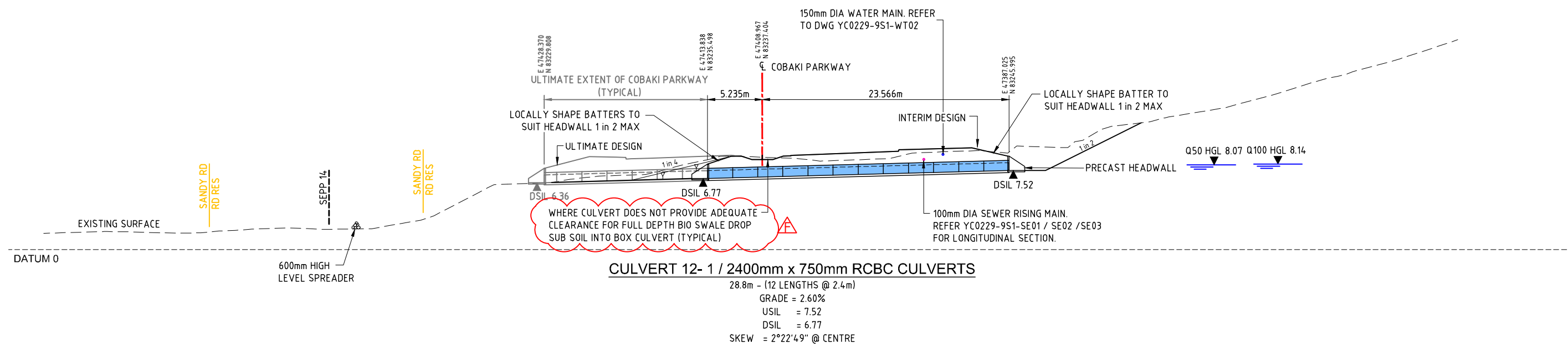
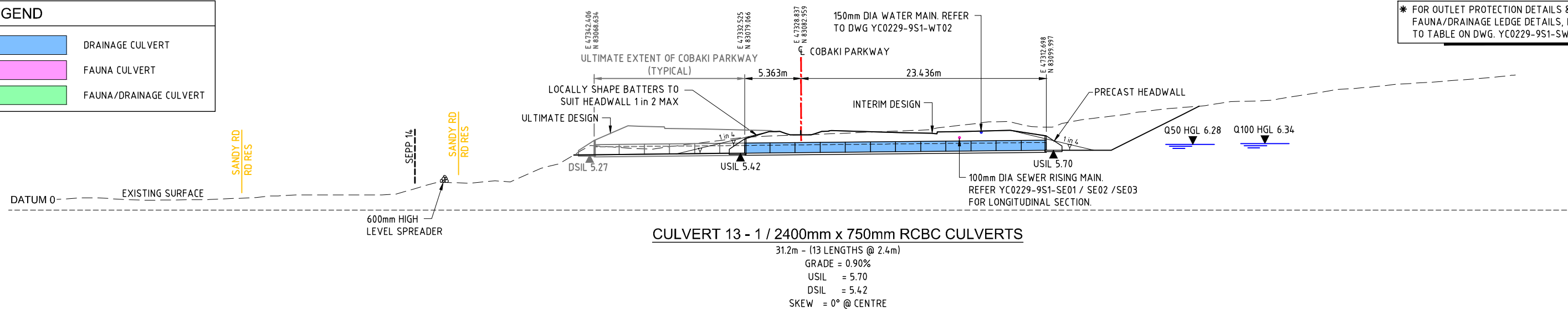
LEVEL 1, 193 FERRY ROAD SOUTHPORT QLD 4215 AUSTRALIA T 07 5571 2232 F 07 5503 1672 info@yeats.com.au www.yeats.com.au

TITLE					
CULVERT DETAILS					
SHEET 3 OF 5					
TASK	BY	INITIAL	DATE	APPROVED	RPEQ No 7825
REVIEW	C.S.		15.10.10		REVISION
DESIGN	M.B.		15.10.10		
DRAWN	G.S.		15.10.10		
DRAWING NUMBER				YC0229-9S1-SW17	
				E	



LEGEND	
	DRAINAGE CULVERT
	FAUNA CULVERT
	FAUNA/DRAINAGE CULVERT

\* FOR OUTLET PROTECTION DETAILS & FAUNA/DRAINAGE LEDGE DETAILS, REFER TO TABLE ON DWG. YC0229-9S1-SW19



STATUS		CONSTRUCTION ISSUE		FOR CONSTRUCTION	
F	SUB SOIL NOTE ADDED	G.S.	15.08.11		
E	GENERAL AMENDMENTS	G.S.	08.08.11		
D	AMENDMENTS FOR COUNCIL APPROVAL	G.S	26.07.11		
C	RESPONSE TO COUNCIL'S INFORMATION REQUEST	G.S	23.03.11		
B	RESPONSE TO COUNCIL'S INFORMATION REQUEST	G.S	25.02.11		
A	ORIGINAL ISSUE	G.S.	15.10.10		
REV	DESCRIPTION	DRAWN	DATE		

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(AT ORIGINAL SHEET SIZE)

SCALE

2 1 0 2 4 6 8 10 1:200

ORIGINAL SHEET SIZE


A1

CLIENT	LEDA MANORSTEAD Pty Ltd
	

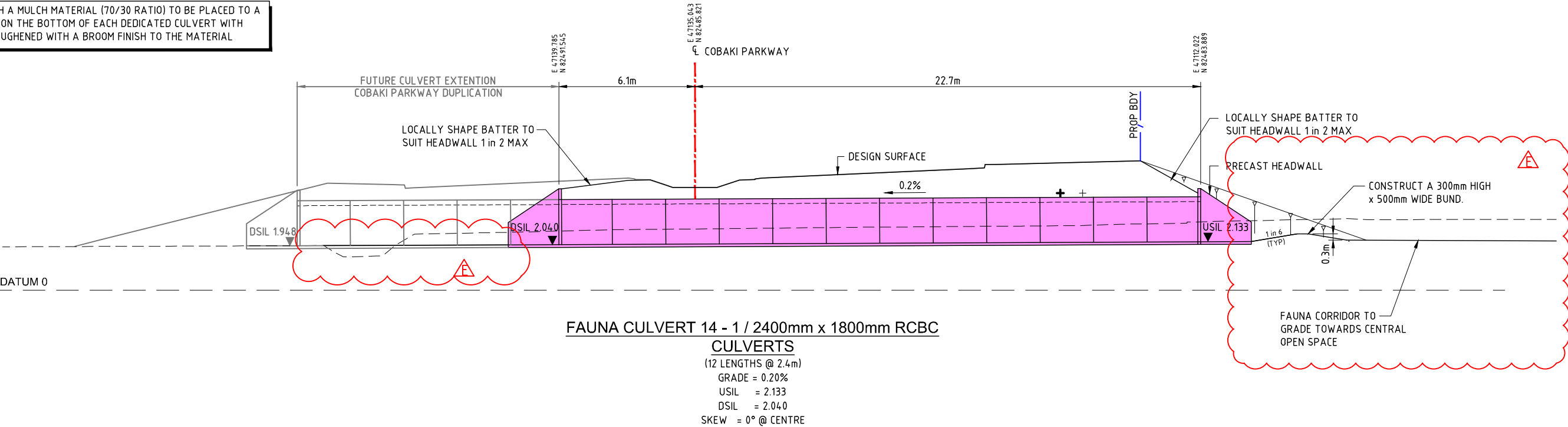
PROJECT

COBAKI PARKWAY NORTH  
CONSTRUCTION CERTIFICATE  
COBAKI, TWEED HEADS WEST  
CIVIL ENGINEERING DRAWINGS



TITLE							
CULVERT DETAILS							
SHEET 4 OF 5							
TASK	BY	INITIAL	DATE	APPROVED	RPEQ No	7825	
REVIEW	C.S.		25.07.10				
					DRAWING NUMBER	REVISION	
DESIGN	M.B.		25.07.10		YC0229-9S1-SW18	F	
DRAWN	G.S.		25.07.10				

♦ SAND MIXED WITH A MULCH MATERIAL (70/30 RATIO) TO BE PLACED TO A DEPTH OF 100mm ON THE BOTTOM OF EACH DEDICATED CULVERT WITH THESE AREAS ROUGHENED WITH A BROOM FINISH TO THE MATERIAL



TENDER DOCUMENTS			
FOR INFORMATION ONLY			
STATUS			
E	COUNCILS INFORMATION REQUEST	G.S.	28.11.11
D	COUNCILS INFORMATION REQUEST	G.S.	16.09.11
C	COUNCILS INFORMATION REQUEST	G.S.	12.08.11
B	RESPONSE TO COUNCILS INFORMATION REQUEST	G.S.	01.04.11
A	ORIGINAL ISSUE	G.S.	15.10.10
REV	DESCRIPTION	DRAWN	DATE

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DRAWING IS NOT TO BE SCALED			
SCALE	(AT ORIGINAL SHEET SIZE)	ORIGINAL SHEET SIZE	
SCALE	1 0 1 2 3 4 5 1:100	A1	

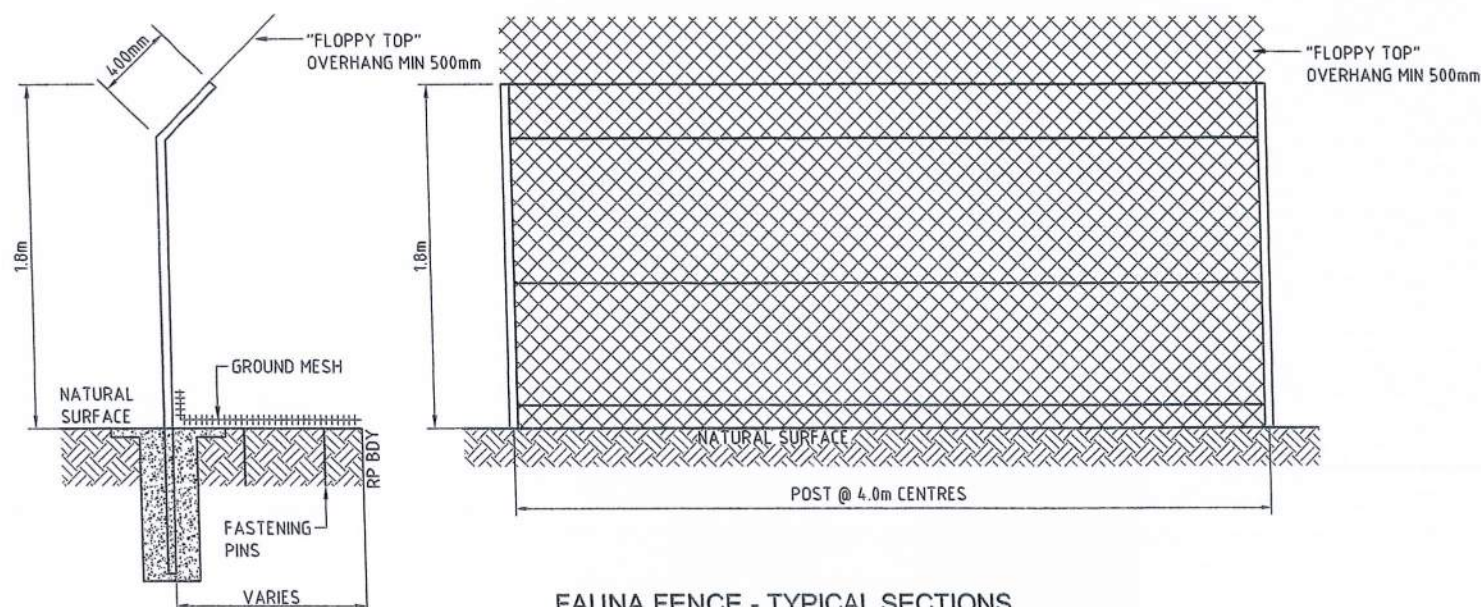
CLIENT	LEDA MANORSTEAD Pty Ltd
	<b>LEDA</b>

PROJECT	COBAKI PARKWAY SOUTH CONSTRUCTION CERTIFICATE COBAKI, TWEED HEADS WEST CIVIL ENGINEERING DRAWINGS
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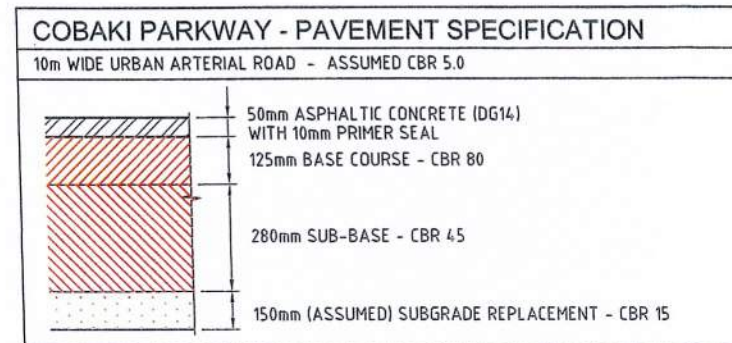
LEVEL 1, 193 FERRY ROAD SOUTHPORT QLD 4215 AUSTRALIA T 07 5571 2232 F 07 5503 1672 info@yeats.com.au www.yeats.com.au

TITLE CULVERT DETAILS					
TASK	BY	INITIAL	DATE	APPROVED	RPEQ No 7825
REVIEW	C.S.		15.10.10		
DESIGN	M.B.		15.10.10		
DRAWN	G.S.		15.10.10		
DRAWING NUMBER YC0229-6S5-SW16				REVISION E	

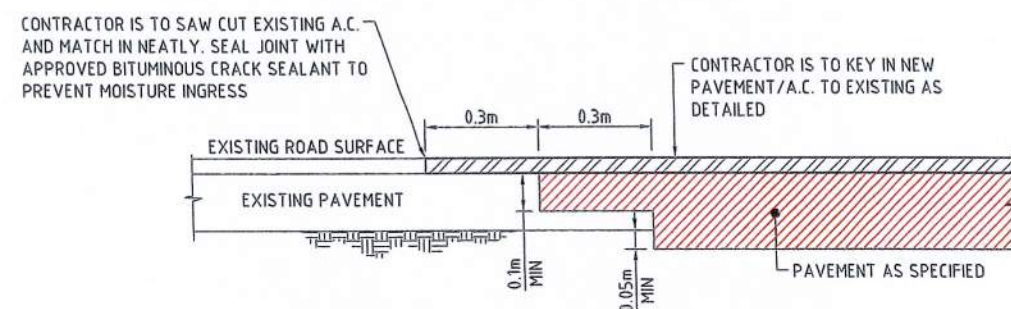




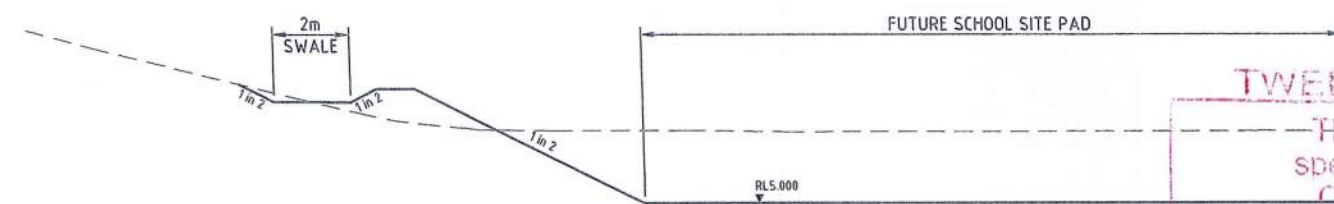
**FAUNA FENCE - TYPICAL SECTIONS**  
SCALE 1:20



**NOTE:**  
ROAD PAVEMENT LAYER DEPTHS ARE SUBJECT TO (4 DAY SOAKED) SUBGRADE CBR TESTING

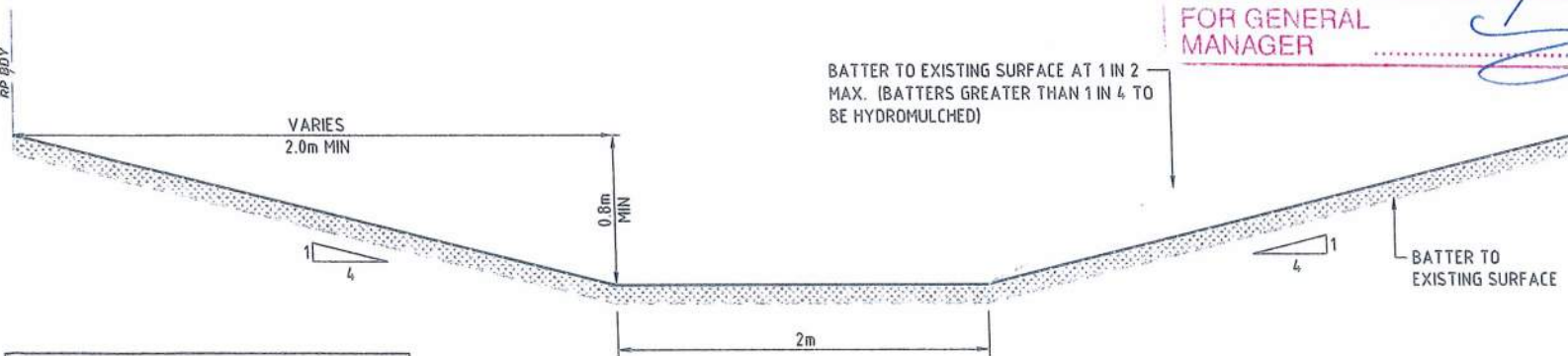


**TYPICAL DETAIL**  
**SHOWING LONGITUDINAL CONSTRUCTION DETAIL**  
**FOR CONNECTION TO EXISTING PAVEMENT/A.C.**  
N.T.S.



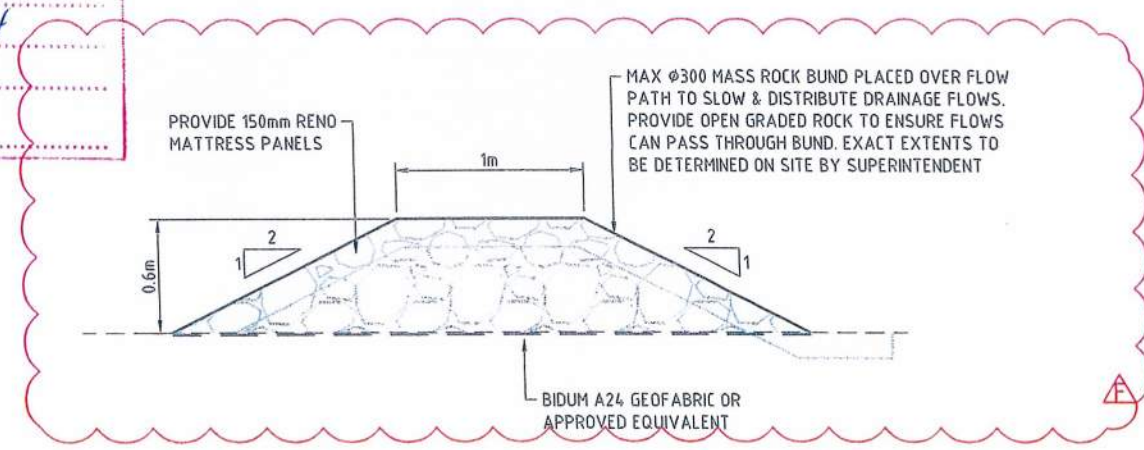
**TYPICAL SECTION**  
**SCHOOL SITE CUT OFF DRAIN**  
SCALE 1:100

**TWEED SHIRE COUNCIL**  
These are the plans and specifications referred to in Construction Certificate  
No. CC08/0800.01  
DATE ISSUED 18/08/11  
FILE No. 654/94/194  
CONSENT No. 94/0194  
FOR GENERAL MANAGER



**TYPICAL SECTION**  
**GRASS LINED SWALE**  
SCALE 1:20

**NOTE**  
ALL SWALES LESS THAN 0.5% AND GREATER THAN 5% ARE TO BE CONCRETE LINED.



**TYPICAL DETAIL**  
**LEVEL SPREADER**  
SCALE 1:20

**RECEIVED**  
**16 SEP 2011**  
BY: \_\_\_\_\_

STATUS: COUNCIL SUBMISSION				FOR APPROVAL		THIS DESIGN AND PLAN IS COPYRIGHT AND IS NOT TO BE USED OR REPRODUCED WHOLLY OR IN PART OR TO BE USED ON ANY PROJECT WITHOUT THE WRITTEN PERMISSION OF YEATS CONSULTING PTY LTD				CLIENT		PROJECT		TITLE		
F	SUB SOIL & SWALE NOTE ADDED			G.S.	15.08.11	DRAWING IS NOT TO BE SCALED				LEDA MANORSTEAD Pty Ltd		COBAKI PARKWAY NORTH CONSTRUCTION CERTIFICATE COBAKI, TWEED HEADS WEST CIVIL ENGINEERING DRAWINGS		TYPICAL DETAILS		
E	CUT OFF DRAIN SECTION & NOTE ADDED			G.S.	08.08.11											
D	AMENDMENTS FOR COUNCIL APPROVAL			G.S.	26.07.11	SCALE (AT ORIGINAL SHEET SIZE)		ORIGINAL SHEET SIZE		LED A		YEATS CONSULTING ENGINEERS		LEVEL 1, 103 FERRY ROAD SOUTHPORT QLD 4215 AUSTRALIA T 07 5571 2232 F 07 5503 1672 info@yeats.com.au www.yeats.com.au		
C	RESPONSE TO COUNCILS INFORMATION REQUEST			G.S.	23.03.11											
B	RESPONSE TO COUNCILS INFORMATION REQUEST			G.S.	25.02.11	AS SHOWN		A1						TASK BY INITIAL DATE APPROVED RPEO No 7825		
A	ORIGINAL ISSUE			G.S.	15.10.10											
REV	DESCRIPTION			DRAWN	DATE									DRAWING NUMBER REVISION		
															YC0229-9S1- TD02 F	



## Appendix 4 – Road Kill Transect Proforma

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A – Boyd Street; Pacific Highway North (north of Boyd Street Overpass) and Pacific Highway South (south of Boyd Street Overpass).

B – Non-flying Mammal, Flying Mammal, Bird, Frog, Reptile.

C - 1 = past 12 hrs 2 = 12-72 hrs 3 = >72 hrs.

Date		Location <sup>A</sup>		Start Time		Finish Time		
Animal No.	Easting	Northing	Vertebrate Group <sup>B</sup>	Species	Sex (m/ f/ u)	Age (a, s/ a, u)	~ Time Dead (1,2,3 <sup>C</sup> )	Comments
1								
2								
3								
4								
5								
6								
7								
8								
9								
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