

14.0 DRAINAGE MAINTENANCE MANAGEMENT PLAN – GILBERT & STHERLAND, JULY 2012

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SYNOPSIS This management plan establishes responsibilities and procedures for the management of drainage maintenance during Stage 1 of the Kings Forest Development, New South Wales.

REVISION HISTORY

REVISION #	DATE	EDITION BY	APPROVED BY	FILE NAME
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SUMMARY

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Drainage Maintenance Management Plan (DMMP) for the Kings Forest Stage 1 Project Application. This DMMP considers the findings of investigations conducted by G&S which are incorporated in the *Kings Forest Stage 1 Project Application Drainage Maintenance Impact Assessment* (July 2012) produced for Project 28 Pty Ltd by G&S (the “DMIA report”).

The DMIA report identifies several potential impacts associated with drainage maintenance works including; hydrological impacts, the disturbance of acid sulfate soils, water quality impacts, erosion and sedimentation and impacts to flora and fauna, triggering the need for a DMMP.

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised):

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;

- The Plan of Development for Precinct 5.

Based on historical need, it is estimated that Blacks Creek would only require maintenance once every ten years to retain the existing hydraulic capacity. Reduced hydraulic capacity is allowed for in the flood modelling, which provides for a reduced maintenance regime. This DMMP is designed to ensure that all drainage maintenance conducted at the Kings Forest development site is conducted in accordance with proven management techniques. The DMMP provides a clear management protocol based on operational policies, performance criteria, implementation strategies and corrective actions, should they be necessary. The DMMP identifies who is responsible for each specific aspect of drainage maintenance management.

The DMMP provides a working tabular format with provision for amendment if required.

This revised report addresses the amendments to the project and the key issues raised in the submissions.

Response to Submissions

Submitter: Department of Planning and Infrastructure

Issue: Drainage maintenance and impacts to threatened species

Response: The DMMP has been revised removing the need for weed spraying or the removal of snags.

Submitter: Tweed Shire Council

Issue: Reporting requirements

Response: Council have been added to the reporting requirements where water quality non-conformances are identified.

Submitter: Tweed Shire Council

Issue: Fish passage

Response: Culvert and causeways will be maintained in accordance with NSW Fisheries *'Why do Fish Need to Cross the Road?'*¹

¹ Fairfull, S. & Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla.

Submitter: NSW EPA

Issue: Scope of proposed works and potential impacts

Response: The DMMP has been revised removing the need for weed spraying or the removal of snags. The disposal of sediment spoil is addressed In Table 14.4.3. Existing roads will be used to access Blacks Creek for mechanical maintenance (Table 14.4.1).

Submitter: Fisheries NSW

Issue: Policy for dredging and reclamation

Response: Mechanical maintenance would be conducted in stages to minimise disturbance to aquatic species. Disturbance of deeper holes, snags and gravel bars would be avoided as per Table 14.4.1.

Submitter: Fisheries NSW

Issue: Policy for minimising water pollution

Response: The spraying of waterways to remove aquatic weeds has been removed from the DMMP.

Submitter: Fisheries NSW

Issue: Policy for snag (large woody debris) management

Response: The removal of snags has been removed from the DMMP.

Submitter: Fisheries NSW

Issue: Consideration of the *Tweed Coast Estuaries Management Plan, 2004-2008*, May 2004 (TCEMP).

Response: As per recommendations in the TCEMP;

- On-going water quality monitoring will be conducted at the locations shown on Drawing No. 10927.1.1 of the *Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan* (G&S 2012).
- Riparian vegetation to be retained adjacent to Blacks Creek as shown on Drawing 10468.4.1 of the *Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan* (G&S 2012).
- Minimum core riparian zone widths will be adhered to as outlined in the NSW Office of Water's '*Guidelines for riparian corridors on waterfront land*'.

Submitter: NSW Office of Water

Issue: Removal of snags be deleted from any management plan

Response: The removal of snags is no longer proposed under the DMMP

Submitter: NSW Office of Water

Issue: Consideration of the NSW Office of Water's '*Guidelines for riparian corridors on waterfront land*' (July 2012)

Response: The DMMP has been amended to include the minimum core riparian zone widths outlined in the NSW Office of Water's '*Guidelines for riparian corridors on waterfront land*'.

Submitter: NSW Office of Water

Issue: Impacts of on-going routine drainage maintenance

Response: The DMMP has been revised removing the need for weed spraying or the removal of snags to ensure Blacks Creek is managed as a functioning waterway.

Submitter: NSW Office of Water

Issue: Surface water quality monitoring parameters

Response: The water quality monitoring parameters (Table 14.4.4) have been expanded to include those listed by the NSW Office of Water.

The implementation table included in the front of this management plan details the actions, responsibilities and performance criteria upon which monitoring and auditing may be implemented.

Kings Forest, Stage 1 - Summary and Implementation Table, Drainage Maintenance Management Plan

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
DMMP 1	Mechanical drainage maintenance	Existing access roads on Blacks Creek	To minimise soil disturbance during the mechanical removal of sediment from Blacks Creek	As necessary (approximately once every ten years)	Contractor's Site Manager, Environmental Consultant	Drain maintenance operations should aim to minimise physical drain disturbance during sediment removal	Visual inspections of bank stability and vegetation root stock during drain maintenance works. Records of sedimentation, flooding, water quality and aquatic species mortality will be retained on site	Table 14.4.1
DMMP 2	Acid sulfate soil treatment	Blacks Creek	No acid sulfate drain spoil is to be disturbed or excavated without appropriate treatment	In conjunction with drain maintenance	Contractor's Site Manager, Environmental Consultant	All material excavated from drains to be limed at prescribed rate before stockpiling	Records of lime delivery and calculated liming rates to be kept on site during maintenance operations and available for inspection at all times	Table 14.4.2
DMMP 3	Sediment and erosion control	Blacks Creek	To prevent the displacement of sediment and soil from drains particularly during storm events	Visual inspections following rainfall events (>25mm in 24hrs)	Consulting Engineer, Contractor's Site Manager	Minimise erosion and the resultant turbidity of discharge waters	Reporting to TSC, only required if insufficient sediment and erosion measures are identified	Table 14.4.3
DMMP 4	Surface water quality management	Drawing No. 10927.1.1 of the Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan (G&S 2012)	To prevent adverse impacts to surface water quality in the downstream receiving environment	Daily in situ testing and weekly collection of samples for laboratory analysis during drain maintenance works	Contractor's Site Manager	Surface water quality downstream of sediment and erosion control measures to comply with Table 14.4.4.	- Results to be recorded and kept onsite - TSC to be notified immediately of breaches. - Water quality reports to be provided to TSC or DECCW upon request	Table 14.4.4

14.1 Introduction

14.1.1 Background

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Drainage Maintenance Management Plan (DMMP) for the Stage 1 Project Application for the proposed Kings Forest development at Kings Forest, New South Wales.

The Director General of the Department of Planning issued amended Environmental Assessment Requirements (DGRs) for the project application on 23 December 2010. The DGRs require that specialist advice be provided to address the following Key Issue:

Key Issue 7.6: Assess the necessity of drains currently in operation across the site and, for those required into the future, assess the impact of any ongoing maintenance required to ensure their effectiveness.

The DMIA report identifies several potential impacts associated with drainage maintenance works including; hydrological impacts, the disturbance of acid sulfate soils, water quality impacts, erosion and sedimentation and impacts to flora and fauna.

The identification of these issues necessitates the production of a DMMP. This management plan has taken in to consideration the NSW Office of Water's 'Guidelines for riparian corridors on waterfront land' (July 2012).

14.1.2 The project application

The Kings Forest Development site covers approximately 870 hectares and is situated south-west of the town of Cudgen. The Kings Forest development will require excavation works. Proposed lake excavations will be to a depth of greater than 4.5m below Natural Surface Level (NSL), whilst the majority of other required excavation at the site will be less than 2m below

NSL. The Kings Forest Stage 1 Project Application proposes earthworks across the site involving total cut volumes of approximately 1,731,012m³, total fill volumes of approximately 1,833,254m³ and approximately 361,894m³ of imported fill.

The Project Application incorporates the following elements:

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

14.1.3 Objectives

This report constitutes a DMMP for the Stage 1 Project Application for the Kings Forest development. The aim of this report is to detail strategies to mitigate the potential environmental impacts associated with the ongoing maintenance of Blacks Creek at the Kings Forest site in terms of:

- hydrological impacts
- disturbance of acid sulfate soils
- surface water quality impacts
- erosion and sedimentation
- impacts to flora and fauna.

14.2 Site drainage

Drainage at Kings Forest has been studied by several previous investigations. The site drainage network was the subject of a report by Phillip Bell & Partners (Kings Forest Stormwater Management Plan, 2001). The drainage system ranges from natural, largely unmodified waterways to minor overland flow paths.

The site is located within the Cudgen Creek catchment and is predominantly drained in an easterly direction by Blacks Creek. Runoff from the site also enters Cudgen Creek under Old Bogangar Road to the north of the site and via the lowlands adjacent to the southern site boundary.

Drainage from the north-eastern portion of the site flows into a State Environmental Planning Policy No. 14 (SEPP14) wetland area prior to discharging from the Kings Forest site. There is no statutory definition that can be applied for the classification of a SEPP 14 wetland.

Determination of SEPP 14 wetlands was undertaken as a mapping exercise, based upon a set of *'botanical indicators, which were deemed, for the purposes of the survey, to characterise wetlands'* (Adam et al., 1985, p. 28).

14.2.1 Drainage maintenance

The flood modelling conducted previously for the site assumed that only Blacks Creek would be maintained to minimise potential build up of sediment and growth of vegetation within and across the channel.

In response to submissions received, the management regime has been modified and the flood modelling has been revised to reflect a much less intrusive management regime, which would not involve clearing or trimming of vegetation or the removal or realignment of snags. However, it may be necessary to address sedimentation within the drain at some time in the future and this management plan provides appropriate management techniques to minimise potential impacts associated with any necessary maintenance activity within Blacks Creek.

All other drains are modelled as not maintained. The resolution of the model is such that the drainage function of the minor drains has been disregarded by the model, so the maintenance of these drains is not required to achieve the level of flood immunity predicted for the developed site.

Black's Creek may need to be maintained to provide adequate drainage for the site and to ensure appropriate flood conveyance. The likely frequency of disturbance would be low (approximately once every ten years) however, necessary maintenance works could potentially result in hydrological impacts, the disturbance of acid sulfate soils, water quality impacts, erosion and sedimentation, impacts to flora and fauna.

The following sections detail the management measures for the management of potential impacts associated with drainage maintenance works.

14.3 DMMP structure

This DMMP acknowledges the potential environmental impacts associated with any future drainage maintenance required at the Kings Forest site, and details strategies to mitigate them.

Each control strategy is based upon proven environmental management methods and is presented as a commitment. The commitments made within this document will form the basis of future assessments, which will be made available to the Tweed Shire Council (TSC) for review.

The DMMP is based on a series of tables for use during drainage maintenance. The person responsible for the implementation of the measures detailed is written on the table itself. The tables then detail the issue, the performance criteria, the implementation strategy, monitoring, auditing, reporting, failure identification and the corrective action. The detachable pages within each section detail the provisions of the DMMP. The format is presented below for reference purposes.

Title

Person responsible	This is the person who has accepted the responsibility of implementing the DMMP provisions detailed on this page.
Issue	The issue with which the table deals.
Operational policy	The operational policy or management objective that applies to the element.
Performance criteria	Performance criteria (outcomes) for each element of the operation.
Implementation strategy	The strategies or tasks (to nominated operational design standards) that will be implemented to achieve the performance criteria.
Monitoring	The monitoring requirements which will measure actual performance (i.e. specified limits to pre-selected indicators of change).
Auditing	The auditing requirements, which will verify implementation of, agreed construction and operation phase environmental management strategies and compliance with agreed performance criteria.
Reporting	Content, timing and responsibility for reporting and auditing of monitoring results.
Identification of incident or failure	The circumstances under which the agreed performance criteria are unlikely to be met and the risk of environmental harm increases dramatically.
Corrective action	The action to be implemented in case a performance requirement is not reached and the person(s) / company(s) responsible for action.

Commitment #

What the management has committed the company to.

An objective of the tabular format is to allow for change and allow the DMMP to be a working document. If items need altering, changes may be made to the individual tables after appropriate consultation with the statutory authorities.

14.3.1 General commitments

Commitment 1

The Developer undertakes to comply with the environmental implementation strategy as contained within the approved Drainage Maintenance Management Plan (DMMP).

Commitment 2

The Developer undertakes to fulfil all commitments made in this DMMP and to carry out its activities on the project site in accordance with relevant current statutory requirements and approved amendments.

14.3.2 Definitions

In this DMMP the terms have the following meanings;

- ASS means Acid Sulfate Soils. This is the collective term for both Actual Acid Sulfate Soils and Potential Acid Sulfate Soils.
- Maintenance means the removal of accumulated sediment from Blacks Creek for the purposes of maintaining conveyance.
- Developer means the party undertaking the development of the land and includes the person nominated as having the responsibility for implementing the provisions of the DMMP.
- Development means the development of the site as defined in this Project Application and future project applications.
- DECCW means the NSW Department of Environment, Climate Change and Water.
- DMMP means the approved Drainage Maintenance Management Plan and includes any amendments that may be approved from time to time.
- POEO Act means the NSW Protection of the Environment Operations Act, 1997.
- Sediment means unconsolidated, fine-grained material (typically derived from the weathering of rocks), that is transported by water and settles on the floor of seas, rivers streams and other bodies of water.
- Silt means sediment having particles finer than sand and coarser than clay (i.e. 2 to 63µm).
- Suspended solids means the concentration of filterable particles in water (retained on a 1.2µm filter) and reported by volume (mg/L).
- TSC means the Tweed Shire Council.
- Turbidity means a measure of the cloudiness of water, which is determined by the amount of light scattered by suspended particles.

14.4 Management of potential impacts – Maintenance phase

The DMMP requires the Developer to mitigate the potential environmental impacts associated with the maintenance of Blacks Creek.

During drain maintenance activities, a visual inspection of water quality within the drain is to be conducted to ensure waters are not excessively turbid or discoloured and that no degradation to flora or fauna has occurred.

14.4.1 Mechanical maintenance

Person responsible	Contractor's Site Manager, Environmental Consultant
Issue	Mechanical maintenance and control of sedimentation in Blacks Creek.
Operational policy	To minimise soil disturbance during the mechanical removal of sediment from Blacks Creek.
Performance criteria	Drain maintenance operations should aim to minimise physical drain disturbance during sediment removal.
Implementation strategy	- To ensure existing roads are used to access Blacks Creek for mechanical maintenance (e.g. excavator, sucker trucks). - Conduct mechanical maintenance in stages to minimise disturbance to aquatic species. - To ensure the disturbance of deeper holes, snags and gravel bars is avoided during any necessary maintenance works. - To ensure the minimum core riparian zone widths outlined in the NSW Office of Water's <i>'Guidelines for riparian corridors on waterfront land'</i> (July 2012) are maintained or established. - To control sediment and acid generation, drain maintenance operations should not be conducted during runoff events. - Drain maintenance should not enlarge or alter the original drain profile. - Drain maintenance operations should aim to maintain drain stability by minimising disturbance to vegetation root stock. - To ensure any sediment that is removed is treated in accordance with Table 14.4.2 and disposed of in an appropriate manner, which will not enable it to become re-entrained in surface flows. - Culverts and causeways should be maintained in accordance with NSW Fisheries <i>'Why do Fish Need to Cross the Road?'</i>²

² Fairfull, S. & Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla

Monitoring	• Carry out visual inspections during drain maintenance to ensure there has been minimal disturbance to the drain profile. • Visually inspect bank stability and vegetation root stock to ensure it is not excessively disturbed by drain maintenance operations.
Auditing	• Visual inspections are to be carried out after rainfall events to verify that runoff has not degraded the profile and stability of recently maintained drains.
Reporting	• The drain maintenance records shall be retained on site for inspection by local and state authorities. • Records of issues such as sedimentation, flooding, water quality and aquatic species mortality within drains shall be maintained on site. • Any fish kills at the site should be recorded.
Identification of incident or failure	• Degradation of drain stability. • Excessive removal of vegetation root stock. • Degradation of surface water quality. • A recorded fish kill.
Corrective action	Identify the reason for stability failure and amend the drain maintenance procedures and/or decrease maintenance intensity as necessary.

Commitment 3

The Developer will appropriately implement drainage maintenance works to minimise physical drain disturbance during sediment removal.

14.4.2 Acid sulfate soil treatment

Person responsible	Contractor's Site Manager, Environmental Consultant
Issue	Assessment and treatment of acid sulfate soils identified onsite.
Operational policy	No acid sulfate drain spoil is to be disturbed or excavated without appropriate treatment.
Performance criteria	All material excavated from drains to be limed at prescribed rate before stockpiling.
Implementation strategy	Lime treatment of drain spoil removed from drains situated below RL 5.0m AHD is to be undertaken according to the following treatment measures: Lime treatment • All spoil removed from drains situated below RL 5.0m AHD is to be treated with lime at a rate of 5kg/m². • To aid mixing, half the lime should be applied to the drain spoil in situ before mechanical maintenance (e.g. weed bucket/ sucker truck). • The remaining half of the lime should be applied as a bed onto which the removed drain spoil material is placed. • Exposed drain batters must be surface limed within 24 hours following drain maintenance. • Limed drain spoil should not be stockpiled within 40m of an existing drain. • Lime in the treatment bed is to be thoroughly mixed into the stockpiled drain spoil as soon as the spoil material is dry enough to cultivate. • If iron monosulfides ('black drain sludge') are removed from the drain, this material should be limed at the prescribed rate and cultivated into the topsoil as soon as the material is dry. • Verification testing should be conducted to ensure that the spoil material has been appropriately treated. In the event that additional liming is required, the treatment process and verification testing should continue until adequate treatment has been achieved.
Monitoring	Collect lime delivery dockets and compare with calculated amounts required.
Auditing	Auditing will be undertaken by the site manager and/or the developer's nominated representative. Alternatively, auditing may be carried out by an independent consultant. The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the DMMP.

Reporting	Records kept on site during maintenance operations and available for inspection at all times.
Identification of incident or failure	Examination of works for evidence of; • Yellow efflorescence on soil surface, • Iron staining of soils or water, • Sulphurous odour and; • Low pH in water bodies.
Corrective action	Testing of drain spoil materials using POCAS method and re-evaluation of prescribed liming rate.

Commitment 4

The Developer will ensure that no acid sulfate drainage spoil is disturbed or excavated without appropriate treatment.

14.4.3 Sediment and erosion control

Person Responsible	Consulting Engineer, Contractor's Site Manager
Issue	Sediment and erosion control.
Operational policy	To prevent the displacement of sediment and soil from drains particularly during storm events. Compliance with the NSW POEO Act (1997).
Performance criteria	Drain maintenance operations should aim to minimise erosion and the resultant turbidity of discharge waters.
Implementation strategy	- To contain sediment during drain maintenance, temporary sediment and erosion control measures (including silt fences, floating silt curtains and sediment fence isolation barriers) are to be installed prior to maintenance works. - To ensure any sediment that is removed is treated in accordance with Table 14.4.2 and disposed of in an appropriate manner, which will not enable it to become re-entrained in surface flows. - Sediment and erosion control measures will be implemented in accordance with sections 13.3.3 and 13.3.4 of the <i>Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan</i> (G&S 2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i>.
Monitoring	Carry out visual inspections after rainfall events (>25mm in 24hrs) to ensure that erosion measures are in place and operational to suit the activities taking place at the time.
Auditing	Visual inspections to be carried out monthly and after rainfall events to verify that control measures are in place and properly maintained.
Reporting	Reporting only required if insufficient sediment and erosion measures are identified.
Identification of incident or failure	- Signs of erosion on site. - Damaged or failed erosion control devices. - Declining/ deteriorating water quality as identified by Environmental Consultant. - Excessive build-up of sediment.
Corrective action	Apply remedial measures to improve sediment and erosion measures. This may include: - the installation of additional erosion and sediment control measures - maintenance of existing controls - additional controls or structures as directed by the Environmental Consultant or the developer's nominated representative.

Commitment 5

The Developer will ensure that appropriate and adequate erosion and sediment control measures are installed and maintained for the duration of drainage maintenance works.

14.4.4 Surface water quality management

Person responsible	Contractor's Site Manager																															
Issue	Surface water quality in the receiving environments, including Cudgen Creek.																															
Operational policy	To prevent adverse impacts to surface water quality in the downstream receiving environment.																															
Performance criteria	It is proposed that site-specific water quality data would be collected over a minimum of twelve months in accordance with Table 13.2.1 of the <i>Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan Report</i> (G&S 2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i> and used to establish water quality criteria for the purpose of comparison with construction and operational phase water quality results. The following interim water quality criteria based on data collected by TSC would be adopted for any surface water downstream of sediment and erosion control measures (e.g. silt curtains or sediment fence isolation barriers). <table border="1"> <thead> <tr> <th>Water Quality Parameter</th><th>Release Criteria</th><th>Criteria Type</th></tr> </thead> <tbody> <tr> <td>pH*</td><td>5.5 – 7.5</td><td>Range</td></tr> <tr> <td>Salinity</td><td><12ppt</td><td>Maximum</td></tr> <tr> <td>Suspended solids</td><td>10mg L⁻¹</td><td>Maximum</td></tr> <tr> <td>Turbidity</td><td>10NTU</td><td>Maximum</td></tr> <tr> <td>Dissolved oxygen</td><td>5mg L⁻¹</td><td>Minimum</td></tr> <tr> <td>Total Iron</td><td>1.7mg L⁻¹</td><td>Maximum</td></tr> <tr> <td>Total Aluminium</td><td>9mg L⁻¹</td><td>Maximum</td></tr> <tr> <td>Litter and gross pollutants</td><td>No man made material >5 mm in any dimension</td><td>--</td></tr> <tr> <td>Oil and grease</td><td>No visible film, no detectable odour</td><td>--</td></tr> </tbody> </table> *Note that pH will be consistent with receiving water quality. If receiving waters are estuarine, pH should be 5.5-7.5; if receiving waters are acidic, pH should be 4.2 – 6.7 in accordance with the <i>Threatened Species Management Plan</i> (JWA 2012) for habitat requirements for Wallum Froglet (<i>Crinia signifera</i>) and Olongburra Frog (<i>Litoria olongburensis</i>).		Water Quality Parameter	Release Criteria	Criteria Type	pH*	5.5 – 7.5	Range	Salinity	<12ppt	Maximum	Suspended solids	10mg L ⁻¹	Maximum	Turbidity	10NTU	Maximum	Dissolved oxygen	5mg L ⁻¹	Minimum	Total Iron	1.7mg L ⁻¹	Maximum	Total Aluminium	9mg L ⁻¹	Maximum	Litter and gross pollutants	No man made material >5 mm in any dimension	--	Oil and grease	No visible film, no detectable odour	--
Water Quality Parameter	Release Criteria	Criteria Type																														
pH*	5.5 – 7.5	Range																														
Salinity	<12ppt	Maximum																														
Suspended solids	10mg L ⁻¹	Maximum																														
Turbidity	10NTU	Maximum																														
Dissolved oxygen	5mg L ⁻¹	Minimum																														
Total Iron	1.7mg L ⁻¹	Maximum																														
Total Aluminium	9mg L ⁻¹	Maximum																														
Litter and gross pollutants	No man made material >5 mm in any dimension	--																														
Oil and grease	No visible film, no detectable odour	--																														
Implementation strategy	Surface water monitoring will be undertaken downstream of sediment and erosion controls (i.e. floating silt curtains or sediment fence isolation barriers). Sediment and erosion control measures will be implemented in accordance with sections 13.3.3 and 13.3.4 of the <i>Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan</i> (G&S 2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i>.																															

	All monitoring equipment shall be maintained in a functional condition, calibrated and serviced at a frequency compliant with the manufacturers' specifications. Further visual assessment shall be undertaken for evidence of: • yellow efflorescence on soil surface • iron staining of soils or water.
Monitoring	In situ testing of pH, electrical conductivity, suspended solids, turbidity, dissolved oxygen, litter and gross pollutants and oil and grease will be conducted daily during drainage maintenance works. Collection of samples for laboratory analysis of total and dissolved iron and aluminium will occur weekly. If iron floc, sediments or iron staining are observed downstream of works, samples should also be taken for laboratory analysis and works halted until water has been treated to adequate levels. Iron indicator strips will be used if practicable.
Auditing	Auditing will be undertaken by the site manager and/or the developer's nominated representative. Alternatively, auditing may be carried out by an independent consultant. The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the DMMP.
Reporting of monitoring results	Water quality monitoring results will be recorded and kept onsite for inspection by local and state government officers. The contractor to notify TSC immediately of breaches with potential to cause harm to the environment. Water quality monitoring reports will be provided to TSC or DECCW upon request.
Identification of incident or failure	The results of the water quality monitoring indicating concentrations exceeding the limits specified in the 'performance criteria' for a single water quality parameter. Deterioration in surface water quality downstream of the development resulting from site works or the discharge of waters from the development site.
Corrective action	Take necessary steps to address the problem to prevent a recurrence. Addition of hydrated lime to contained waters to increase pH to within the recommended range (consistent with the receiving environment). Addition of gypsum to contained waters to reduce suspended solids as required. Drainage maintenance works to cease until appropriate monitoring has occurred and results verify that the release criteria have been met.

Commitment 6

Management will ensure, through inspection and in situ analysis that no adverse impact on surface water quality results from drainage maintenance on site.

14.5 Administration of the DMMP

14.5.1 Amendment of the DMMP

The Developer may make an application to Tweed Shire Council to amend the provisions of this DMMP. The application shall:

- be in writing; and
- specify the provisions of the DMMP to which the application relates; and
- state how the proposed amendments achieve the objectives of the provisions to which the amendments relate.

Tweed Shire Council shall approve the amendment where Council is satisfied, acting reasonably, that the proposed amendments achieve the objective of the provisions to which the amendment relates.

14.5.2 Incident management

The Developer and any person appointed by the Developer as having responsibility for a control strategy set out in this DMMP have clearly defined responsibilities under the NSW *Protection of the Environment Operations Act* (1997) to report any incidents likely to cause material or serious environmental harm.

15.0 BUFFER MANAGEMENT PLAN, PRECINCTS 1 AND 5 – JAMES WARREN & ASSOCIATES, AUGUST 2012

Implementation and Summary Table

Action No	Action	Location (reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
Vegetation Protection								
BMP - 1	Erection of temporary high visibility fencing in accordance with AS 4970-2009	Precinct 1 -along edge of 30m inner buffer zone Precinct 5 – along truncated inner buffer zone	1. To protect retained vegetation (incl. Endangered & EEC's) from construction activities by restricting machinery and contractor access 2. To discourage access to the construction site by native fauna	Prior to site work commencing.	Project 28 Pty Ltd – Site Manager with sign off by Environmental Officer	Fencing erected in accordance with design specification and required timing Fencing maintained over reporting period. Any breaches reported and promptly repaired.	Daily checks of fencing. Reporting at 6 monthly intervals noting status of works (including photos), monitoring frequency, any incidents and nature of management response.	Proponent assumes maintenance responsibility until revegetation work is self-sustaining i.e. 3 - 5yrs
BMP - 2	Erection of temporary signage: "Environmental Protection zone- No Unauthorised Entry".	Approximately 100m intervals along all temporary fencing (see above)	1. To protect retained vegetation from construction activities by restricting machinery and contractor access	Prior to site work commencing.	Project 28 Pty Ltd- Site Manager	Signage maintained over reporting period. Any breaches reported and promptly repaired	Daily checks of fencing/ signage.	Temporary signage will be erected prior to construction that indicates the location of EPZs
BMP- 3	High visibility tagging of Threatened flora species and EEC's	Where Threatened flora and EEC's occur	1. To protect Threatened vegetation from construction activities including accidental damage when carrying out management actions i.e. weeding	Prior to site work commencing	Project 28 Pty Ltd – Site Manager with sign off by Environmental Officer	Continued persistence of Threatened flora and EEC's	Annually for 5 years: survival, height, flowering, fruiting, signs of natural recruitment, potential threats	Precincts 1 & 5 VMP and TSMP
BMP- 4	Erection of permanent signage:	Approximately 100m intervals	1. Notification of Koala	During construction	Project 28 Pty Ltd- Site	Signage maintained	Daily checks of	Proponent assumes

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Action No	Action	Location (reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
	No Unauthorised Access; Dogs prohibited; No dumping of rubbish; Rehabilitation works in progress	Along all Koala-proof fencing (see above)	habitat 2. Notification of restricted access	phase, prior to occupation	Manager	over reporting period. Any breaches reported and promptly repaired	fencing/ signage.	maintenance responsibility until revegetation work is self-sustaining i.e. 3 - 5yrs
Stormwater and water quality management								
BMP- 5	Background water quality monitoring	In water bodies within and adjacent to the construction site	1. To establish appropriate discharge criteria for the construction phase	Prior to commencement of works and maintained until stabilisation by revegetation at completion of works	Nominated environmental consultant	Background monitoring pre-construction water quality: chemical and physical water quality assessment	Results of water quality monitoring to be reported to TSC	Stormwater Management Plan (Section 12) & Erosion and Sediment Control Plan (Section 13)
BMP- 6	Temporary stormwater treatment measures installed prior to disturbance	Where required in water bodies downslope of construction areas	1. To maintain water quality of receiving waters during the construction phase of the development 2. To prevent the displacement of sediment and soil into ecologically sensitive water bodies 3. Prevent dispersal of weed seeds and vegetative material	Prior to commencement of works	Contractors site manager, environmental consultant	All discharges and water bodies have water quality in line with background monitoring	Surface water quality assessed monthly and following rainfall events	Stormwater Management Plan (Section 12) & Erosion and Sediment Control Plan (Section 13)
Weed Control								
BMP- 7	Weed control	In accordance with Precinct 1 and 5 Weed Management Plan e.g. slashpine wildings mechanically removed or manually cut (chainsaw or loppers) in areas of native vegetation, areas of exotic grasses (Setaria, whiskey grass) sprayed out with glyphosate, targeted weed control while health and Koala trees establishing						

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Action No	Action	Location (reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
Heath regeneration and revegetation								
BMP- 8	Stockpile topsoil	Where appropriate	1. For use in regeneration, to promote natural heath recruitment	During the construction phase	Project 28 Pty Ltd- Site Manager	Topsoil stockpiled for re-use	Refer Section 15.5 of this BMP for monitoring requirements	N/A
BMP- 9	Ripping	Areas of natural heath regeneration	1. To promote natural heath recruitment and regeneration	During the construction phase	Project 28 Pty Ltd- Site Manager	Ripping completed where appropriate and natural regeneration occurring	Refer Section 15.5 of this BMP for monitoring requirements	N/A
Koala compensatory habitat planting								
BMP- 10	Planting of Koala feed trees	Within inner buffer zones (FIGURES 10 & 10A – 10L, APPENDIX 2)	To improve the quality and quantity of Koala habitat on the site and facilitate dispersal across the site	At the completion of bulk earthworks	Suitably qualified Bush Regeneration company	Approximately 10,294 Koala food trees planted in accordance with the Performance Criteria outlined in the Precinct 1 & 5 VMP, Precinct 2, 3, 4, 6, 7, 8, 9, 10, 11 VMP and Precinct 12, 13 & 14 VMP	Growth and condition of plantings to be monitored and reporting completed until self-sustaining, i.e. 3 - 5yrs	Rehabilitation monitoring/ reporting is outlined in the Flora and Fauna Monitoring Report
Buffer Maintenance								
BMP-11	Maintenance of Ecological buffers (refer Section 15.4 of the BMP)	Precinct 2 -4 & 6-14 Buffer zones	To ensure buffers become established (i.e. plantings) and are fully functioning	During the construction phase (refer Section 15.4.5 of this BMP for timing details)	Suitably qualified Bush Regeneration company	Buffers maintained until appropriately established and Performance Criteria have been met (Section 15.5.8 of this BMP) Performance criteria: foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit); species	As above	N/A

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Action No	Action	Location (reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
						composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site (NEH 2012); noxious and environmental weeds are to be eradicated; infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council; natural recruitment of native seedlings throughout planting areas; and plantings providing variable habitats for native fauna species. Completion criteria: When performance criteria have been met, completion will have occurred		
Acid Frog compensatory habitat								
BMP- 12	Creation of Wallum sedge frog habitat	Within inner buffer zones (FIGURES 10 & 10A – 10L, APPENDIX 2)	To improve the quality and quantity of Acid frog habitat on the site and facilitate dispersal across the site	At the completion of bulk earthworks	Project 28 Pty Ltd- Site Manager / Ecologist	Creation of Acid frog habitat in accordance with the Precinct 1 & 5 TSMP	Monitoring and reporting as outlined in the Flora and Fauna Monitoring Report	39.30ha of suitable habitat for Wallum sedge frogs will be created across the site in which other Acid frogs such as Wallum froglets will also

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Action No	Action	Location (reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
								utilise for foraging and breeding habitat

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List of Abbreviations

APZ – Asset Protection Zone
BMP - Buffer Management Plan
DGEARs - Director General Environmental Assessment Requirements
DoP – NSW Department of Planning
EECs - Endangered Ecological Communities
EPZs - Environmental Protection Zones
FAMP – Feral Animal Management Plan
SEPP - State Environment Planning Policy
TSMP – Threatened Species Management Plan
VMP – Vegetation Management Plan
WMP - Weed Management Plan

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15.1 Introduction

15.1.1 Executive Summary

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- ♦ Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- ♦ Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- ♦ Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- ♦ The Plan of Development for Precinct 5.

This revised Buffer Management Plan (BMP) addresses the amendments to the project and the key issues raised in the submissions.

15.1.2 Aims & Objectives

15.1.3 Background

State Environmental Planning Policy (Major Projects) 2005 (Amendment No 10) was gazetted in November 2006, resolving the zonings of the Kings Forest site (**FIGURE 1, APPENDIX 2**). Threatened flora, habitat for threatened fauna, Endangered Ecological Communities (EECs) and (State Environmental Planning Policy) SEPP 14 Wetlands are protected within zoned Environmental Protection Zones (EPZs). Provision was made for a 50 m ecological buffer to these areas.

Subsequent to gazettal of the SEPP Amendment, a Concept Plan for Kings Forest was prepared and lodged with DoP. The objectives of ecological buffers at the Kings Forest site were originally discussed in the BMP (JWA 2009) that accompanied the Concept Plan Application. The 2009 BMP included a literature review on the types and purposes of environmental buffers.

15.1.4 Aim of this Report

The aim of this BMP is to provide guidelines, strategies and methods for the treatment and management of ecological buffers to Cudgen Nature Reserve and EPZs within Precincts 1 & 5 of the Kings Forest residential development. **FIGURE 2 (APPENDIX 2)** shows

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the final Precinct Plan for the Kings Forest site and **FIGURE 3 (APPENDIX 2)** shows the final Scope of Works Plan.

The following section details the objectives of ecological buffers under the State Environmental Planning Policy (Major Projects) 2005 (Amendment No 10) and the Concept Plan approval (06-0318). Compliance with these requirements is discussed in detail in **SECTION 15.6** of this management plan.

15.1.5 Objectives of buffers at Kings Forest

SEPP (Major Projects) Amendment

Clause 7(2) of the SEPP (Major Projects) Amendment states that the objectives of the ecological buffers are:

- (a) To protect wetlands or areas of particular habitat significance;*
- (b) To restrict development so that, as far as practicable, it does not occur within ecological buffers;*
- (c) To help ensure that development is designed, sited and managed so as to minimise its impact on the ecological and hydrological functions of the ecological buffers; and*
- (d) To encourage the restoration and maintenance of the native vegetation and ecological processes of the land within and adjacent to wetlands or areas of particular habitat significance.*

Clause 7(3) of the SEPP (Major Projects) Amendment requires that development on land within an ecological buffer is to:

- (a) incorporate effective measures to manage wetlands or areas of particular habitat significance, and*
- (b) be designed and sited to maintain connectivity of vegetation and minimise vegetation clearing, soil disturbance and alterations to the rate, volume or quality of surface and ground-water flows, and*
- (c) retain and maintain all existing native vegetation outside the area immediately required for the development, and*
- (d) incorporate measures to regenerate native vegetation for all disturbed areas within the buffer, and*
- (e) incorporate appropriate stormwater and erosion control measures to protect the buffer from surface water run-off or other disturbance.*

Clause 7(4) of the SEPP (Major Projects) Amendment provides that, when considering whether or not there is a practicable alternative to siting development inside an ecological buffer, the consent authority must consider:

- (a) the design, type and site cover of the proposed development, and*
- (b) the physical characteristics of the land on which the development is proposed to be carried out, and*
- (c) the suitability of the land for the proposed development.*

The consent authority may, of course, give consideration to additional matters.

Concept Plan Approval
Condition B3 states that:

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"Further heathland is to be provided with long-term protection and allowed to naturally regenerate on the site.

The further heathland to be protected is to be that contained within the 50m ecological buffer in the locations depicted as 'Heath to be Naturally Regenerated' in Figure 2A titled 'Heath Regeneration and Revegetation Areas' drawn by James Warren and Associates and dated 22 March 2010. The heathland in these locations is to be protected and regenerated for the full 50m width of the ecological buffer.

The details of this further protection are to be submitted along with the preferred long term protection mechanism, such as land use zoning, to the satisfaction of the Director-General prior to determination of Stage 1".

15.2 Ecological Buffers within Precincts 1 & 5

15.2.1 Introduction

The following sections provide a discussion on the treatment of the ecological buffers within Precincts 1 & 5. Impacts of the buffer treatments and bulk earthworks on the vegetation communities are also analysed.

15.2.2 Buffer Treatments

Precinct 1

A rural supplies development is proposed for Precinct 1 (**FIGURE 4, APPENDIX 2**). An ecological buffer of 50 m width will be provided between the development and the Environmental Protection Zone (EPZ) to the southeast. The typical proposed buffer arrangement is shown in **FIGURE 5 (APPENDIX 2)**. Revegetation of approximately 0.33 ha of the area mapped as littoral rainforest in the inner 30 m buffer will occur as shown in **FIGURE 5 (APPENDIX 2)**. **TABLE 1** contains a list of species that will comprise the revegetation of the Precinct 1 buffer.

TABLE 1
SPECIES LIST FOR REVEGETATION WITHIN
PRECINCT 1 ECOLOGICAL BUFFER

Scientific Name	Common Name
Tall trees: Planting density = one plant/50m ²	
<i>Acmena hemilampra</i>	Broad-leaved Lilly Pilly
<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
<i>Litsea reticulata</i>	Bolly Gum
Small / medium trees: Planting density = one plant/25m ²	
<i>Acmena smithii</i>	Lilly Pilly
<i>Alectryon coriaceus</i>	Beach Alectryon
<i>Cryptocarya glaucescens</i>	Jackwood
<i>Cryptocarya microneura</i>	Murrogun
<i>Cryptocarya triplinervis</i>	Three-veined Cryptocarya
<i>Cupaniopsis anacardioides</i>	Tuckeroo
<i>Dubosia myoporoides</i>	Corkwood
<i>Elaeocarpus obovatus</i>	Blueberry Ash
<i>Endiandra discolor</i>	Rose Walnut
<i>Endiandra sieberi</i>	Hard Corkwood
<i>Ficus coronata</i>	Sandpaper Fig
<i>Glochidion ferdinandi</i>	Cheese Tree
<i>Guioa semiglauca</i>	Guioa
<i>Melicope vitiflora</i>	Northern Evodia
<i>Mischocarpus pyriformis</i>	Yellow Pear-fruit
<i>Notelaea longifolia</i>	Large Mock-olive
<i>Pittosporum undulatum</i>	Native Daphne
<i>Polyscias elegans</i>	Celery Wood
<i>Syzygium oleosum</i>	Blue Lilly Pilly
Shrubs: Planting density = one plant/15m ²	
<i>Acronychia oblongifolia</i>	White Aspen
<i>Acronychia imperforata</i>	Logan Apple
<i>Canthium coprosmoides</i>	Coast Canthium
<i>Cordyline stricta</i>	Narrow-leaved Palm Lily
<i>Lepidozamia peroffskyana</i>	Peroffsky's Lepidozamia
<i>Rapanea variabilis</i>	Muttonwood
Tall herbs / Rushes: Planting density = one plant/10m ²	
<i>Alpinia caerulea</i>	Native Ginger
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush

The 20 m Asset Protection Zone (APZ) will be located outside of the 50 m ecological buffer. Management within the outer 20 m buffer will be in accordance with the Bushfire Risk Assessment report (Bushfiresafe (Australia) Pty Ltd, 2012). There is no development proposed within the inner 30 m buffer zone, however, a Koala fence will be constructed between the outer and inner buffer zones.

Impacts on the vegetation within the outer 20 m buffer zone are discussed in **SECTION 15.2.4).**

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Precinct 5

A residential subdivision is proposed in Precinct 5 (**FIGURE 6, APPENDIX 2**). In accordance with the approved Buffer Management Plan (JWA 2009) a minimum 50 m buffer (containing inner and outer zones) between the residential development in Precinct 5 and the Environmental Protection Zones (EPZs) to the east is proposed. The typical proposed buffer arrangement is shown in **FIGURE 7 (APPENDIX 2)**.

A portion of the outer 20 m of the ecological buffer will accommodate part of the Asset Protection Zone (APZ) and the stormwater management areas (bio- infiltration and vegetated swales) (**FIGURE 7, APPENDIX 2**). Construction will be restricted to the 20 m outer buffer zone. A Koala fence will be constructed between the outer buffer and truncated inner buffer zone (**FIGURE 7, APPENDIX 2**). Land to be dedicated to NPWS commences at the property boundary (at the junction of the 20 and 30m buffer).

15.2.3 Impacts on Native Vegetation within Buffers

Continued farming practices (i.e. cattle grazing, periodic slashing etc.) and ongoing weed infestations over the site have resulted in some changes to the extent and structure of the vegetation communities since the previous detailed mapping which occurred in 2005. The mapping of vegetation communities within the ecological buffers was therefore recently updated (August 2011) (**FIGURE 8, APPENDIX 2**). Utilising the updated mapping within the buffers, impacts of the proposed development have been analysed in the following sections.

15.2.4 Impacts on Native Vegetation within Buffers to Precincts 1 and 5

Precinct 1

As the APZ will be located outside of the Precinct 1 ecological buffer, in accordance with the Bushfire Risk Assessment report (Bushfiresafe (Australia) Pty Ltd, 2012), there will be no direct impact from the development on the Precinct 1 buffer zone.

Precinct 5

Part of the APZ will be located inside the Precinct 5 ecological buffer (in the outer 20 m). The outer 20 m of the ecological buffer will accommodate stormwater management areas (bio-infiltration and vegetated swales), Koala exclusion fencing, and in some places, the construction of roads and services (**FIGURE 5, APPENDIX 2**). Vegetation within the 20 m outer buffer zone will be removed. There will also be minor incursions to the inner 30 m buffer zone resulting from small amounts of fill in these areas. There will be no infrastructure within the 30 m buffer.

TABLE 2 outlines the degree to which the vegetation communities, within the buffers to the EPZs, will be impacted. **FIGURE 9 (APPENDIX 2)** illustrates the impact areas.

TABLE 2
IMPACTS ON VEGETATION COMMUNITIES WITHIN
PRECINCT 5 ECOLOGICAL BUFFER

Vegetation Communities	Total area (ha)	Area to be lost (ha)
Community 1 - Highly Modified		
1(a) Substantially cleared of native vegetation	5.82	2.89
1(b) Camphor laurel dominant closed forest (with rainforest species)	-	-
1(c) Native plantation/plantings	-	-
1(d) <i>Leptospermum petersonii</i> plantation (with heathland species)	-	-
1(e) Exotic pine plantation/pine wildings	0.13	0.13
1(f) Exotic grassland dominated (with heathland species)	1.98	1.18
1(g) Exotic grassland dominated (with regrowth Acacia & other native species)	-	-
Subtotal	7.93	4.2
Community 2 - Freshwater Wetland		
2(a) Hillside seepage swamp	-	-
2(b) Ponds & fringing wetland	0.04	0.0
2(c) Sedgeland/rushland	-	-
Subtotal	0.04	0.0
Community 3 - Heathland & Shrubland		
3(a) Dry coastal heathland to shrubland	0.44	0.0
3(b) Wet coastal heathland to shrubland	-	-
3(c) Mixed wet/dry coastal heathland to shrubland (with Scribbly gum)	-	-
3(d) Regenerating wet/dry coastal heathland to shrubland	3.10	1.11
3(e) Regenerating wet/dry coastal heathland to shrubland (with exotic pines)	0.57	0.52
Subtotal	4.11	1.63
Community 4 - Swamp Sclerophyll Floodplain Forest		
4(a) Forest red gum open forest to woodland/Broad-leaved paperbark closed forest to woodland	-	-
4(b) Swamp mahogany open forest to woodland & heathland species	-	-
4(c) Scribbly gum/Swamp mahogany open forest to woodland	-	-
4(d) Swamp box open forest to woodland	-	-
4(e) Broad-leaved paperbark closed forest to woodland	-	-
4(f) Broad-leaved paperbark closed forest to woodland (with rainforest species)	-	-
4(g) Broad-leaved paperbark closed forest to woodland/Swamp mahogany open forest to woodland	-	-
4(h) Swamp sclerophyll & heathland species (with exotic pines)	-	-
4(i) Regenerating Broad-leaved paperbark closed forest to woodland & heathland species	0.13	0.13
4(j) Regenerating Swamp mahogany open forest to woodland	0.62	0.04
Subtotal	0.75	0.17
Community 5 - Dry to Moist Open Forest		
5(a) Blackbutt wet to dry open forest	-	-
5(b) Blackbutt/Tallowwood open forest	-	-
5(c) Blackbutt with grassy understorey	-	-
5(d) Scribbly gum open forest to woodland	-	-

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Vegetation Communities	Total area (ha)	Area to be lost (ha)
5(e) Regenerating Scribbly gum open forest to woodland & heathland species	1.00	0.0
Subtotal	1.00	0.0
Community 6 - Rainforest		
6(a) Littoral rainforest	-	-
6(b) Regenerating sub-tropical rainforest	-	-
Subtotal	-	-
TOTAL	13.83	6.0

The inner buffer zone (i.e. adjacent the Cudgen Nature Reserve) to a width of approximately 20 m is heavily vegetated and includes substantial trees that will be retained (**PLATE 1**). **PLATE 1** also illustrates that the balance area of the inner buffer zone (i.e. approximately 10m) is predominantly comprised of exotic pasture grass.

PLATE 2 shows the southern parts of Precinct 5 and the inner 30 m of the ecological buffer is predominantly comprised of exotic pasture grass, with some native vegetation regrowth occurring between periodic slashing.



PLATE 1: View of buffer to the east of Precinct 5, looking south. *Note:* the fence line is approximately 30 m from the Kings Forest/Cudgen Nature Reserve boundary to the east (left of fence), with the trees occupying approximately 20 m of that area.



PLATE 2: View of Buffer looking north along western edge of 'finger' of vegetation in the south of Precinct 5. Pines and other exotic vegetation occur within the proposed EPZ and will be removed.

In summary, the earthworks for Precinct 5 will impact on a total of 6 ha of vegetation within the buffer zones. Of this 6 ha, 4.2 ha or 70% of the impact will be to highly modified vegetation (i.e. cleared and/or covered by exotic grasslands).

Impacts on the remaining areas of native vegetation are summarised as follows:

- ♦ 27% of the total impact will be to heath and shrubland communities;
- ♦ All Heath and shrubland communities to be lost (1.63 ha in total) are disturbed but regenerating;
- ♦ The remaining impacts will be to Swamp Sclerophyll Forest (3%).

15.2.5 Amelioration of Buffer Impacts

Precinct 1

There will be no earthworks in the Precinct 1 buffer. The inner 30 m buffer zone to the EPZ adjacent to Precinct 1 will be revegetated with Littoral Rainforest species (**TABLE 1 & FIGURE 5, APPENDIX 2**). Approximately 0.33 ha will be revegetated within the 30 m buffer. A combination of weed control and Koala and Acid frog habitat enhancement will be implemented in accordance with the relevant management plans (JWA 2012a; JWA 2012b JWA 2012c; JWA 2012e).

Precinct 5

Regeneration and/or revegetation of heath communities is proposed within the buffer to the EPZ adjacent to Precinct 5. A combination of weed control, heath rehabilitation, and Koala and Acid frog habitat enhancement will be implemented in accordance with the relevant management plans (JWA 2012a; JWA 2012b JWA 2012c; JWA 2012e).

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FIGURES 10, 10A – 10L (APPENDIX 2) illustrate the regeneration and/or revegetation areas totaling 8.19 ha within Precinct 5.

TABLE 3 below provides a summary of the amount of proposed regeneration/revegetation works within Precinct 5 ecological buffers.

TABLE 3
**SUMMARY OF PROPOSED REGENERATION/
REVEGETATION WORKS IN PRECINCT 5 ECOLOGICAL BUFFERS**

Vegetation Community	Current extent	Proposed impacts	Proposed regeneration/revegetation	Net gain
3(a) Dry coastal heathland to shrubland	0.44	0.0	8.19 ha	6.56 ha
3(b) Wet coastal heathland to shrubland	-	-		
3(c) Mixed wet/dry coastal heathland to shrubland (+ Scribbly gum)	-	-		
3(d) Regenerating wet/dry coastal heathland to shrubland	3.10	1.11		
3(e) Regenerating wet/dry coastal heathland to shrubland with pines	0.57	0.52		
TOTAL	4.11	1.63	8.19 ha	6.56 ha

Proposed regeneration and revegetation measures will result in a long-term net gain of 6.56 ha of heathland within the Precinct 5 ecological buffers.

Planting of Koala feed and shelter trees will be completed where appropriate within the buffers to EPZs. These plantings will generally occur in combination with heath regeneration/revegetation activities and will contribute significantly as mitigation for the loss of any vegetation within the buffer zones. Areas identified for planting preferred Koala food trees are shown in **FIGURES 10, 10A – 10L (APPENDIX 2)** and quantified in **APPENDIX 1. SECTION 15.3.9** provides further discussion on Koala food tree compensation.

Furthermore, compensatory habitat for Acid frogs will also be created within ecological buffers and will include core breeding habitat and forage habitat areas. The creation of this habitat will also occur in combination with heath regeneration/revegetation activities. Details are provided in the Precinct 1 & 5 Threatened Species Management Plan (JWA 2012b).

15.3 Specific Management Strategies

15.3.1 Introduction

The specific management strategies for the Precinct 1 & 5 buffer areas are detailed in the following sections and will include:

- ♦ Protective measures;
- ♦ Weed control;
- ♦ Heath regeneration & revegetation;
- ♦ Koala compensatory habitat plantings;

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- ♦ Acid frog compensatory habitat;
- ♦ Pest management; and
- ♦ Adaptive management.

15.3.2 Protective Measures

This section outlines the measures that will be taken to protect the significant natural values adjacent to Precincts 1 & 5 during the construction and operational phases.

15.3.3 Vegetation Protection

Construction Phase

During construction activities, temporary high visibility fencing will be erected between the APZ and 20m outer buffer zone at Precinct 1 and the truncated inner buffer zone at Precinct 5. Fencing will be erected in accordance with Australian Standard 4970-2009 Protection of Trees. Temporary signage at approximately 100m intervals will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".

This will assist in the protection of the retained vegetation from all construction activities by restricting access from machinery and contractors.

Operational Phase

A Koala proof fence in accordance with the Kings Forest Stage 1 KPOM (JWA 2012e) will be constructed as follows:

- between the outer and inner buffer zones in Precinct 1; and
- between the outer buffer and truncated inner buffer zone at Precinct 5 (i.e. along the eastern side of the stormwater management areas (bio-infiltration and vegetated swales) **(FIGURE 7, APPENDIX 2)**.

Signage will be provided on or about the fences stating the following:

- ♦ No Unauthorised Entry
- ♦ Dogs Prohibited
- ♦ No dumping of rubbish
- ♦ Rehabilitation works in progress

Whilst the primary aim of these fences is the prevention of access by Koalas to residential areas, they will also provide permanent protection to vegetation by precluding pedestrian access and vehicular access during the operational phase.

15.3.4 Protection of Threatened Flora

Construction Phase

None of the identified Threatened flora species occur within the proposed ecological buffers. The Precinct 1 & 5 VMP (JWA 2012a) provides detailed protective measures for threatened flora occurring within EPZs. These protective measures will be implemented during bulk earthworks and construction activities.

Operational Phase

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None of the identified Threatened flora species occur within the proposed ecological buffers. The Precinct 1 & 5 TSMP (JWA 2012b) provides detailed protective measures for threatened flora occurring within EPZs. These protective measures will be implemented during the operational phase.

15.3.5 Protection of EECs and SEPP 14 Wetlands

Construction Phase

The Precinct 1 & 5 VMP (JWA 2012a) provides detailed protective measures for EEC's occurring within EPZs and for SEPP 14 Wetlands. These protective measures will be implemented during bulk earthworks and construction activities.

Operational Phase

The Precinct 1 & 5 VMP (JWA 2012a) provides detailed protective measures for EEC's occurring within EPZs. These protective measures will be implemented during the operational phase.

15.3.6 Stormwater Management

Surface water runoff during construction and operations will be managed and mitigated in accordance with the erosion and sediment control measures detailed in the Erosion and Sediment Control Plan (Gilbert & Sutherland, July 2012). Temporary stormwater management and treatment measures will be installed prior to disturbance and maintained until such time as the disturbed areas are stabilised by revegetation upon completion of the earthworks. Temporary measures will include the provision of a sediment fence around the perimeter of any disturbed areas.

15.3.7 Weed Control

Due to the significant disturbance history, Kings Forest supports a variety of weed species of which Slash pine is the most common. Plantations have resulted in the species being naturalised on the site. Progeny range in size from small seedlings to trees 15-20 metres. In some areas there is significant invasion into native vegetation communities, while in other areas there may be only one or two plants.

Weeds will be controlled within the Precinct 1 & 5 ecological buffers to ensure the protection of EPZs and the Cudgen Nature Reserve, particularly during construction. Disturbance during the construction will create a significant opportunity for weeds to colonise and establish. Weed control will be completed in accordance with the Weed Management Plan (WMP) for Precincts 1 & 5 (JWA 2012c) and will begin in conjunction with the bulk earthworks.

15.3.8 Heath Regeneration and Revegetation

All Rehabilitation/Regeneration works to be carried out within Precinct 1 & 5 ecological buffers will be completed in accordance with the Precinct 1 & 5 VMP (JWA 2012a).

Revegetation will commence immediately upon completion of both the proposed Kings forest Parkway and the stormwater management areas (bio-infiltration and vegetated swales) adjacent to Precinct 5 resulting in a vegetative barrier to prevent weed invasion into the EPZs and Cudgen Nature Reserve.

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Revegetation of heath communities is proposed within the majority of the buffers to the EPZs within Precincts 1 & 5 (**FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1**). The re-use of existing top soil will be important in the process of rehabilitation heath communities.

Topsoil is an important source of seeds and propagules and has been effectively used in rehabilitation of native vegetation communities (e.g. [Bellairs & Bell 1993](#); [Koch & Ward 1994](#); [Ward et al. 1996](#)). Therefore, handled correctly, the topsoil seedbank can be used to successfully revegetate after disturbances like bulk earthworks.

At the commencement of the Stage 1 earthworks at Kings Forest, stockpiles of topsoil will be created where appropriate. This soil will then be used in the regeneration of the heath communities within the buffer zones (refer **APPENDIX 1** in the Precinct 1 & 5 VMP).

To optimise the recovery of native vegetation rehabilitation areas the manner in which the top soil is handled is important. The following will be considered:

- ♦ It is important to consider the timing of topsoil recovery. Stripping topsoil immediately after summer seed drop may improve the germinable seed load ([Berg 1975](#));
- ♦
- ♦ The seed bank is usually concentrated in the upper soil layer (i.e. 40–50 mm) so it is important to only remove this depth of soil. A greater depth will dilute the seed bank and reduce the effectiveness of the soil as a potential mechanism for natural regeneration (Putwain & Gillham 1990);
- ♦
- ♦ Topsoil will be used as soon as possible after stripping to prevent loss of seed viability ([Koch et al. 1996](#); [Mahesh et al. 1996](#)); and
- ♦
- ♦ Top soil will be replaced at maximum depths of 100 mm ([Rokich et al. 2000](#)).

15.3.9 Koala Compensatory Habitat plantings

Planting of Koala feed and shelter trees, within the inner buffers, will be completed in accordance with the KPOM (JWA 2012e) (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1**). This will establish linkages between areas of Koala habitat and increase foraging resources for the species in the long term. Planting methodology and a species list is outlined in Precinct 1 & 5 VMP (JWA 2012a).

15.3.10 Acid frog compensatory habitat

The creation of core Acid frog breeding habitat will be completed in Precinct 1 & 5 ecological buffers in combination with heath regeneration/revegetation measures and Koala compensatory habitat plantings (**FIGURE 10 & 10A – 10L, APPENDIX 2**). The Acid frog compensatory habitat will be created in accordance with the Precinct 1 & 5 TSMP (JWA 2012b).

15.3.11 Pest Management

Several feral animal species have been identified as a problem on the Kings Forest site (e.g. Red Fox, Cane Toads). A Stage 1 FAMP (JWA 2012d) has been prepared for the Kings Forest site. Various strategies are discussed for the control of feral animals occurring at the site. Recommendations are provided with regard to the timing and implementation of these strategies.

15.3.12 Adaptive Management

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Where necessary, alteration to the design and maintenance of works required, to ensure the objectives of the BMP are achieved, are then made.

Adaptive management strategies will be determined by the information provided in monitoring reports. Adaptive management strategies that may be required within this BMP are as follows:

- Amendment of species list for revegetation works;
- Replacement of enhancement plantings that do not survive;
- Alteration of weed control methods or timing.

Before the implementation of any adaptive management strategy a brief report is be provided to Project 28 Pty Ltd and other relevant agencies detailing the proposed management actions and the predicted outcomes. The implementation must be approved by the relevant authority prior to implementation.

15.4 Maintenance

15.4.1 Introduction

Ecological buffers will require maintenance during the construction phase to ensure they become well established and fully functioning. This section outlines the maintenance requirements during the construction phase. Maintenance will be completed focusing in three areas:

- General weed control;
- Care and/or labelling of plants natural regenerating in heath communities; and
- Care (i.e. watering, staking, mulching, protection) of heath and Koala food plantings.

15.4.2 Weed Control

Targeted weed control will be completed whilst heath communities and Koala food trees are establishing. Weed control methods are outlined in the WMP (JWA 2012c).

15.4.3 Natural Regeneration

Areas of regeneration will be continually assessed to detect and record seed germination. Seedlings will be marked and/or labelled and any weeds removed to increase the probability of survival.

15.4.4 Koala Food Tree Plantings

Maintenance for the compensatory Koala food tree plantings will include the following:

- ensuring adequate soil nutrient levels by periodic fertilising;
- ensuring adequate soil moisture levels;
- surveying for evidence of over browsing and applying adaptive management strategies (if necessary); and
- replacing any plantings that fail.

15.4.5 Timing of Maintenance

Maintenance visits will occur:

- On a fortnightly basis for an appropriate time to survey seedling recruitment in heath regeneration areas;
- Two weeks after enhancement plantings;
- Bi-monthly (check on plantings and weeds) for the first year; and
- Six monthly (check on plantings and weeds) for the 2nd, 3rd, 4th and 5th years.

15.5 Monitoring and Reporting

15.5.1 Introduction

Monitoring is an ongoing part of any rehabilitation works. The condition of revegetation areas can be assessed by checking environmental conditions and matching these with management aims and objectives. The results obtained through monitoring can help managers to prioritise management actions and keep track of the health of rehabilitated areas.

A well-designed monitoring program will allow project managers to detect results months, years, or decades following implementation of a plan. This section outlines the monitoring requirements for the Precinct 1 & 5 ecological buffers.

15.5.2 Rehabilitation Monitoring

15.5.3 Monitoring Requirements

The monitoring of ecological buffers will include regular visits by a qualified ecologist who is to complete the following:

- Transects
 - Ten (10) transects are to be placed within the Precinct 1 & 5 ecological buffers;
 - Transect locations are to be permanently marked;
 - Transects are to be 30 metres in length;
 - During monitoring visits tape measures are to be placed on the ground and the specific measureable features recorded along the transects;
 - Specific measurable features include:
 - Areas of vegetation cover (native species);
 - Areas of weed cover;
 - Areas of bare ground/mud;
 - Number, percentage and species of planted stems surviving;
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- Quadrats

- Three (3) quadrats (1m²) are to be placed along each of the transects;
 - Quadrats must be placed a minimum of 5m apart along the length of the transect;
 - Quadrats are to be placed randomly within five (5) metres of the transect line;
 - The boundary of the quadrat with respect to the tape measure (e.g. between 3.5 – 4.5 metres on tape measure) will be recorded;
 - For each quadrat the following specific measurable features will be recorded:
 - Plant species occurring
 - Percentage cover
 - Height
 - Relative abundance of native species
 - Weed cover
 - Number, percentage and species of planted stems surviving
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- ♦ Fixed Photo points
 - A central transect marker on each established monitoring transect is to be used as permanent photo station for photographic monitoring;
 - Four (4) photos are to be taken from each central transect marker. Photos are to be taken to the north, south, east and west;
 - Photos will be labelled with the:
 - Transect code
 - Direction of view
 - The date & time
 - Photos must be supplied in the monitoring reports in a form of prints no smaller than 4" x 6" and must be colour.

15.5.4 Timing of Monitoring Visits

The monitoring is to be completed by a suitably qualified ecologist. Site visits will occur:

- ♦ Six (6) weeks after primary weeding;
- ♦ Six (6) weeks after initial plant-out;
- ♦ Every six (6) months thereafter until groundcovers are sufficiently established (i.e. between two (2) - three (3) years)
- ♦ Annually after establishment. Monitoring will cease after five (5) years or until the vegetation is self-sustaining (whichever is the earliest) unless performance criteria have not been met, whereby monitoring will continue annually until performance criteria have been met.

15.5.5 Long term Monitoring

Along with the regular monitoring within the ecological Buffers, the overall vegetation composition is to be regularly assessed and recorded. Long term monitoring will use both aerial photos and yearly assessments (ground truthing) of the vegetation communities using a hand held GPS.

The Long term monitoring of the vegetation composition with the Precinct 1 & 5 ecological buffers will include:

- ♦ A detailed vegetation map at a scale of 1:5,000 is to be completed within the ecological buffers every twelve (12) months;

- Each year, after completion of vegetation mapping, a report is to be completed showing the changes in the composition of the vegetation communities within the ecological buffers. The results are to be shown in a table that shows the vegetation community and the area of the vegetation community as a percentage of the ecological buffers. Monitoring will cease after five (5) years unless performance criteria have not been met, whereby monitoring will continue annually until performance criteria have been met.

15.5.6 Fauna Monitoring

Further to the monitoring of the progress of rehabilitation, an annual fauna survey will be completed within Precinct 1 & 5 ecological buffers until performance criteria are met (**refer Section 15.5.8**). A baseline survey will be completed within the Precinct 1 & 5 ecological Buffers prior to commencement of construction to determine species presence (refer Flora and Fauna Monitoring Report). The fauna surveys will target threatened species recorded, or predicted to occur, within the vicinity of Precincts 1 & 5 and will include the following methodology (where appropriate):

- Elliott trapping;
- Cage trapping;
- Pitfall trapping;
- Arboreal Elliott trapping;
- Spotlighting/stag watching;
- Call playback;
- Dawn & dusk bird surveys;
- Hair tubes; and
- Active searching.

15.5.7 Water Quality Monitoring

A detailed water quality monitoring regime is included in the Overall Water Management Plan (Gilbert & Sutherland, July 2012) and will ensure that significant impacts on ecological buffers and ecologically significant areas are avoided.

15.5.8 Performance Criteria

A number of criteria will indicate successful rehabilitation of the ecological buffers, including:

- Growth rates;
- Foliage Projective Cover;
- Species composition targets based on accepted benchmarks for the specific vegetation communities on the Kings Forest site;
- Noxious and environmental weeds are to be eradicated;
- Natural recruitment of native seedlings throughout planting areas;
- Maintenance of 100% of planted diversity; and
- Plantings providing variable habitats for native fauna species.

Performance criteria will be assessed for the ecological buffers as follows:

- The photos taken during monitoring visits, in combination with the annual monitoring and mapping of native vegetation composition and the results of the annual fauna survey, will be used to determine the density and diversity of native flora and fauna species the area is supporting.

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- ♦ *When the Ecologist has determined that all performance criteria have been met, completion will have occurred.*

15.5.9 Reporting

15.5.10 Rehabilitation monitoring reports

Following each inspection by the qualified ecologist, a report will be prepared that will include tables and photographs from the monitoring visits. At the end of each year a detailed report will be prepared for the Office of Environment & Heritage (OEH) and Tweed Shire Council (TSC). The report will discuss the following:

- ♦ Works undertaken;
- ♦ Progress of regeneration/revegetation areas against performance criteria using photos and tables showing the results of the monitoring visits;
- ♦ Significant problems encountered (death of seedlings, broken fences, vandalism etc.) and the effect of these on the plantings and aims of the revegetation or regeneration strategy;
- ♦ Success or failures of measures implemented to rectify previously identified problems;
- ♦ Measures to be taken to rectify new problems; and
- ♦ Performance against performance criteria (**Section 15.5.8**).

15.5.11 Fauna monitoring reports

A report will be prepared for OEH & TSC after each annual fauna survey and will include the following:

- ♦ Results of the fauna survey;
- ♦ A comparison of results with previous years;
- ♦ Discussion regarding the absence of previous species/occurrence of new species;
- ♦ Any habitat maintenance recommendations (i.e. additional nest boxes etc.);
- ♦ Discussion regarding the occurrence of any pest species; and
- ♦ Recommendations for controlling pest species (if required).

15.6 Compliance with Statutory Requirements

15.6.1 Background

This section discusses compliance with the requirements of ecological buffers under the State Environmental Planning Policy (Major Projects) 2005 (Amendment No 10) and the Concept Plan approval (06-0318).

15.6.2 The SEPP (Major Projects) Amendment

15.6.3 Introduction

A literature review on the types and purposes of environmental buffers was included in the approved Buffer Management Plan (JWA 2009) prepared for the Concept Plan Application. The approved 2009 Buffer Management Plan established the following principles with respect to ecological buffers (with the exception of the southern zone i.e. Golf Course). Buffers were to consist of a:

- ♦ *Minimum 30 m vegetated inner zone; and*

- Maximum 20 m outer zone. The outer zone may contain, subject to approval in each case, roads, footpaths and cycle ways, an asset protection zone (APZ), stormwater management and passive recreation areas.

The 2009 Buffer Management Plan (JWA 2009) also noted that:

The application of this principle will be the subject of zone-specific Buffer Management Plans submitted in support of each Project Application or Development Application, and is supported by the Department of Environment and Climate Change.

As foreshadowed in the Concept Plan, it is proposed as part of the Project Application that compatible works would be undertaken in the 20m outer buffer with no infrastructure proposed within the 30m inner buffer.

15.6.4 Compliance with Clause 7(2)

Clause 7(2) of the SEPP (Major Projects) Amendment states that the objectives of the ecological buffers are:

- (a) To protect wetlands or areas of particular habitat significance;
- (b) To restrict development so that, as far as practicable, it does not occur within ecological buffers;
- (c) To help ensure that development is designed, sited and managed so as to minimise its impact on the ecological and hydrological functions of the ecological buffers; and
- (d) To encourage the restoration and maintenance of the native vegetation and ecological processes of the land within and adjacent to wetlands or areas of particular habitat significance.

The following details will be taken into consideration when determining compliance with Clause 7(2) of the SEPP (Major Projects) Amendment.

- This management plan for Precincts 1 & 5 provides specific management strategies as well as a detailed monitoring and reporting program to ensure significant values within and adjacent to ecological buffers are maintained, protected and rehabilitated.
- The physical alteration to the buffer would typically involve less than a one metre variation to the existing surface. However, the proposed revegetated 1-in-4 batters would ensure that the stormwater management areas (bio-infiltration and vegetated swales) were appropriately integrated with the balance of the buffer area.
- There will be no associated hard infrastructure (concrete, pipes etc.) located within the inner 30m portion of the buffer;
- It is intended that part of the buffer, from and including the Koala fence to the adjacent EPZ, will be dedicated to NPWS in conjunction with other Environmental Protection zoned land to be dedicated to it as an addition to Cudgen Nature Reserve.
- The proposed stormwater management areas (bio-infiltration and vegetated swales) fulfil a number of the objectives for ecological buffers under Clause 7(2), primarily the protection of wetlands and areas of habitat significance by virtue of its role in maintaining the existing hydrological regime in the neighbouring nature reserve. In order to maintain the existing groundwater hydrological regime, recharge is required along the eastern boundary (Gilbert & Sutherland, September 2011);
- Whilst the runoff directed to the stormwater management areas (bio-infiltration and vegetated swales) is likely to contain nutrients at levels that are relatively higher than groundwater nutrient levels, plant uptake of these nutrients and filtration through the bio-infiltration and vegetated swales will minimise their concentration in waters that ultimately contribute to the groundwater table. This proposal has the dual benefit of

stormwater treatment and enhancing the growth rate and vigour of vegetation planted within the buffer as part of the rehabilitation program.

It is considered that the proposed development within the outer 20m of the buffer, limited to roads and services, the maintenance of asset protection zones and provision of stormwater management areas (bio-infiltration and vegetated swales), is a practicable solution.

15.6.5 Compliance with Clause 7(3)

Clause 7(3) of the SEPP (Major Projects) Amendment requires that development on land within an ecological buffer is to:

- (a) *incorporate effective measures to manage wetlands or areas of particular habitat significance, and*
- (b) *be designed and sited to maintain connectivity of vegetation and minimise vegetation clearing, soil disturbance and alterations to the rate, volume or quality of surface and ground-water flows, and*
- (c) *retain and maintain all existing native vegetation outside the area immediately required for the development, and*
- (d) *incorporate measures to regenerate native vegetation for all disturbed areas within the buffer, and*
- (e) *incorporate appropriate stormwater and erosion control measures to protect the buffer from surface water run-off or other disturbance.*

The objectives for the ecological buffer (per Clause 7(2) of the SEPP Amendment) will be met, considering Clause 7(3), in that:

- ♦ measures will be incorporated to satisfy sub-clause (a) - the management of wetlands or areas of particular habitat significance, in conjunction with sub-clause, sub-clause (b) – the minimisation of alterations to the rate, volume or quality of surface and ground-water flows, and sub-clause (e) - the provision of appropriate stormwater and erosion control measures to protect the buffer from surface water run-off or other disturbance. Such measures will include the construction of stormwater management areas (bio-infiltration and vegetated swales) along the entire length of the buffer generally within its outer 20m zone. The swale will be vegetated in the same way as the adjacent 30m inner buffer zone such as to be visually indistinguishable.
- ♦ Sub-clause (b) will be further satisfied, and sub-clauses (c) and (d) satisfied, in that the development will
 - maintain connectivity of vegetation and minimise vegetation clearing and soil disturbance, and
 - enable the retention of native vegetation outside the area required for development, and
 - incorporate measures to regenerate vegetation in other buffer areas disturbed by the development, if any.

15.6.6 Compliance with Clause 7(4)

Clause 7(4) of the SEPP (Major Projects) Amendment provides that, when considering whether or not there is a practicable alternative to siting development inside an ecological buffer, the consent authority must consider:

- (a) *the design, type and site cover of the proposed development, and*

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- (b) the physical characteristics of the land on which the development is proposed to be carried out, and
- (c) the suitability of the land for the proposed development.

The objectives for the ecological buffer (per Clause 7(2) of the SEPP Amendment) will be met, considering Clause 7(4) of the SEPP Amendment, having regard for:

- (a) the design, type and site cover of the development in the outer 20m, in that:
 - the bio-infiltration and vegetated swale has been designed and positioned to prevent impacts on adjacent ground water dependant ecosystems,
 - the bio-infiltration and vegetated swale will be fully revegetated once constructed,
- (b) the physical characteristics of the land on which the development is proposed to be carried out, in that:
 - it is level and contains no significant native vegetation,
 - the existing, substantial vegetation approximately 20m in width along most of the boundary with Cudgen Nature Reserve will be retained, so that, from a buffer function perspective,
- (c) based on the above points, the land within the 20m outer buffer is suitable for the proposed development.

15.6.7 Concept Plan Approval (06-0318)

Condition B3 of the Concept Plan Approval (06-0318) states that:

"Further heathland is to be provided with long-term protection and allowed to naturally regenerate on the site.

The further heathland to be protected is to be that contained within the 50m ecological buffer in the locations depicted as 'Heath to be Naturally Regenerated' in Figure 2A titled 'Heath Regeneration and Revegetation Areas' drawn by James Warren and Associates and dated 22 March 2010. The heathland in these locations is to be protected and regenerated for the full 50m width of the ecological buffer.

The details of this further protection are to be submitted along with the preferred long term protection mechanism, such as land use zoning, to the satisfaction of the Director-General prior to determination of Stage 1".

The BMP (JWA 2009) approved as part of the Concept Plan application established the following principles with respect to ecological buffers (with the exception of the southern zone i.e. Golf Course). Buffers were to consist of a:

- Minimum 30m vegetated inner zone; and
- Maximum 20m outer zone. The outer zone may contain, subject to approval in each case, roads, footpaths and cycle ways, an asset protection zone (APZ), stormwater management and passive recreation areas.

It is therefore proposed, as part of the stage 1 Project Application, that compatible works would be undertaken in the 20m outer buffer. However, to provide for further retention and protection of regenerating heath communities, as shown in Figure 2A (JWA 22nd March 2010), the extent of bulk earthworks and engineering design in the buffers has been minimised as much as is feasible and practicable.

We have reviewed the road/earthworks proposal prepared by Mortons Urban Solutions (Plan no. 12301-ALL-040 Amendment C) with respect to the heath areas shown in Figure 2A (JWA 22nd March 2010). The original plan 2A showing Heath Regeneration and Revegetation Areas is attached as **FIGURE 11 (APPENDIX 2)**. The areas proposed for heath regeneration and revegetation have been revised and are now shown in **FIGURE 12 (APPENDIX 2)**.

It should be noted that continued farming practices (i.e. cattle grazing, periodic slashing etc.) and ongoing weed infestations on the site have resulted in some changes to the heath mapping over the site since 2005. Some areas previously mapped as 'Existing heath to be retained' have become significantly infested with weeds (particularly Slash pine) and are now mapped as 'Heath to be naturally regenerated'. Conversely, some areas of heath previously mapped as 'Heath to be naturally regenerated' based on 2005 fieldwork are considered to have sufficiently regenerated to now be mapped as 'Existing heath to be retained'.

TABLE 4 below shows a comparison of the 'Heath Regeneration and Revegetation Areas' shown within ecological buffers in the original Figure 2A and the updated version of Figure 2A.

TABLE 4
COMPARISON OF HEATH AREAS WITHIN ECOLOGICAL BUFFERS
BETWEEN FIGURE 2A (MARCH 2010) AND THE UPDATED FIGURE 2A

	Existing heath to be retained within ecological buffers (ha)	Heath to be naturally regenerated within ecological buffers (ha)	Heath to be revegetated within ecological buffers (ha)	TOTAL HEATH AREAS WITHIN ECOLOGICAL BUFFERS (ha)
Figure 2A (March 2010)	0.04	8.16	21.55	29.76
Current Figure 2A (September 2011)	0.34	12.83	19.82	32.99
Net gain/loss	+0.3	+4.67	-1.73	+3.24

The re-mapping of the heath communities has resulted in an additional 3.24 ha of heath being retained and protected within the area defined by FIGURE 2A (JWA 22nd March 2010). This additional area of heath is comprised of 0.3 ha of existing heath plus 4.67 ha of heath that will naturally regenerate minus an area of 1.73 previously proposed to be revegetated.

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APPENDIX 1 – COMPENSATORY HABITAT AREAS

TABLE 1
COMPENSATORY HABITAT AREA CALCULATIONS

Koala Food Tree Planting Areas	Area (ha)
Koala Food Tree Planting Areas - Site excluding golf course	60.48
Koala Food Tree Planting Areas - Golf course only	10.64
Koala Food Tree Planting Areas - TOTAL	71.12

Wallum Sedge Frog Compensatory Habitat	Area (ha)
Wallum Sedge Frog Compensatory Habitat - Site excluding golf course	32.40
Wallum Sedge Frog Compensatory Habitat - Golf course only	6.90
Wallum Sedge Frog Compensatory Habitat - TOTAL	39.30

Wallum Froglet Compensatory Habitat	Area (ha)
Wallum Froglet Compensatory Habitat - Site	9.47
Wallum Froglet Compensatory Habitat - TOTAL	9.47

Heath Rehabilitation	Area (ha)
Heath to be Naturally Regenerated	42.19
Heath to be Revegetated	69.02
Heath Rehabilitation - TOTAL	111.21

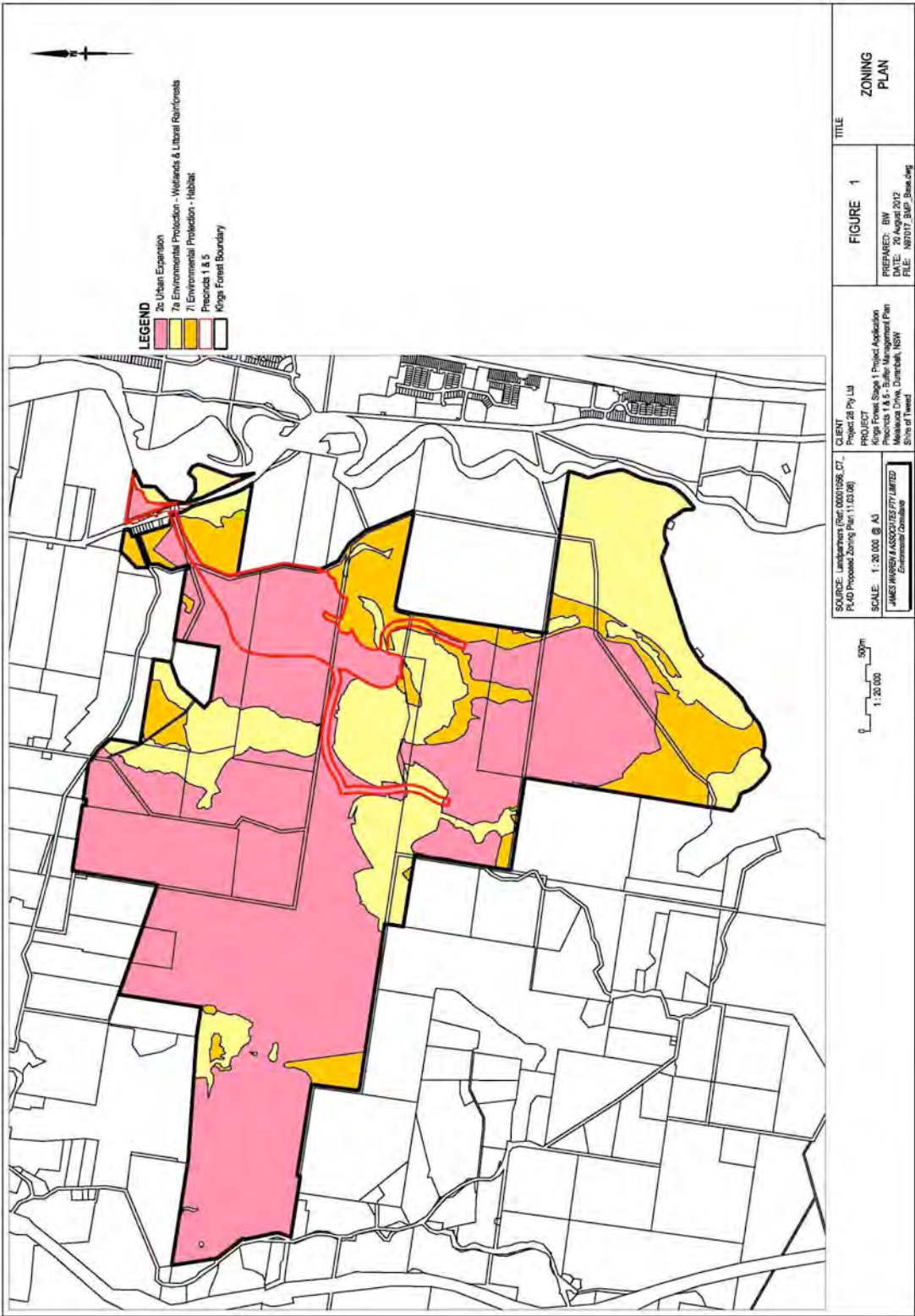
Overlapping Areas	Area (ha)
Overlapping areas of Wallum Sedge Frog, Koala and Heath Compensatory Habitat	40.24
Areas designated for Koala Compo Habitat & Heath Reveg only	10.21
Areas designated for Koala Compo Habitat & Heath Regen only	14.82
Areas designated for Koala Compensatory Habitat only (no overlap)	6.19
Areas designated for Heath Revegetation only (no overlap)	24.74
Areas designated for Heath Regeneration only (no overlap)	21.69

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APPENDIX 2 – FIGURES

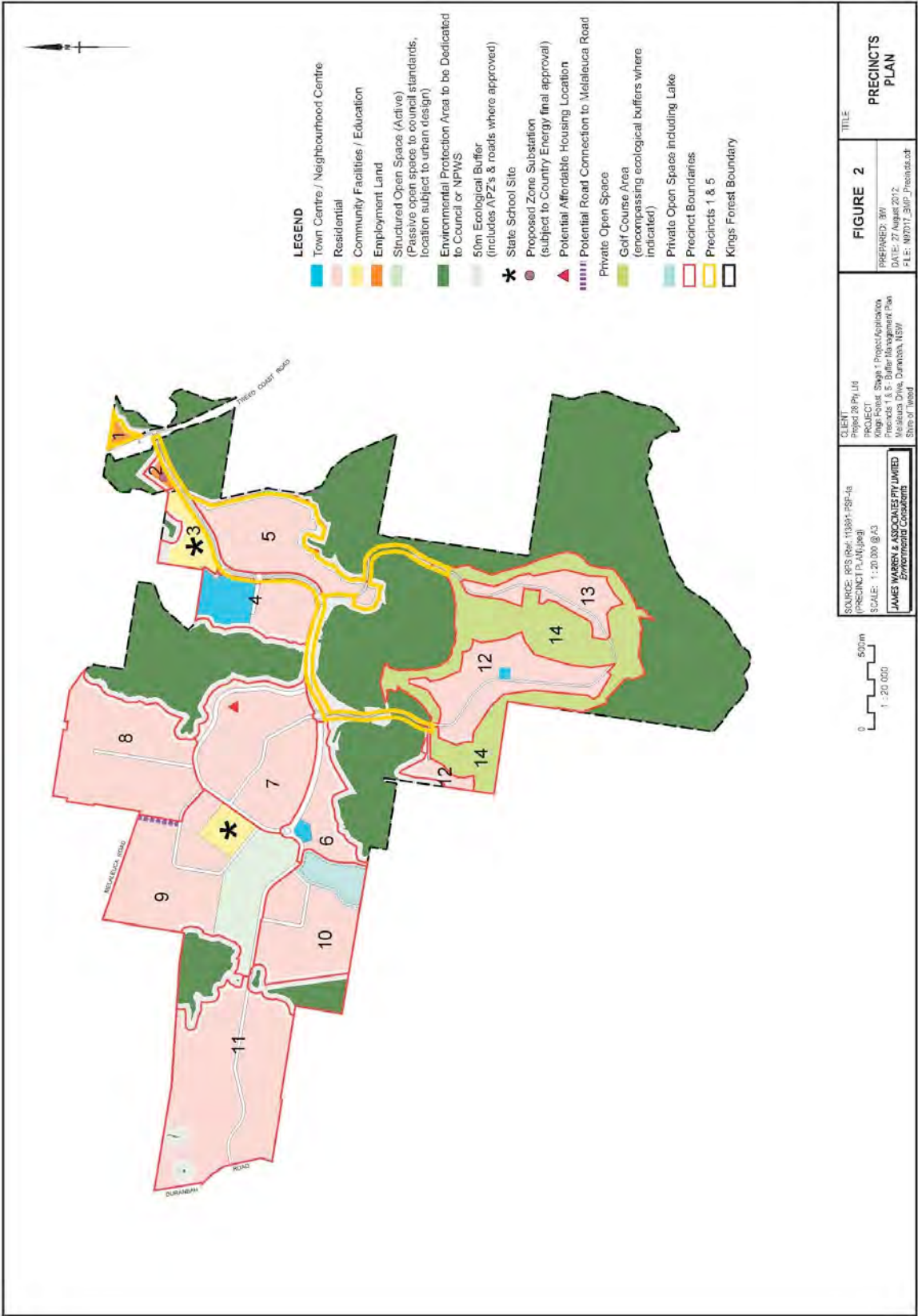


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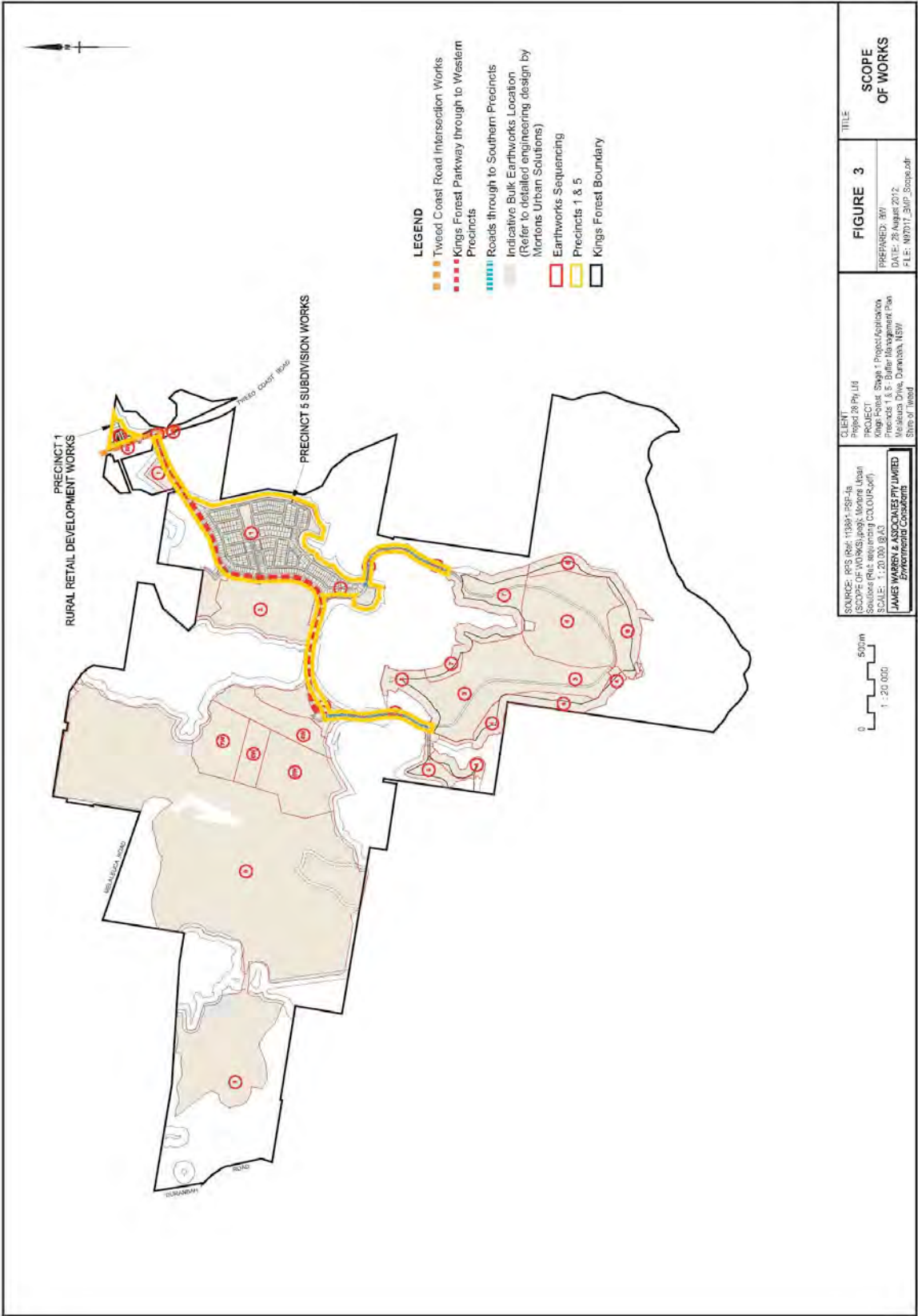
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A.C.N. 093 157 165
Town Planning & Development Consultants



Darryl Anderson Consulting Pty Ltd

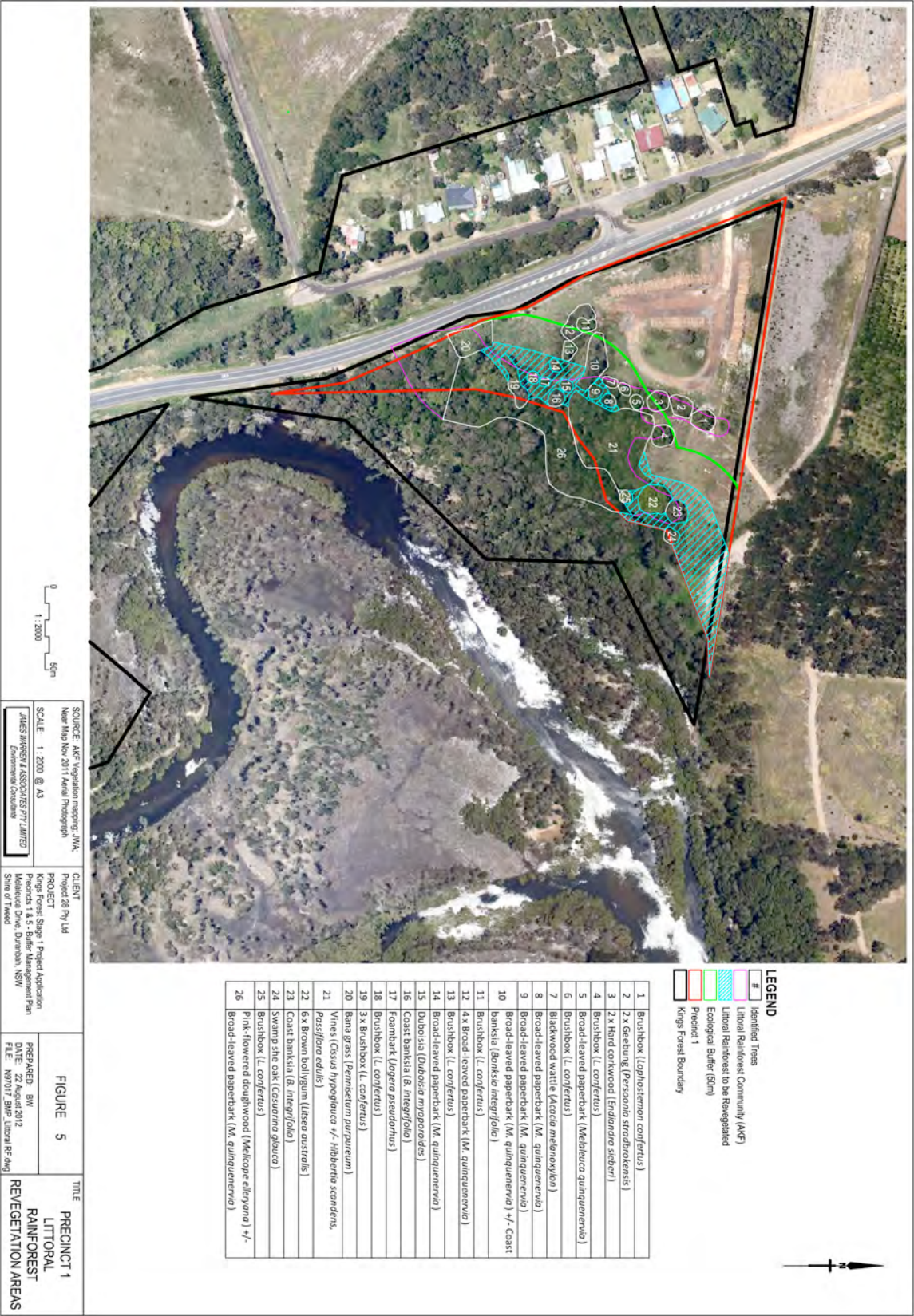
A.C.N. 093 157 165

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15-32



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15-37

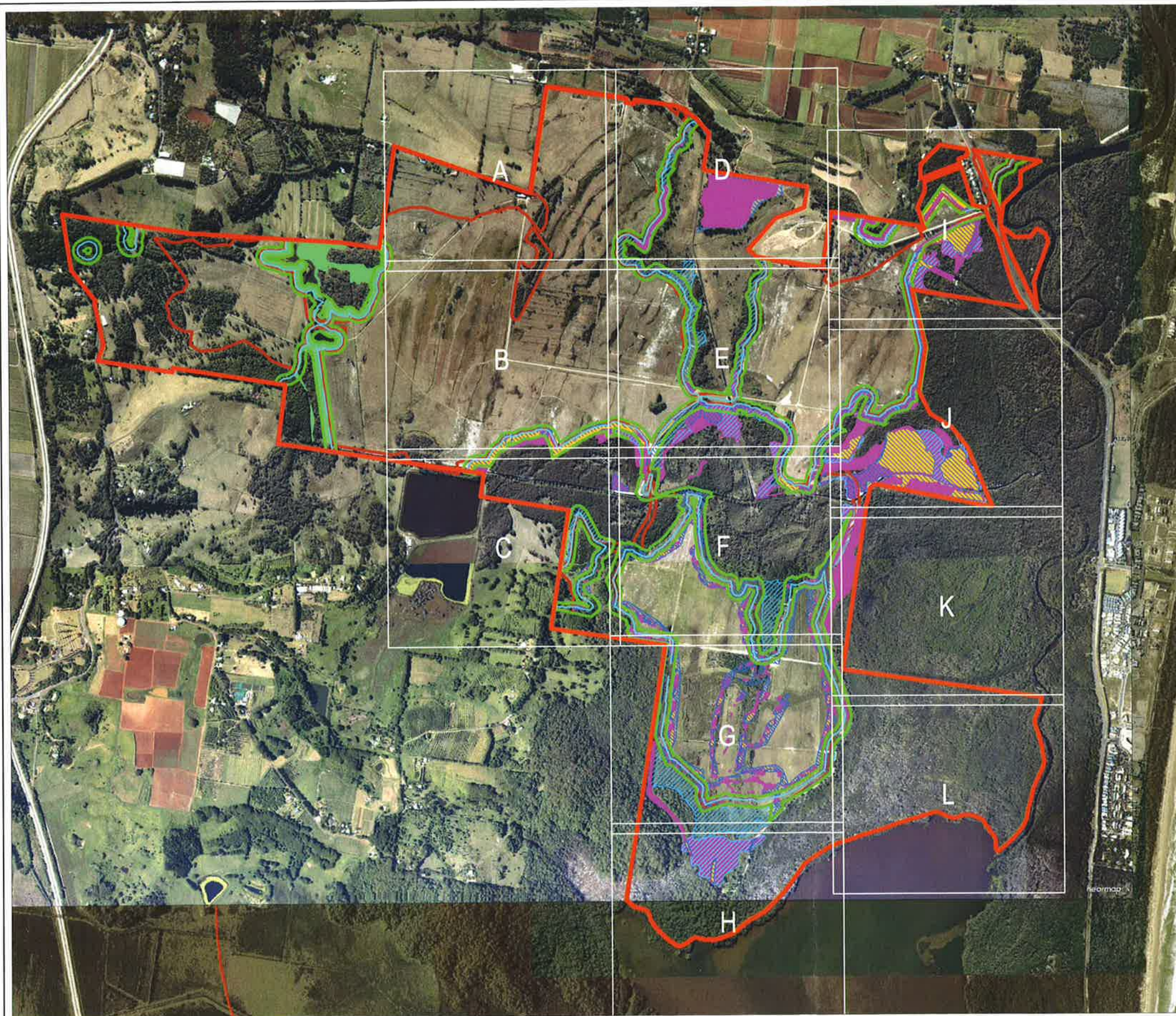


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15-38



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Wallum Froglet Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 500m
1 : 20 000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 20 000 @ A3

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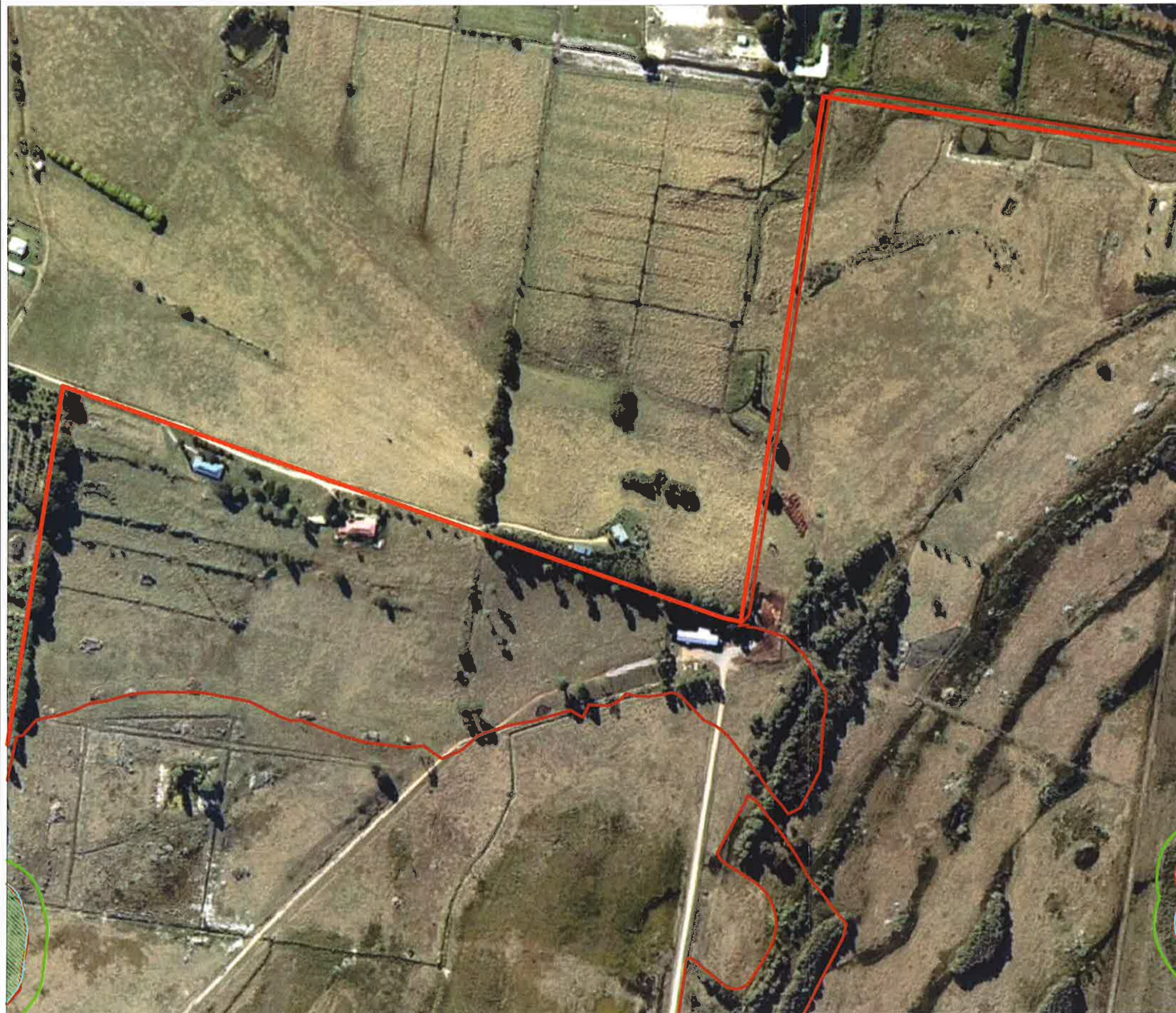
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



LEGEND

-  Heath to be Naturally Regenerated
-  Heath to be Revegetated
-  Wallum Sedge Frog Compensatory Habitat
-  Wallum Froglet Compensatory Habitat
-  Koala Food Tree Planting Areas
-  Ecological Buffer (50m)
-  Inner APZ (30m)
-  Extent of Bulk Earthworks
-  Kings Forest Boundary

0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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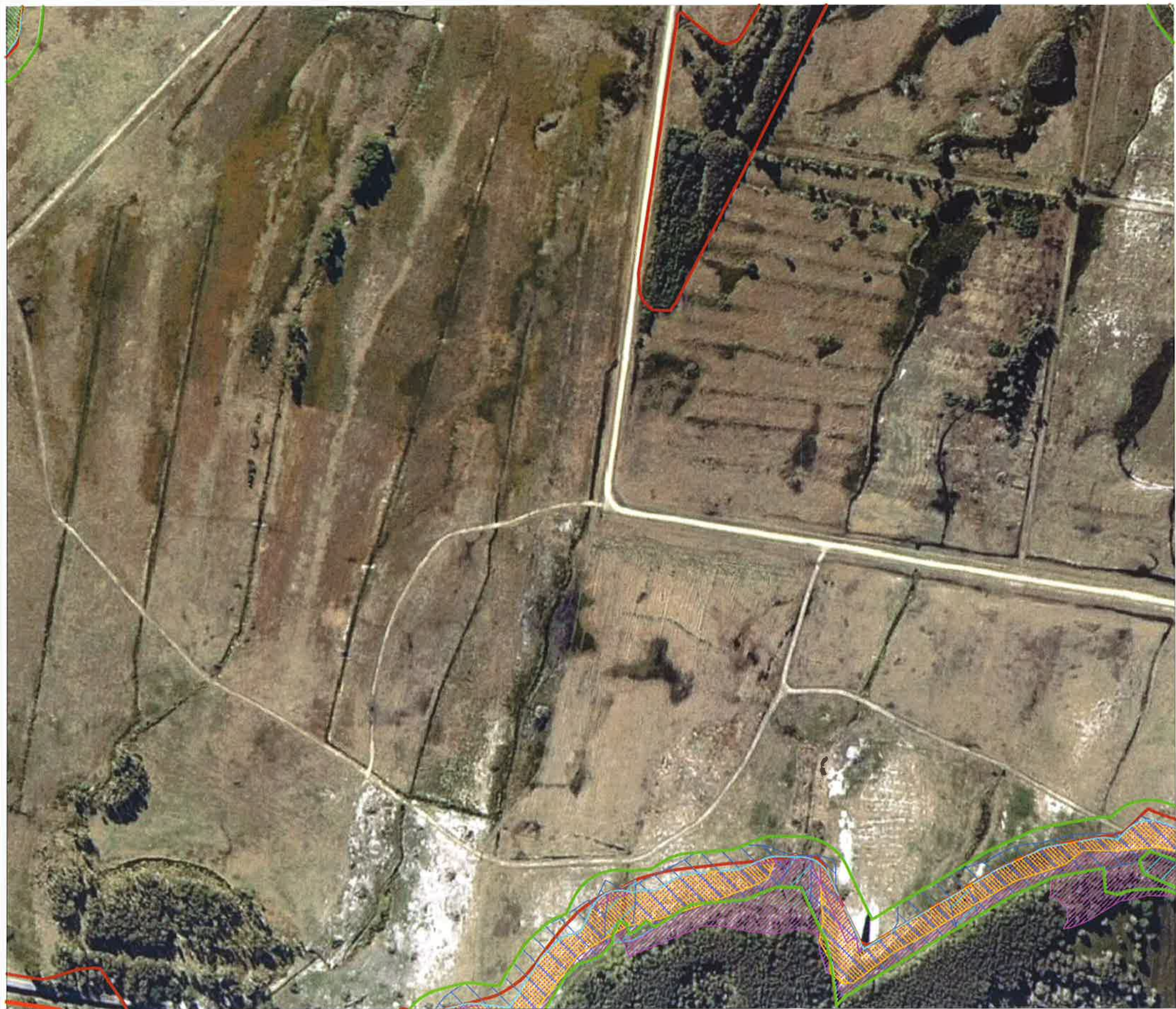
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10A

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



- LEGEND**
- Heath to be Naturally Regenerated
 - Heath to be Revegetated
 - Wallum Sedge Frog Compensatory Habitat
 - Wallum Froglet Compensatory Habitat
 - Koala Food Tree Planting Areas
 - Ecological Buffer (50m)
 - Inner APZ (30m)
 - Extent of Bulk Earthworks
 - Kings Forest Boundary

0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10B

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE
**PROPOSED
COMPENSATORY
HABITAT**



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10C

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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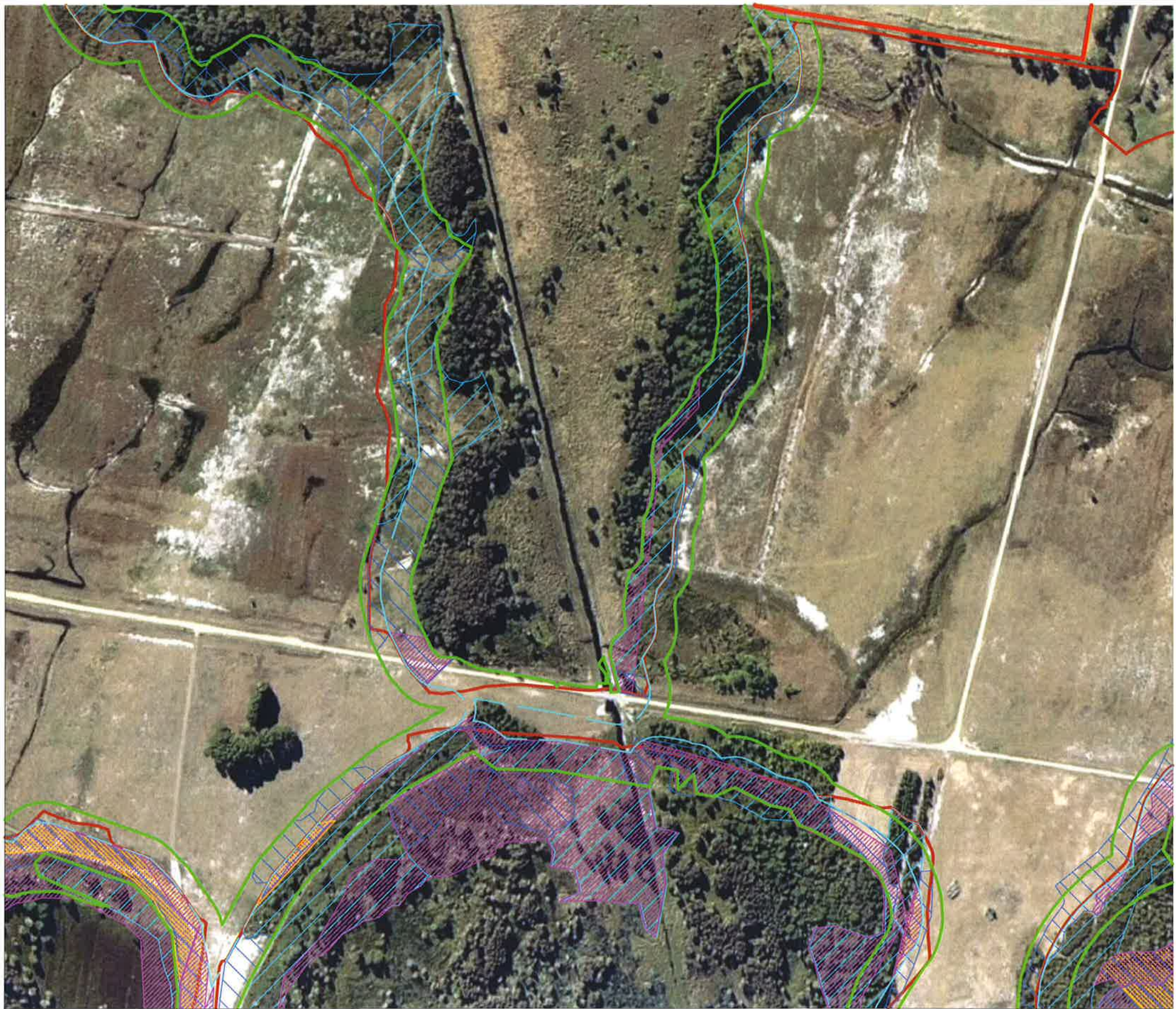
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10D

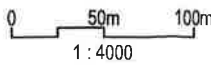
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DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



- LEGEND**
- Heath to be Naturally Regenerated
 - Heath to be Revegetated
 - Wallum Sedge Frog Compensatory Habitat
 - Koala Food Tree Planting Areas
 - Ecological Buffer (50m)
 - Inner APZ (30m)
 - Extent of Bulk Earthworks
 - Kings Forest Boundary

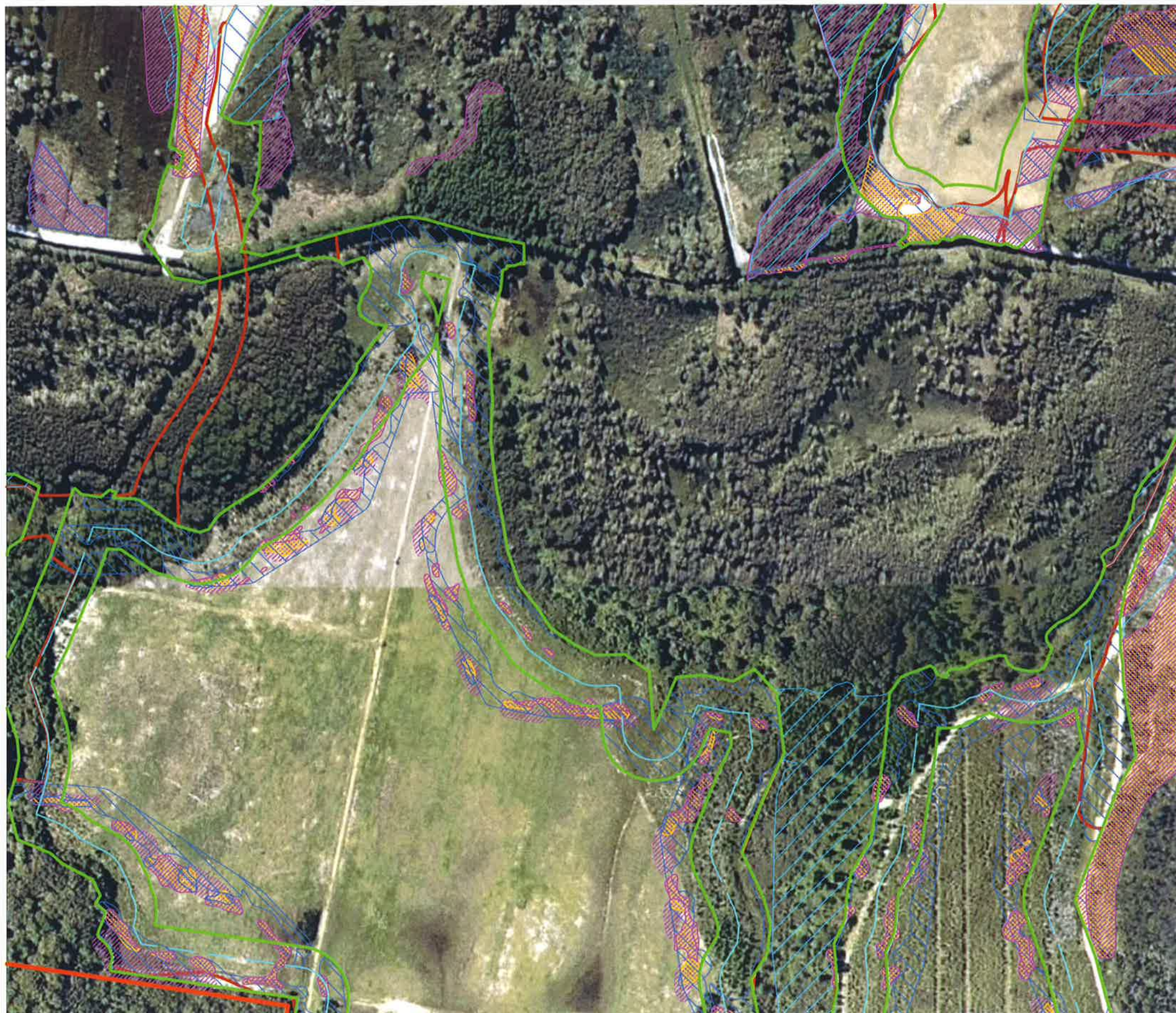


SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo
SCALE: 1 : 4000 @ A3
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PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10E
PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE
PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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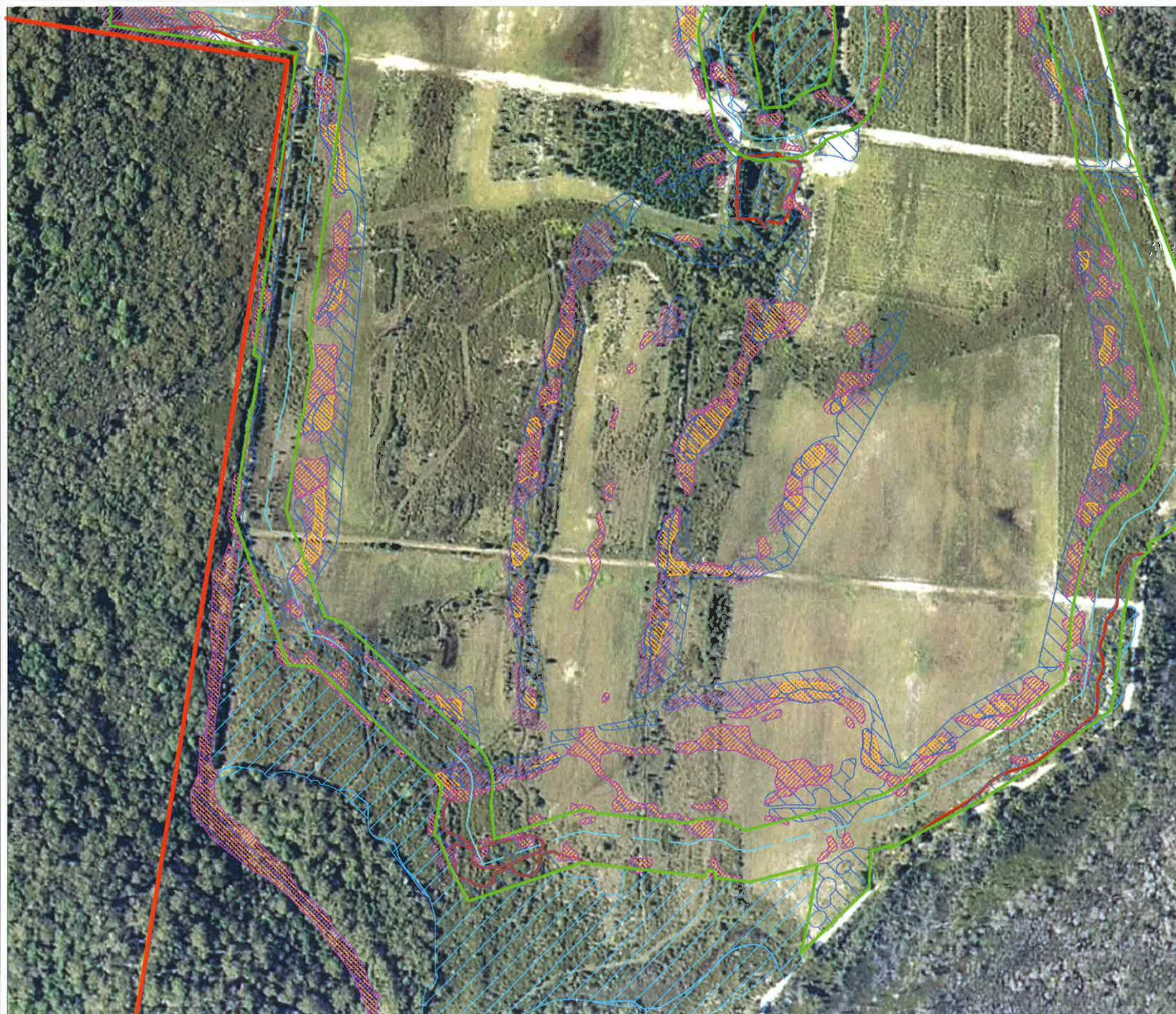
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10F

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10G

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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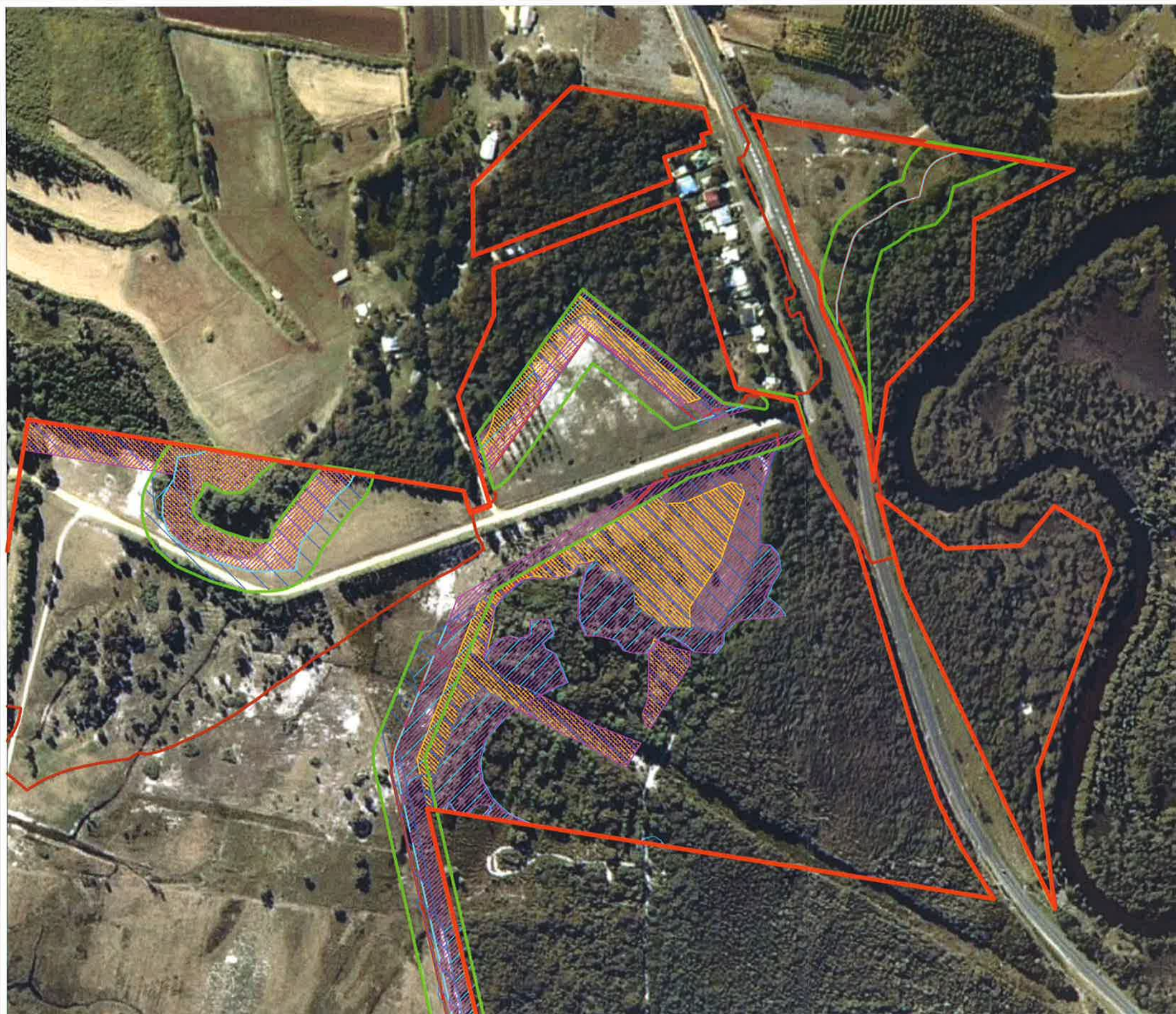
CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10H

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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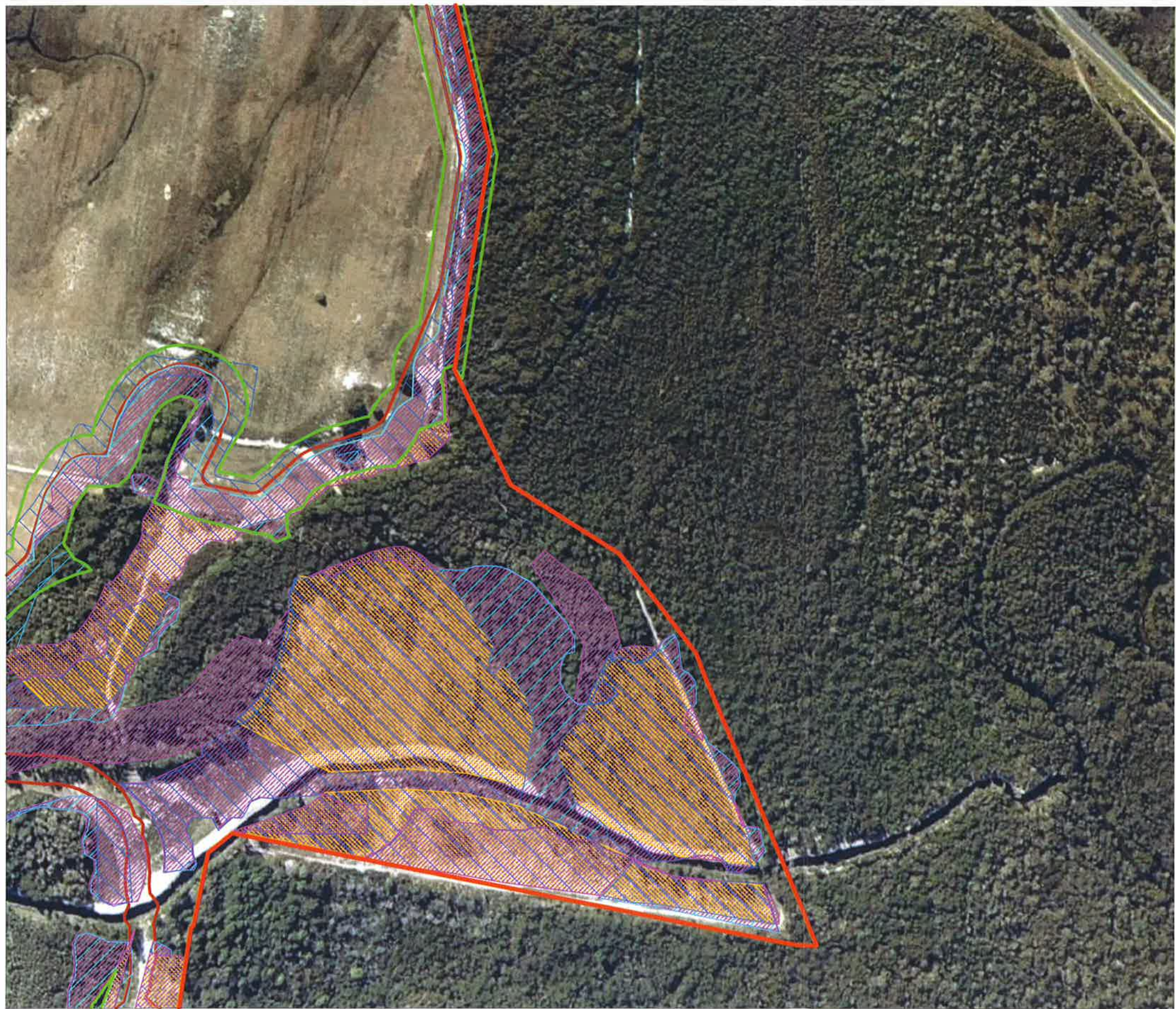
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 101

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



- LEGEND**
- Heath to be Naturally Regenerated
 - Heath to be Revegetated
 - Wallum Sedge Frog Compensatory Habitat
 - Koala Food Tree Planting Areas
 - Ecological Buffer (50m)
 - Inner APZ (30m)
 - Extent of Bulk Earthworks
 - Kings Forest Boundary



SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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PROJECT
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Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10J

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



- LEGEND**
- Heath to be Naturally Regenerated
 - Heath to be Revegetated
 - Wallum Sedge Frog Compensatory Habitat
 - Koala Food Tree Planting Areas
 - Ecological Buffer (50m)
 - Inner APZ (30m)
 - Extent of Bulk Earthworks
 - Kings Forest Boundary

0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1 : 4000 @ A3

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Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10K

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE
PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Heath to be Naturally Regenerated
- Heath to be Revegetated
- Wallum Sedge Frog Compensatory Habitat
- Koala Food Tree Planting Areas
- Ecological Buffer (50m)
- Inner APZ (30m)
- Extent of Bulk Earthworks
- Kings Forest Boundary



0 50m 100m
1:4000

SOURCE: JWA Site Investigations; Near Map
June 2011 Aerial Photo; LandPartner's 2007
Aerial Photo

SCALE: 1:4000 @ A3

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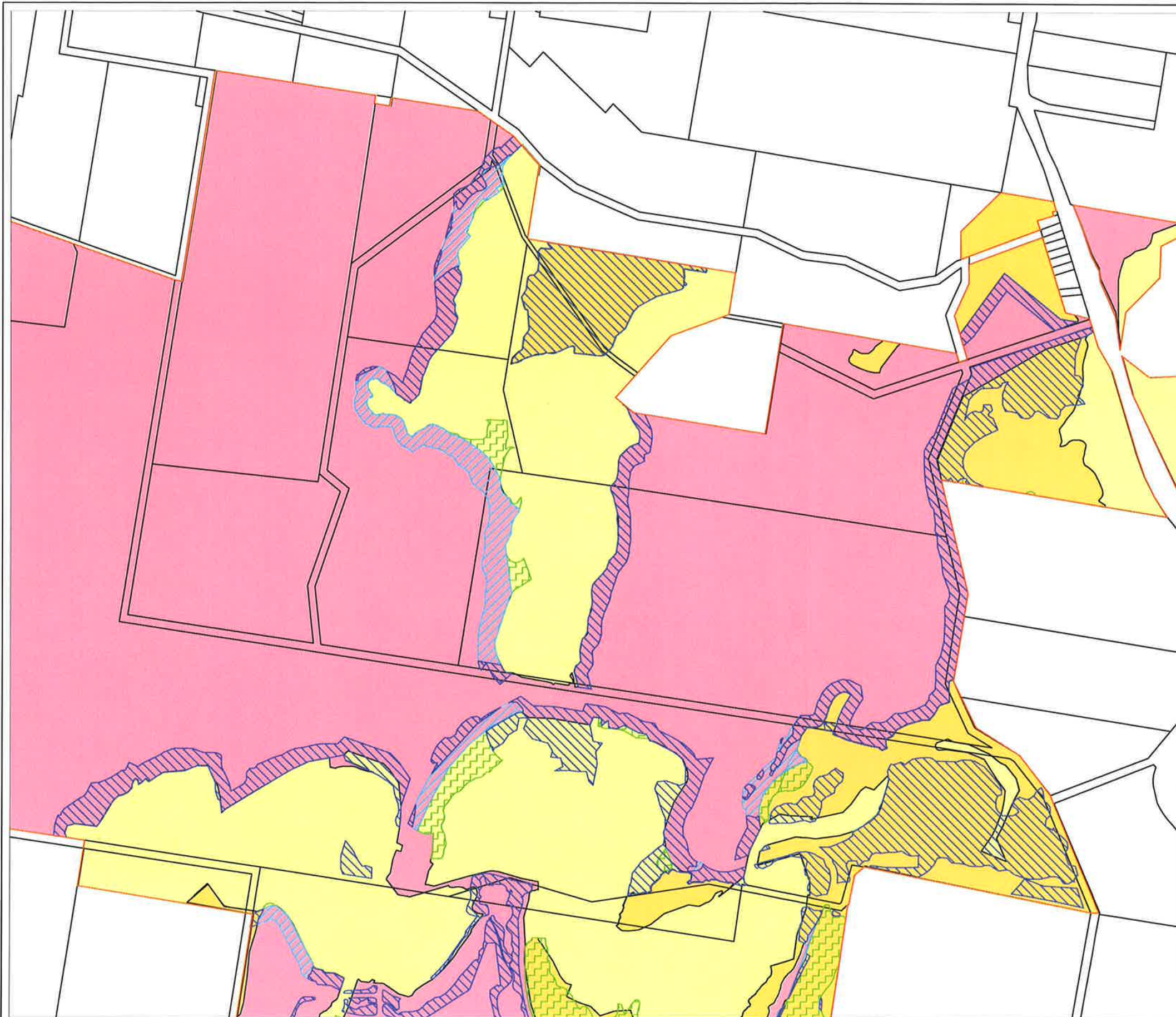
CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precinct 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 10L

PREPARED: BW
DATE: 15 October 2012
FILE: N97017_BMP_Base.dwg

TITLE

PROPOSED
COMPENSATORY
HABITAT



LEGEND

- Existing Heathland & Shrubland to be retained within Environmental Protection Zones (7.08ha)
- Heath to be Naturally Regenerated (8.46ha)
- Heath to be Revegetated (53.279ha)
- 2c Urban Expansion
- 7a Environmental Protection - Wetlands & Littoral Rainforests
- 7l Environmental Protection - Habitat
- Kings Forest Boundary



0 250m
1 : 10 000

SOURCE: JWA Site Investigations;
Landpartners (Ref: 00001056_C7_
PL4D Proposed Zoning Plan 11.03.08)
SCALE: 1 : 10 000 @ A3

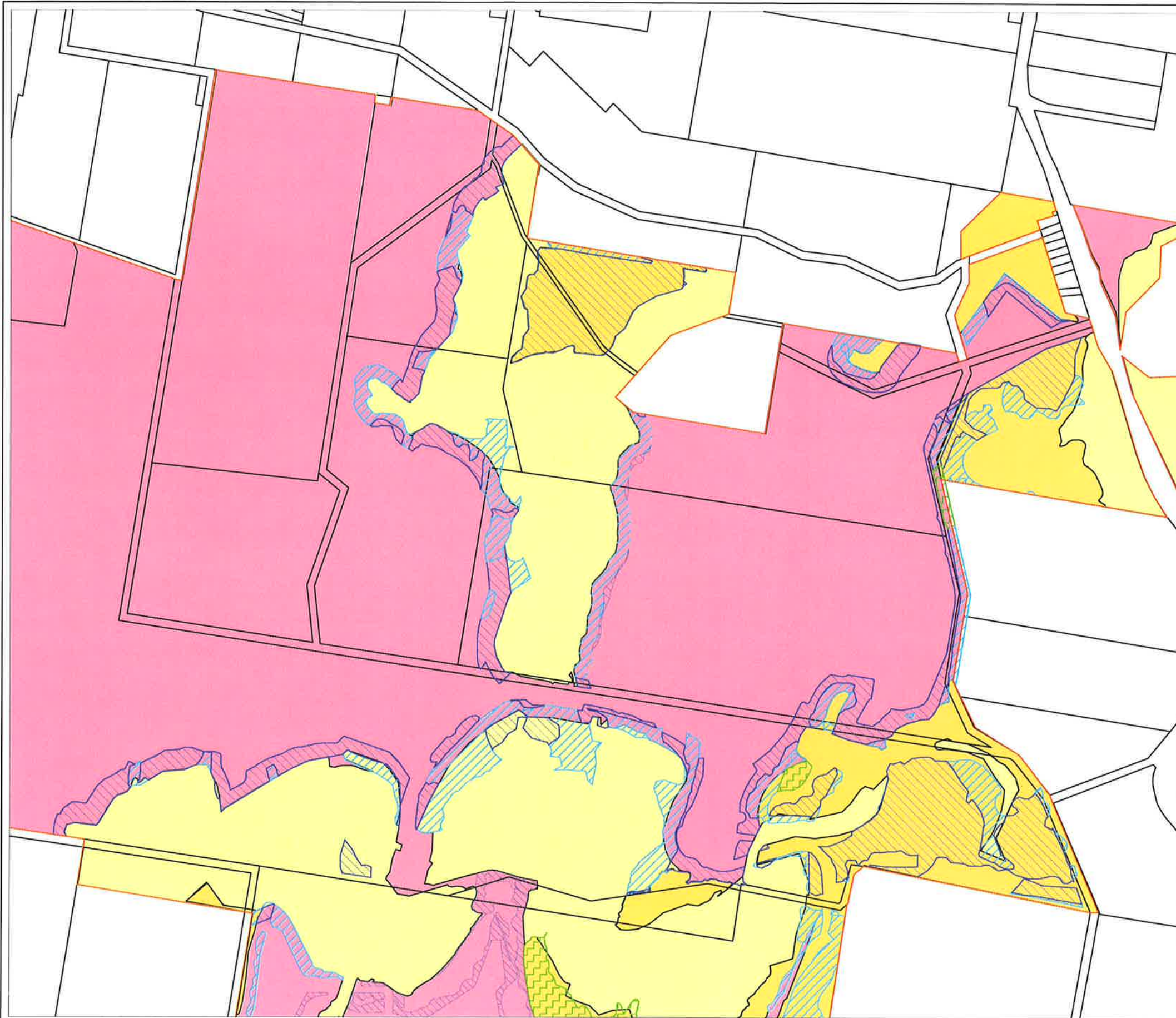
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PROJECT
Kings Forest Stage 1 Project Application
Precincts 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 11

PREPARED: BW
DATE: 20 August 2012
FILE: N97017_Heath.dwg

TITLE
2010 HEATH
REGENERATION
& REVEGETATION
AREAS



LEGEND

- Existing Heathland & Shrubland to be retained within Environmental Protection Zones (2.07ha)
- Heath to be Naturally Regenerated (24.79ha)
- Heath to be Revegetated (41.67ha)
- 2c Urban Expansion
- 7a Environmental Protection - Wetlands & Littoral Rainforests
- 7l Environmental Protection - Habitat
- Kings Forest Boundary



0 250m
1 : 10 000

SOURCE: JWA Site Investigations;
Landpartners (Ref: 00001056_C7_
PL4D Proposed Zoning Plan 11.03.08)
SCALE: 1 : 10 000 @ A3

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Kings Forest Stage 1 Project Application
Precincts 1 & 5 - Buffer Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 12

PREPARED: BW
DATE: 20 August 2012
FILE: N97017_Heath.dwg

TITLE
REVISED HEATH
REGENERATION
& REVEGETATION
AREAS