Figures

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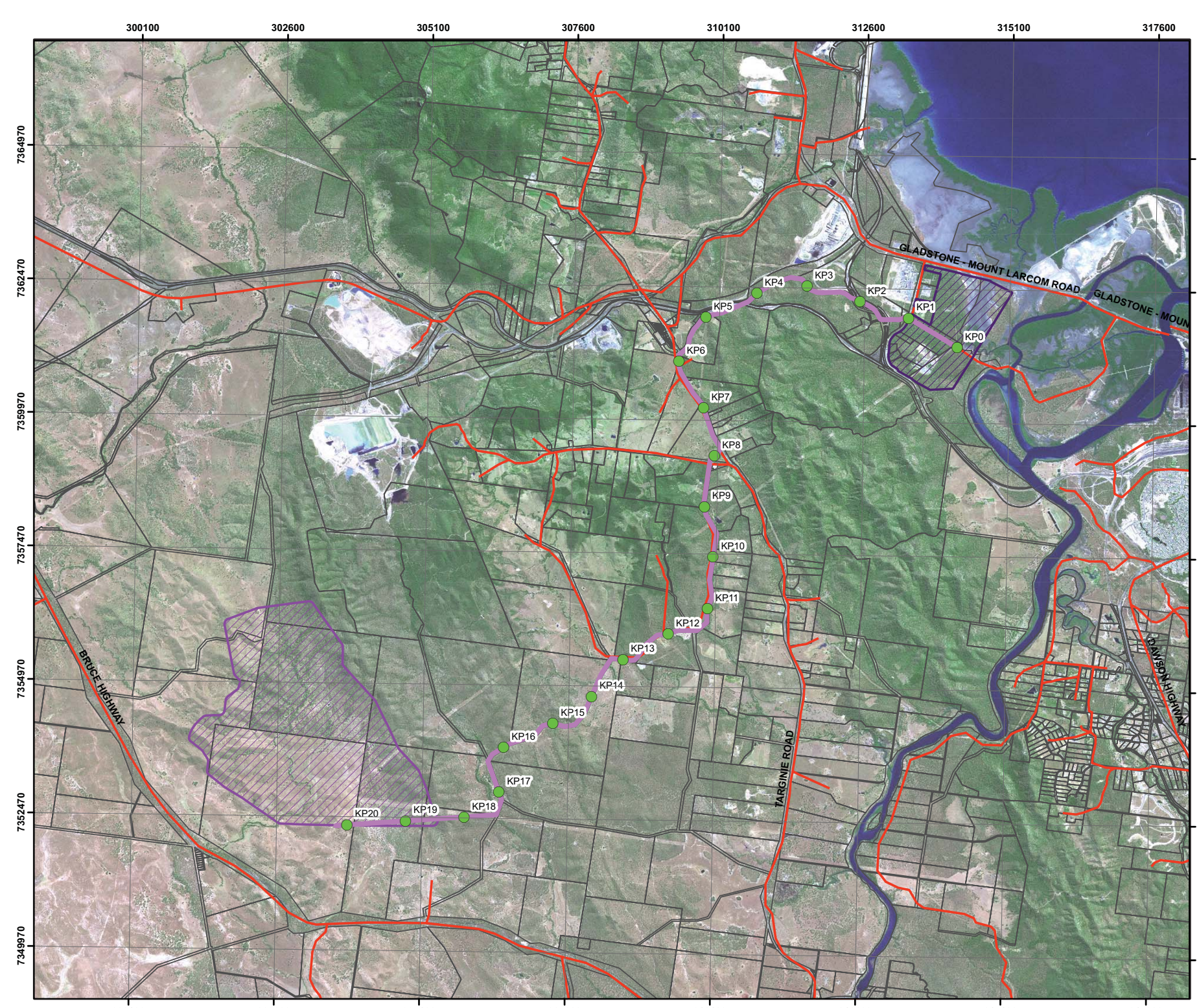


PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Alternate Residue Yarwun
- KPs (1km)
- RSF Boundary
- Yarwun Boundary
- Roads
- DCDB

N

Datum GDA94 56s

0 0.4 0.8 1.6 2.4

Kilometres

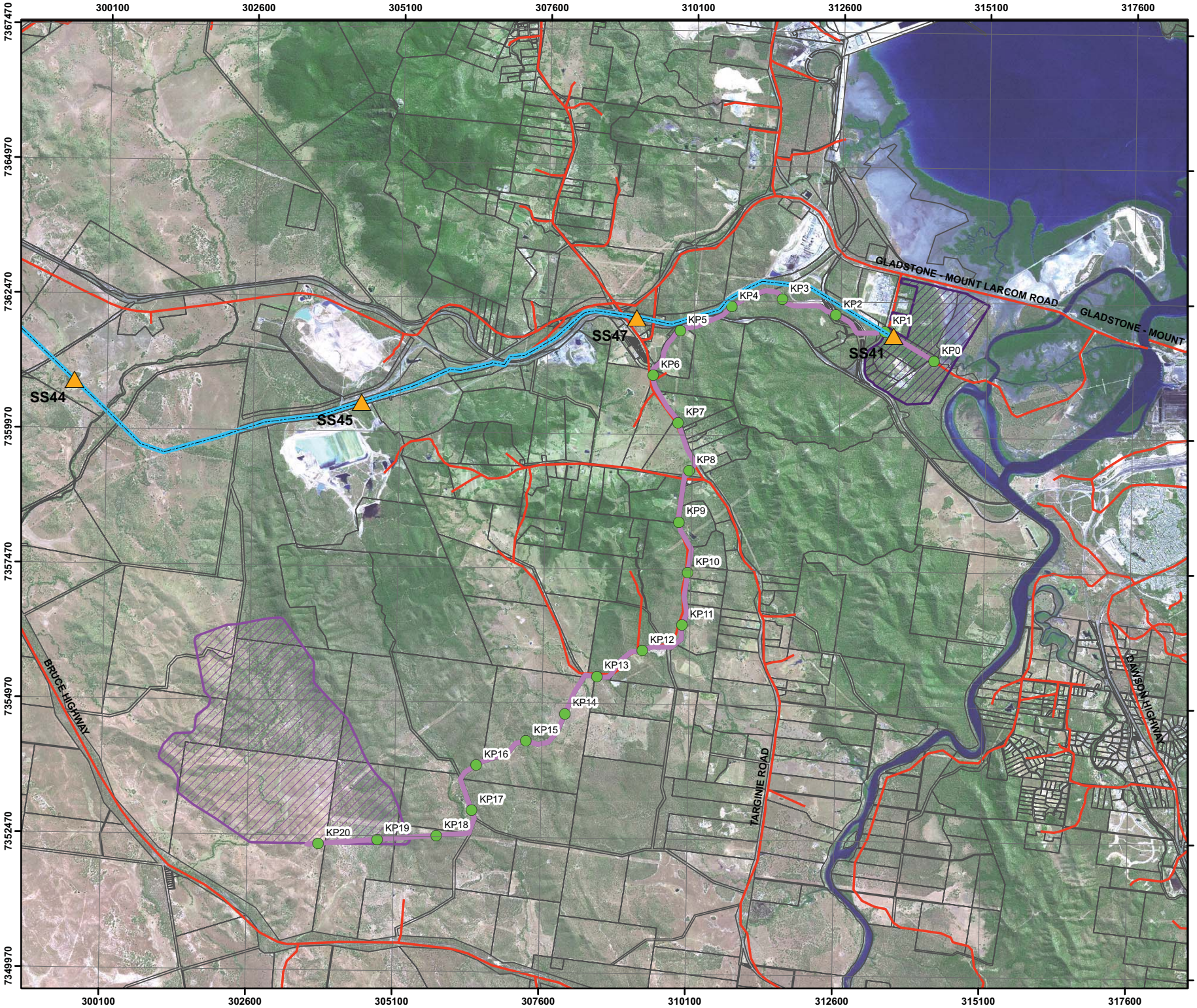
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery, RSF Boundary & imagery supplied by RLMS. 2007. (c) RLMS, 2007.
DCDB & roads sourced from the Department of Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Locality
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F1



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Soil Sampling Sites
- Alternate Residue Yarwun
- KPs (1km)
- Former Alignment Option
- RSF Boundary
- Yarwun Refinery
- Roads
- DCDB

N

Datum GDA94 56s

0 0.4 0.8 1.6 2.4

Kilometres

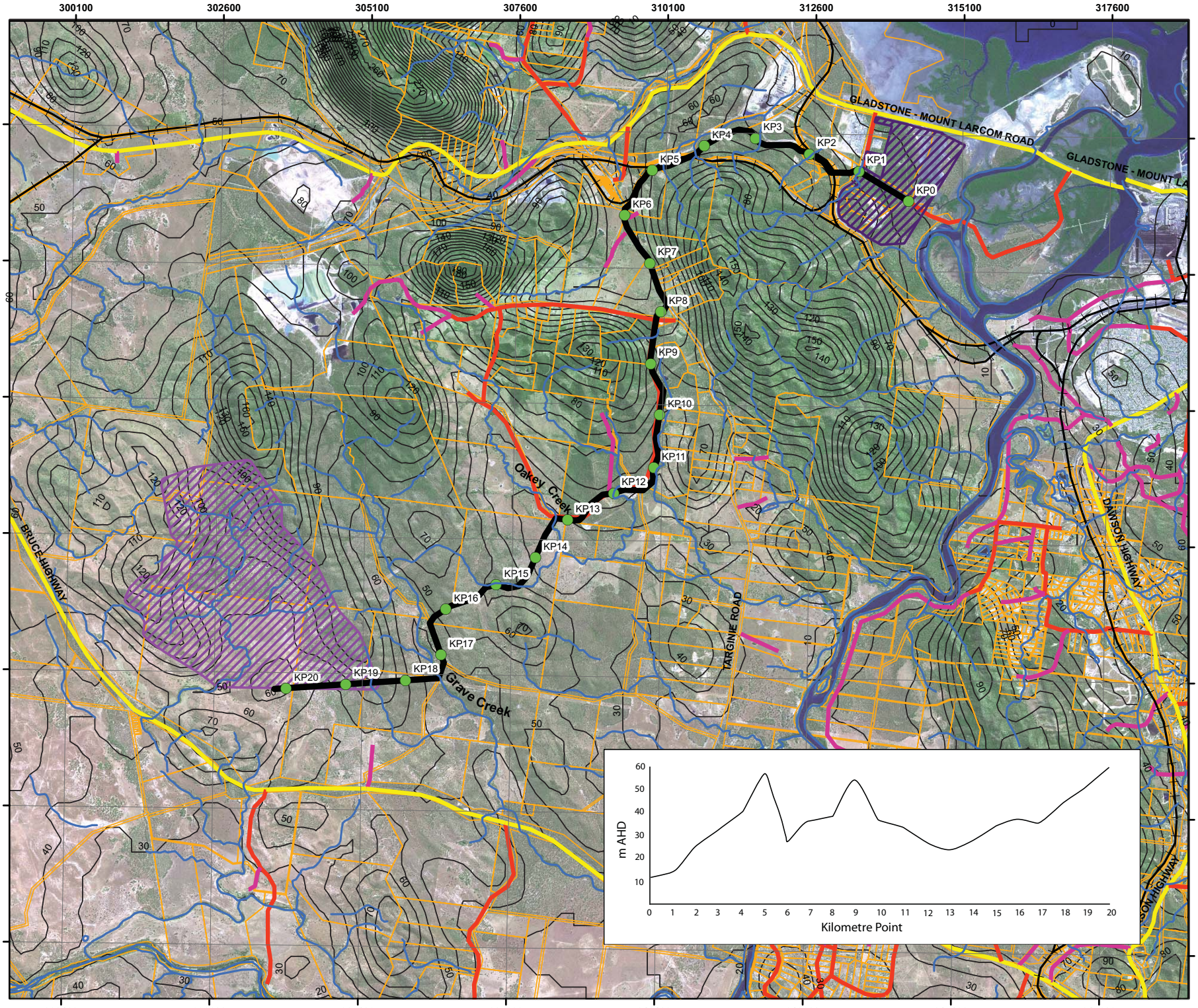
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery, RSF Boundary & imagery supplied by RLMS. 2007. (c) RLMS, 2007.
DCDB & roads sourced from the Department of Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Soil Survey Sites
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F2



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Alternate Residue Pipeline
- KPs (1km)
- RSF Boundary
- Yarwun Refinery
- Railway Line
- Minor Road
- Principal Road
- Track
- DCDB
- Contours
- Waterways

N

Datum GDA94 56s

0 0.375 0.75 1.5 2.25

Kilometres

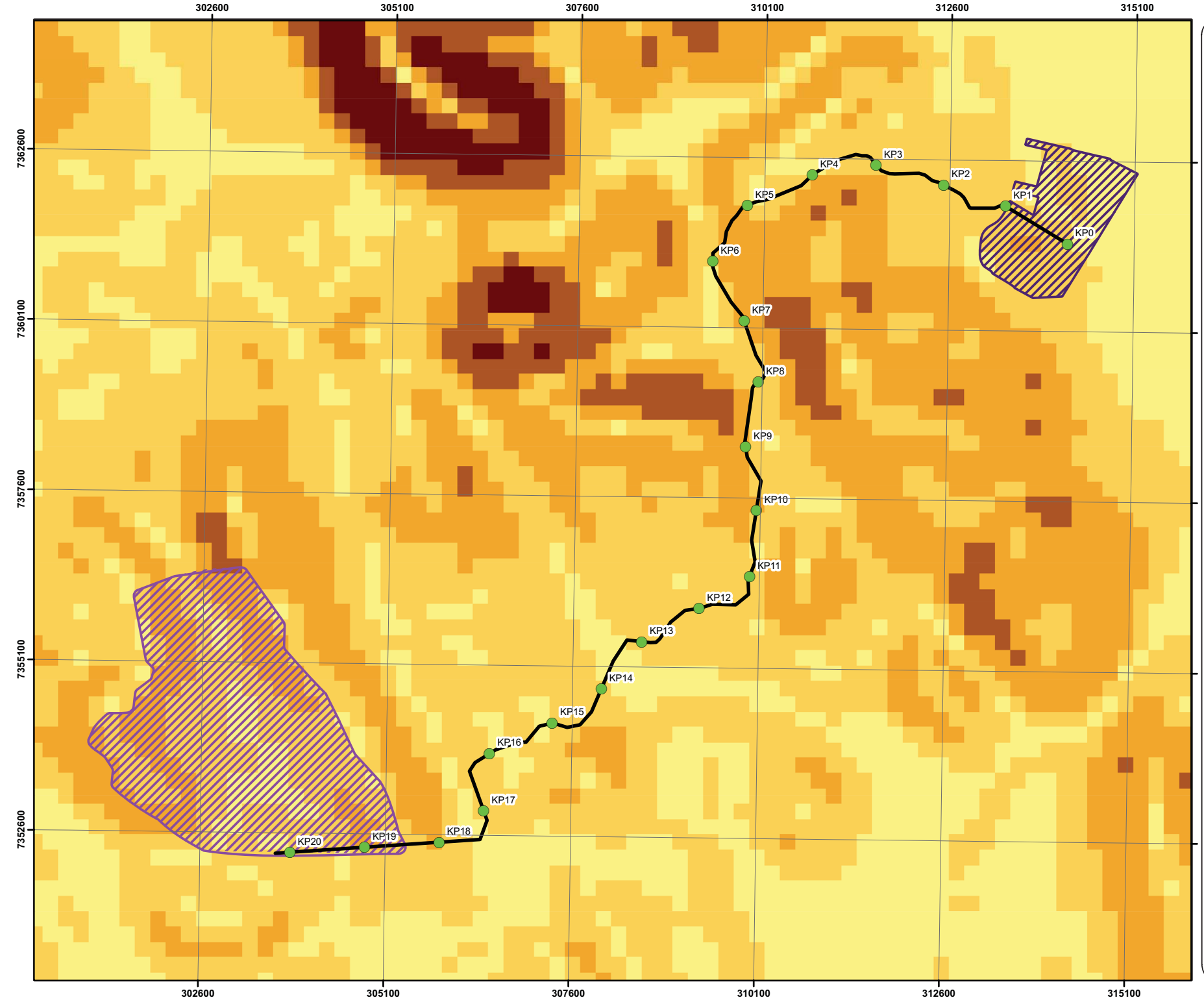
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery, RSF Boundary & imagery supplied by RLMS. 2007. (c) RLMS, 2007. Contours, DCDB, roads & railway sourced from the Department of Natural Resoures & Water, 2005. (c) NRW, 2007. Based on or contains DEM data provided by the Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Topography
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F3



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Alternate Residue Yarwun
- KPs (1km)
- RSF Boundary
- Yarwun Refinery

Slope

- 0 - 2%
- 3 - 4%
- 5 - 10%
- 11 - 80%
- > 80%

N

Datum GDA94 56s

0 0.35 0.7 1.4 2.1

Kilometres

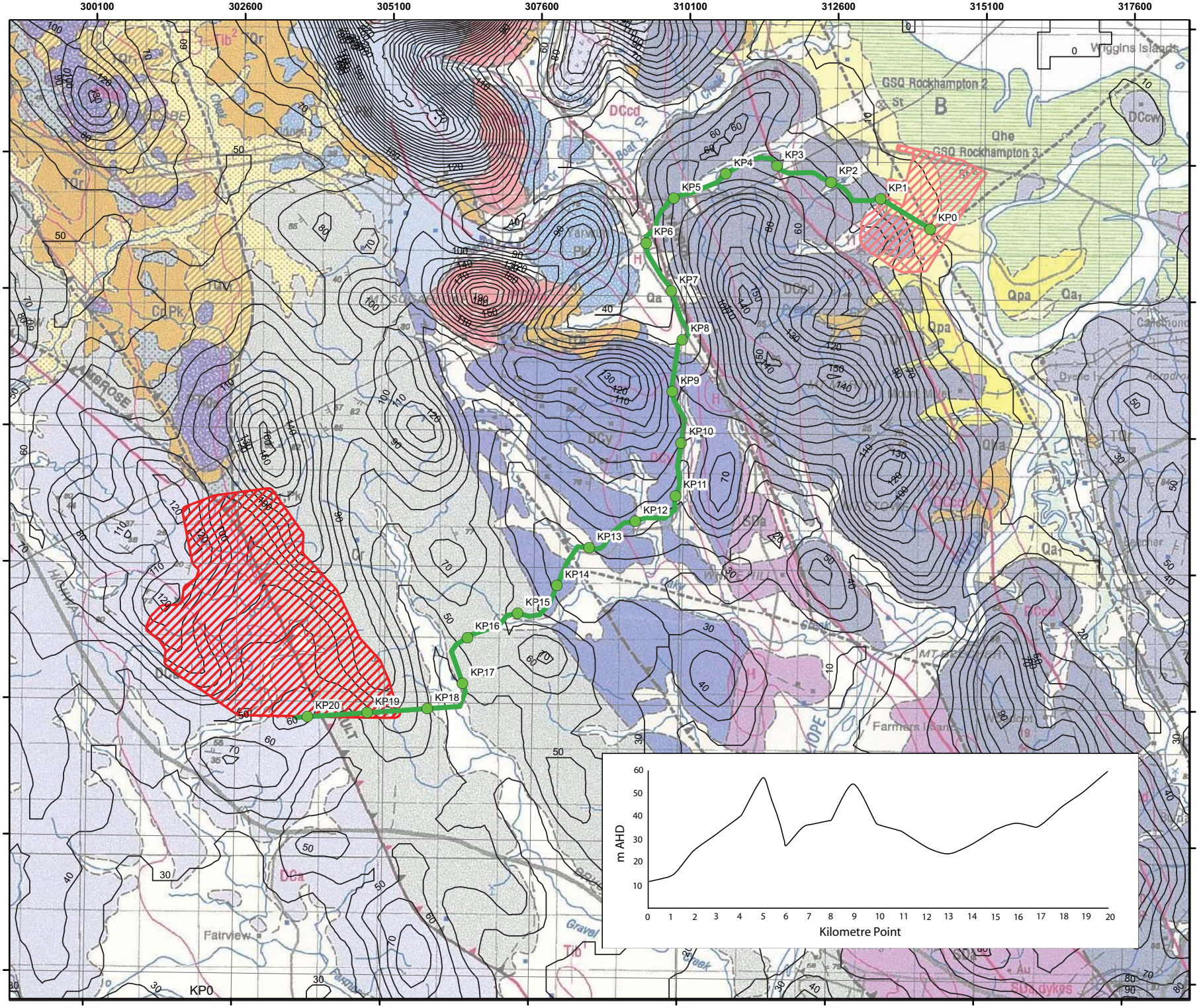
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery & RSF Boundary supplied by RLMS. 2007. (c) RLMS, 2007.
Based on or contains DEM data sourced from the Department of Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Slope Analysis
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F4



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Altenate Residue Pipeline
- KPs (1km)
- Yarwun Refinery
- RSF Boundary
- Contours

N

Datum GDA94 56s

0 0.375 0.75 1.5 2.25

Kilometres

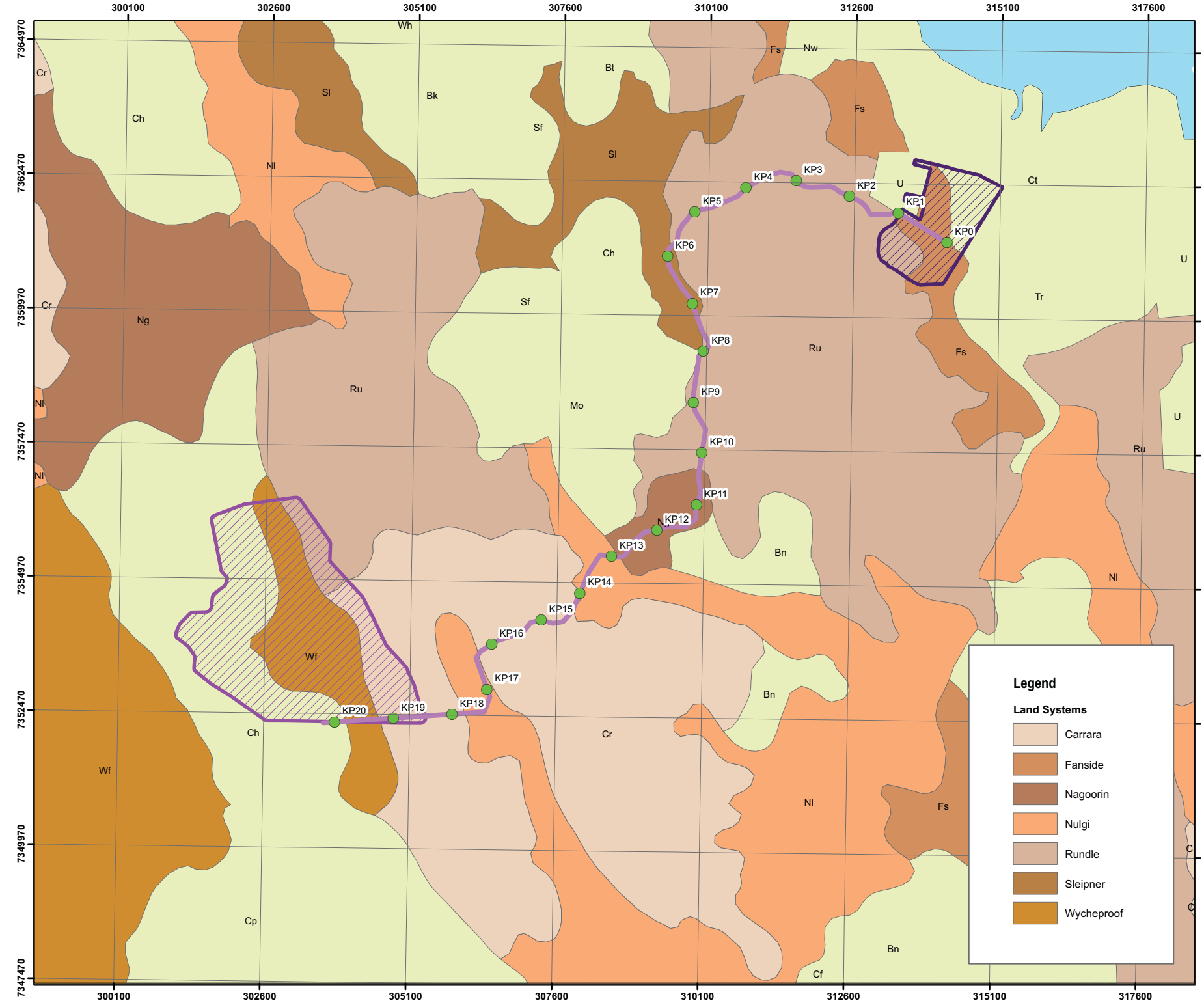
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery, RSF Boundary supplied by RLMS. 2007. (c) RLMS, 2007. Geology data sourced from the Department of Natural Resources & Water, 2001. (c) NRW, 2007. Based on or contains DEM data provided by the Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Geology and Cross-section
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F5



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Alternate Residue Yarwun
- KPs (1km)
- Yarwun Refinery
- RSF Boundary

N

Datum GDA94 56s

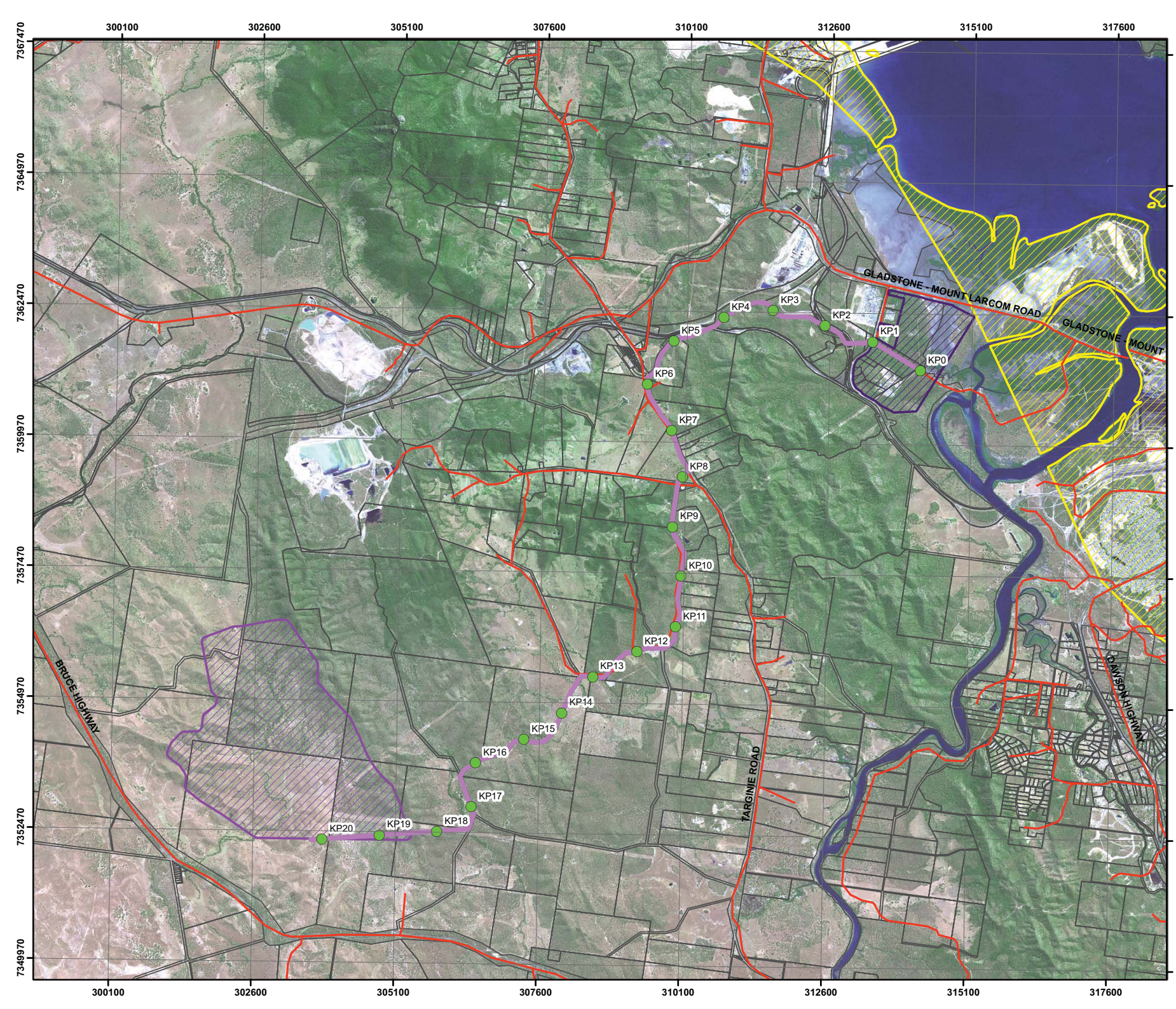
0 0.375 0.75 1.5 2.25
Kilometres
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery, RSF Boundary supplied by RLMS. 2007. (c) RLMS, 2007. Land systems data sourced from the Department of Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Land Systems
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F6



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Indicative locations of Acid Sulfate
- Alternate Residue Yarwun
- KPs (1km)
- RSF Boundary
- Yarwun Refinery
- Roads
- DCDB

N

Datum GDA94 56s

0 0.4 0.8 1.6 2.4

Kilometres

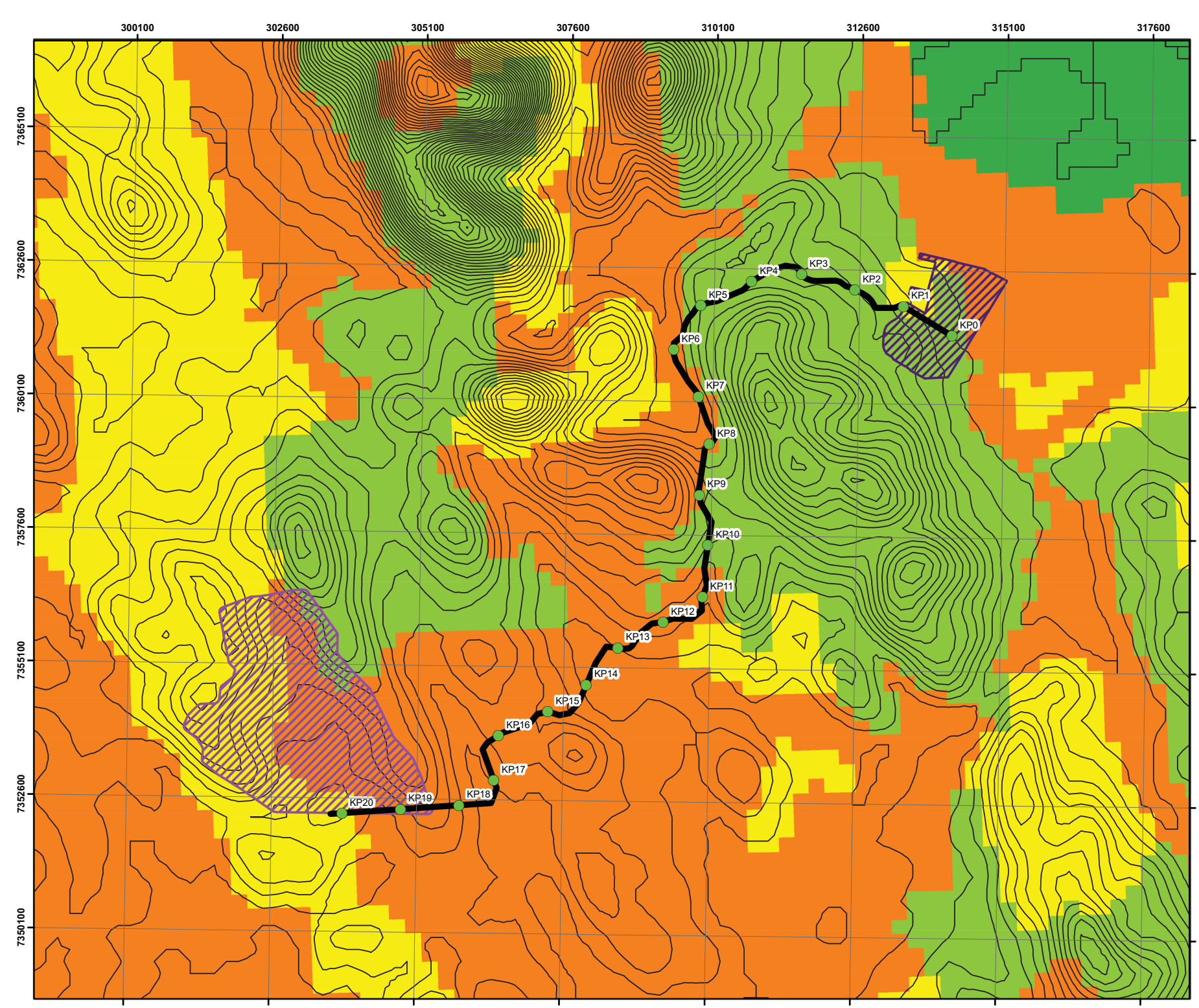
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery, RSF Boundary & imagery supplied by RLMS. 2007. (c) RLMS, 2007.
Acid Sulfate, DCDB & roads data sourced from the Department of Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Acid Sulfate
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F7



PROJECT NUMBER B6018400301
DATE August 2007
DRAWN CS
VERSION A

Legend

- Alternate Residue Yarwun
- KPs (1km)
- RSF Boundary
- Yarwun Refinery
- Contours

Erosion Resistance

- High
- Medium High
- Medium
- Medium Low
- Low

N

Datum GDA94 56s

0 0.3750.75 1.5 2.25
Kilometres
1:65,000 at A3

Source:
Alternate Residue Yarwun, Yarwun Refinery & RSF Boundary supplied by RLMS. 2007. (c) RLMS, 2007.
Based on or contains data provided by the Natural Resources & Water, 2005. (c) NRW, 2007.

Proposed Alternate Residue Pipeline Erodibility
RLMS
Alternative Residue Yarwun
Pipeline Route
Gladstone

HLA

Figure
F8

Appendix A: Terrain Units and Soil Types Identified in URS, 2007

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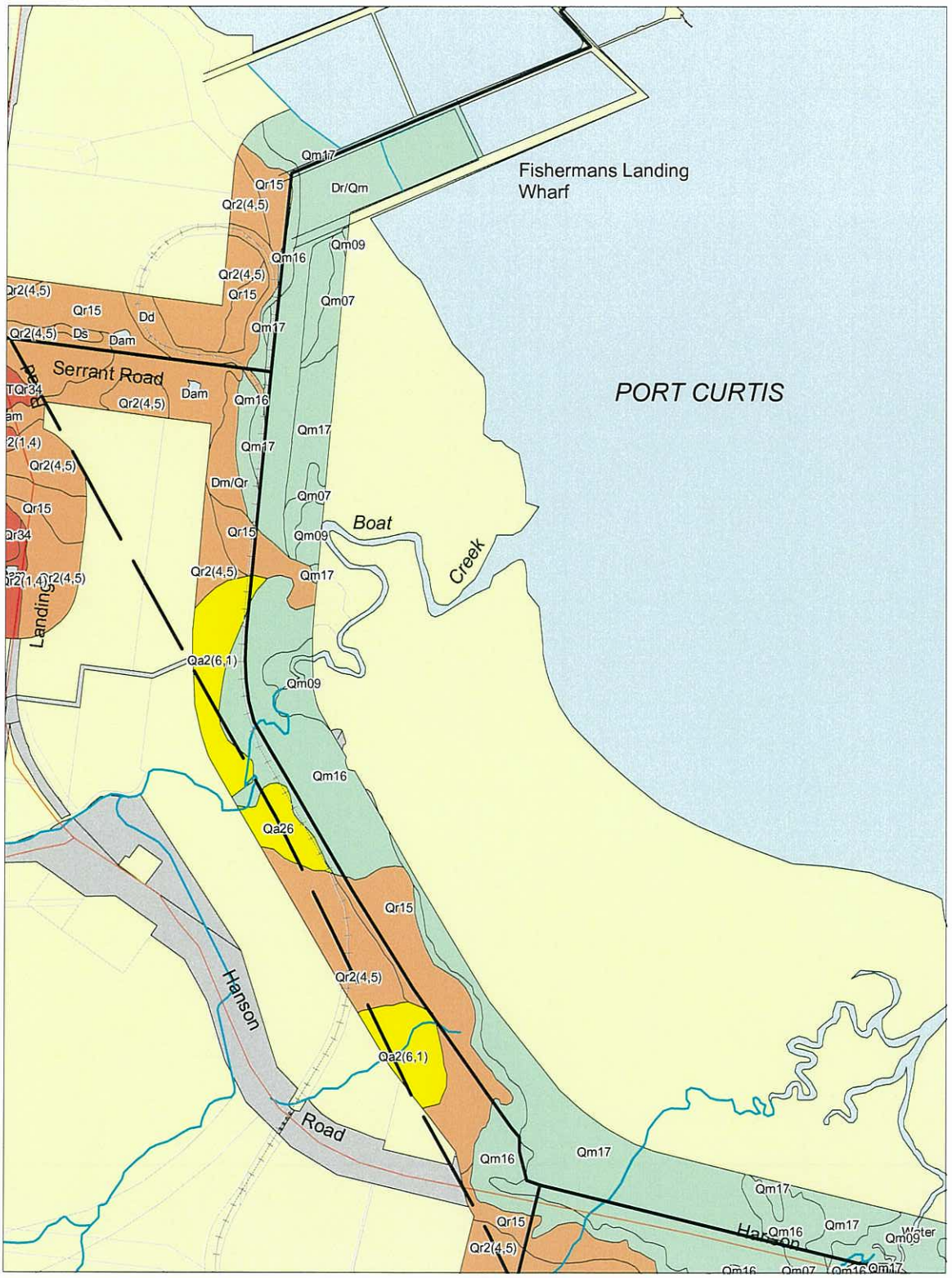

Note: Refer to Table 10.1.1 for a Key to the Identification of Terrain Units.

0 500m 1000m

Scale 1:25000 (A4)

LG Chem Boundary

Proposed Pipeline Routes

Inferred Fault Line (Department of Mines 1983)

Dw84 Terrain Unit Boundary and Symbol

Sample Location

Client: LG CHEM	Project: ENVIRONMENTAL IMPACT STATEMENT GLADSTONE CA/EDC PLANT		Title: TERRAIN UNITS PLANT SITE TO WHARF CORRIDOR
URS	File: 51520-003-g-116.wor Date : 04/02/03 Checked: AJD Revision: A Approved: CMP	51520-003-559	Figure: 10.1.2 A4

Appendix 2

Flora and Fauna Assessment for Alternate Residue Pipeline – Gladstone Nickel Project HLA Envirosciences Pty Ltd

Flora and Fauna Assessment for Alternative Residue Pipeline Gladstone Nickel Project

1 November 2007

Prepared for:
RLMS
GPO Box 2292
Brisbane Qld 4001

Report by:
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HLA Ref: B60184001_ARP_RPTFinal_1Nov07.doc

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DISTRIBUTION

Flora and Fauna Assessment for Alternative Residue Pipeline
Gladstone Nickel Project
1 November 2007

Copies	Recipient	Copies	Recipient
3 + 1 CD	**Kym Davie** **RLMS** **Level 5, 379 Queens Street** GPO Box 2292 Brisbane Qld 4001		
1	**HLA-Envirosciences Pty Limited (HLA ENSR)** Project File		

This document was prepared for the sole use of RLMS and the regulatory agencies that are directly involved in this project, the only intended beneficiaries of our work. No other party should rely on the information contained herein without the prior written consent of HLA-Envirosciences Pty Limited (HLA ENSR) and RLMS.

By

HLA-Envirosciences Pty Limited (HLA ENSR)
ABN: 34 060 204 702
Level 1, 57 Berwick Street Fortitude Valley QLD 4006
PO Box 720 Fortitude Valley QLD 4006

Con Lokkers
Associate Environmental Scientist

David Fleming
Environmental Scientist

Peer Reviewer: **Date:** 2/11/07

Steve Fox
Workgroup Manager – Environmental Services

Peer Reviewer: Date:

_____

Steve Fox
Workgroup Manager – Environmental Services

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GLOSSARY OF TERMS

ARP	Alternative Residue Pipeline
CORVEG	Queensland Herbarium database of vegetation field data
DEW	Department of the Environment and Water Resources
EPA	Environmental Protection Agency
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVR species	Species listed as Endangered, Vulnerable or Rare under Commonwealth or State legislation
GPN	Gladstone Pacific Nickel
HDD	Horizontal Directional Drilling
HERBRECS	Queensland Herbarium database of flora specimen collections
NC Act	*Nature Conservation Act 1992*
RE	Regional Ecosystem
RSF	Residue Storage Facility
VM Act	*Vegetation Management Act 1999*

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EXECUTIVE SUMMARY

Gladstone Pacific Nickel proposes to construct a residue pipeline from a refinery site near Yarwun to a residue storage facility (RSF) approximately 14 km south-west of the refinery. The primary alignment runs mostly in road reserves and adjacent to existing and previous rail corridors, with a total length of approximately 20.2 km. A second proposed alignment involves horizontal directional drilling (HDD) from the refinery site to approximately KP 9.3 of the primary alignment. A third alignment follows a generally similar path to the primary alignment, but runs mostly outside road reserves.

HLA – Envirosciences Pty Limited (HLA-ENSR) has conducted desktop and field assessments of potential impacts of construction and maintenance of the proposed residue pipeline. Assessments have concentrated on the primary alignment, but the other options were also investigated. Mitigation measures to avoid or minimise impacts have been recommended based on the results of these investigations.

Constraints identified along the proposed alternate residue pipeline primary alignment included:

- Clearing of up to 33.5 ha of remnant vegetation (although this figure is likely to be substantially lower due to existing clearing within road reserves);
- Mount Stowe State Forest adjoining the alignment from KP 9.0-13.2;
- Narrow corridor of remnant vegetation along the alignment from KP 13.2-15.6;
- Small patches of Endangered vegetation (RE 11.11.18 and RE 11.3.11) lying just west of the cleared road corridor at KP 8.15-8.3 and north-west of the cleared road corridor at KP 12.8-12.9;
- Small strips of Of Concern vegetation (RE 11.3.4) transected by the alignment at KP13.2-13.4, KP 14.5-14.6 and KP 14.9-15.0;
- Of Concern vegetation (RE 12.11.14) transected by the alignment from KP 4.4-4.8;
- Small creek and Of Concern vegetation (RE 11.3.4) lying just east of the alignment from KP 10.3-11.5;
- Of Concern vegetation (RE 11.3.4) lying just east of the alignment from KP 5.9-6.3; and
- Not of Concern communities transected by or adjacent to about 10.1 km of the alignment.

Field surveys did not detect any flora or fauna species that are considered to be Endangered, Vulnerable or Rare (EVR) under Australian or State legislation. However, potential habitat was recorded for 10 EVR flora species and 13 EVR fauna species. The alignment contains potential habitat for 57 fauna species of Regional Significance and 4 of these species were recorded during field surveys. Provided suitable mitigation measures are implemented during construction and maintenance activities, no significant impacts on these species are considered likely.

The second alignment (HDD from KP 0-9.3) is likely to limit surface impacts to entry and exit points and associated lay down areas. However, detailed assessment of impacts associated with this proposal requires further information on construction techniques (including dimensions of disturbance areas), which were not available at the time of preparation of this report.

The third alignment (primarily outside road reserves) is considered to have generally greater impacts than the primary alignment. These include transecting the Endangered RE at KP 8.15-8.3, transecting State Forest at KP 6.0-6.4 and impacting on a small creek from KP 10.3-11.5.

From an ecological perspective, Alignment 1 is the preferred option for the majority of the residue pipeline route. Alignment 2 (HDD route) may be the preferred option for the section of the route from KP 0-9.3, depending upon assessment of the proposed entry / exit points. Further investigations into the feasibility and potential ecological impacts of the proposed HDD route are recommended, if this option is to proceed further.

Specific mitigation measures recommended to minimise ecological impacts of the primary alignment include:

- From KP 9.0-13.2, minimise indirect impacts of clearing and associated disturbances adjacent to the Mount Stowe State Forest west of the road reserve;
- From KP 8.15-8.3, ensure clearing and disturbance do not impact on the Endangered vine thicket community (RE 11.11.18) west of the existing road clearing;
- From KP 12.8-12.9, ensure clearing and disturbance do not impact on the Endangered vine thicket community (RE 11.3.11) north-west of the existing road clearing;
- From KP 4.4-4.8, move the alignment 50 m northwards to avoid Of Concern Ironbark woodland (RE 12.11.14);
- From KP 5.9-6.3, minimise impacts of clearing and disturbance on Of Concern Blue Gum / Ironbark woodlands (RE 11.3.4) east of the road reserve;
- From KP 10.3-11.5, minimise impacts of clearing and disturbance on the small creek and Of Concern Blue Gum / Ironbark woodlands (RE 11.3.4) east of the road reserve;
- From KP 13.2-15.6, move the alignment 50 m eastwards and southwards to avoid a narrow corridor of remnant vegetation that connects two large remnant blocks; and
- Minimise the width of corridor clearing at KP 13.2-13.4, KP 14.5-14.6 and KP 14.9-15.0 to minimise impacts on Of Concern Blue Gum / Ironbark woodlands (RE 11.3.4).

These specific mitigation measures aim to minimise impacts of the proposed pipeline on Endangered REs, Of Concern REs and Mount Stowe State Forest. State regulatory authorities give more stringent protection to Endangered and Of Concern REs and State Forest, while Commonwealth legislation protects the Endangered vine thicket communities.

Provided that general mitigation measures recommended in this report are followed, significant ecological impacts from the construction and maintenance of the proposed residue pipeline are likely to be limited to the direct impact of clearing up to 33.5 ha of remnant vegetation. As portions of the proposed alignment are already partially cleared, actual clearing requirements will be substantially less, estimated to be in the order of 20-25 ha.

1 INTRODUCTION

RLMS has commissioned HLA-Envirosciences Pty Limited (HLA ENSR), a subsidiary of ENSR Corporation (an AECOM company), to conduct a flora and fauna assessment for a proposed alternative residue pipeline. GPN has proposed this alignment as an alternative to the original alignment, which was assessed previously (HLA, 2006). The residue pipeline will run from the Gladstone Pacific Nickel Limited (GPN) Refinery near Yarwun to the proposed RSF, approximately 14 km to the south-west of the refinery. The study area is located approximately 10 km west of Gladstone in Calliope Shire and is shown in **Figure F1**.

An alignment for the proposed residue pipeline has been provided which makes use of existing infrastructure corridors and road reserves (i.e. Alignment 1). In addition, two alternative alignments have been provided which include major deviations and other minor route changes from Alignment 1. Brief descriptions of the primary alignment and two alternatives are provided below.

Alignment 1 (primary route)
This alignment leaves the proposed refinery site and travels generally westwards beside rail corridors to the north of Mount Stowe State Forest. It joins the Calliope River Road just south of the township of Yarwun at KP 5.9, then follows the road reserve south until KP 7.8. It turns south-west to rejoin the road reserve at the junction of Spring Valley Road and Boyle's Road at KP 8.1. It travels within the road reserve of Boyle's Road until KP 13.2. It turns south to follow an unnamed road reserve until its intersection with a high voltage powerline corridor at KP 17.4 and then branches off westwards to the proposed residue dam. The total length of the primary alignment is approximately 20.2 ha.

Alignment 2
This alignment leaves the proposed refinery site in the south-west corner and follows a high voltage powerline easement which traverses Mount Stowe State Forest and Calliope Conservation Park. It is proposed to tunnel under the existing easement using Horizontal Directional Drilling (HDD). Although the entry and exit sites are yet to be determined, the pipeline would connect at approximately KP 9.3 of the Alignment 1 option and continue to the proposed residue dam as described above.

Alignment 3
This alignment is similar to that of the Alignment 1 option except for several deviations and other minor route changes. The primary deviations are described below:

- Following an existing electricity easement from KP 5.0 to the crossing of Calliope River Road at KP 6.8 and then passing in a straight line to the junction of Spring Valley Road and Boyles Road at KP 8.1;
- Following the western edge of Boyle's Road (outside the road reserve) to KP 13.0; and
- Branching off from Boyle's Road and continuing in a gentle arc to the proposed residue dam.

A discussion of the Alignment 1 option will form the basis of this report, with reference to the Alignment 2 and 3 options where relevant. All KP locations are given relative to Alignment 1. All three alignments are shown in **Figure F1**.

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2 SCOPE OF WORKS

The existing floral and faunal characteristics of the proposed residue pipeline were assessed using desktop and field studies, including:

- Collation and ground-truthing of Regional Ecosystem (RE) and Ecologically Sensitive Area (ESA) mapping;
- Collation of flora and fauna data from available data sources, including Endangered, Vulnerable and Rare species (EVR species);
- Targeted field surveys for EVR flora species;
- Field assessment of fauna habitat types and values;
- Field surveys for pest flora and fauna; and
- Incidental observations of other ecological constraints (e.g. erosion areas).

Information was used to:

- Assess potential impacts and constraints of the proposed pipeline alignments;
- Identify alignments that minimise impacts on flora, fauna, REs and ESAs; and
- Recommend appropriate mitigation measures to help avoid and minimise potential impacts on ecological features and values.

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3 ASSUMPTIONS AND LIMITATIONS

Access constraints limited the area that could be surveyed during the present study. Heavy rains limited access into low-lying areas along the proposed haul road during the first field trip in June. Substantial areas were accessible only by foot. Existing land tenure, land use and infrastructure (e.g. railway lines, conveyors) also constrained access to some areas.

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4 FLORA

4.1 Flora Assessment Methods

The flora assessment consisted of two stages: a desktop study followed by a field assessment of the proposed residue pipeline alignments. The flora assessment was conducted by Dr Con Lokkers (Associate Environmental Scientist) and Amy Kruger (Environmental Scientist).

4.1.1 Determination of Flora Species and Vegetation Community / RE Significance Level

The status of vegetation communities / REs is ascribed as per their listings in the EPBC Act as Critically Endangered, Endangered or Vulnerable and / or the VM Act as Endangered, Of Concern and Not of Concern.

Listed EVR flora taxa are defined as those taxa listed in the EPBC Act and / or the NC Act as Critically Endangered, Endangered, Vulnerable or Rare. All other native flora species have been designated as Least Concern.

4.1.2 Flora Desktop Assessment

The desktop components included:

- Review of the flora and fauna assessment for the residue pipeline and slurry pipeline originally proposed by GPN (HLA, 2006). This report assessed a 181 km pipeline alignment from the GPN mine site near Marlborough to the proposed refinery site located at Gladstone;
- Collection and review of existing Commonwealth Department of Environment and Water Resources (DEW) Protected Matters data and Queensland Herbarium HERBRECS and CORVEG data within a search area of approximately 55 km by 55 km centred on the alignments;
- Review of Queensland Herbarium RE mapping for a 10 km wide corridor centred on the alignments to identify those vegetation communities mapped by the Environmental Protection Agency (EPA) at a scale of 1:100 000;
- Review of ESAs mapped by the EPA within a search area of approximately 55 km by 55 km centred on the alignments;
- Examination of aerial and satellite imagery to gain an appreciation of the project's proximity to sensitive areas, assess vegetation patterns and identify target areas for field investigations; and
- Review of EPA Biodiversity Planning Assessment data to identify areas that are recognised as State, Regional or Local Biodiversity Significance or flagged as important for their integrated biodiversity values within close proximity to the project area. The study area lies within the Brigalow Belt North Bioregion.

It is recognised that the information gained from these databases has caveats attached to it regarding the robustness or completeness of the information.

HERBRECS and CORVEG data is based almost exclusively on plant specimens actually recorded as present in the given locations. The absence of any specimen records for a particular species from an area does not imply that the species does not occur in that area.

Data from the DEW Protected Matters website is based on a combination of actual records, primarily from State Government databases, combined with modelled distributions of species according to their ecological characteristics. It is generally considered to be a poor substitute for records of actual species occurrences. The mapping of a particular species in a search area does not guarantee that the species actually occurs in that area.

4.1.3 Flora Field Survey

Field assessments were conducted on two site visits from 21 to 23 June 2007 and from 14 to 15 August 2007, over a total period of 4.5 days. The first survey examined Alignment 3, but was impeded by heavy rain. The second survey assessed Alignments 1 and 2. Each survey examined a 30 m wide corridor, but assessed surrounding areas where relevant (e.g. to identify options for avoiding ecological constraints on the proposed alignment).

The field surveys included:

- Investigation of the presence / absence or likely presence / absence of EVR flora species and communities identified in Australian and State legislation;
- Ground truthing of 68 sites along the potential alignment options. Of these, 20 sites were detailed Tertiary level assessments and the remainder were assessed to Quaternary level. Quaternary assessments recorded dominant canopy species only while Tertiary assessments recorded an inventory of all woody flora species, their average height and their approximate abundance (including native and exotic flora species). At least one tertiary survey site was located within each RE type encountered along the alignment. Tertiary assessments also included targeted searches for potential EVR flora species and regionally significant species. Comprehensive flora species lists and detailed abundance data were not collected or considered necessary for the purposes of this assessment; and
- Observations on the wider environment of the pipeline alignments so that the potential impacts associated with proposed clearing could be discussed in the local, regional and State contexts.

The flora site surveys were in accordance with the Queensland Herbarium vegetation survey methods described in Neldner *et al.* (2005). The following data was collected for the Tertiary sites:

- Confirmation of mapped RE;
- General description of vegetation;
- Structural characteristics of vegetation (based on life forms, approximate height and canopy cover);
- Groundcover characteristics;
- Vegetation condition (integrity) (as either pristine, excellent, very good, good, average, degraded or completely degraded);
- Occurrence of weed species (especially species declared under State legislation);
- Dominant species in each structural component of the vegetation;
- Patch size and shape;
- Landscape characteristics;

- Soil characteristics; and
- Notes on particular sensitivities to the proposed impacts.

The locations of Tertiary and Quaternary flora assessment sites are described in **Appendix A**. Locations of tertiary sites are mapped in **Figure F2a**. Tertiary flora assessment data sheets are included in **Appendix B**.

GPS coordinates were taken using hand held GPS (accuracy +/- 10-20 m) to identify locations of EVR flora species and to assist in validating the existing Queensland Herbarium RE mapping. The general distributions of declared and other significant pest plants within the corridor were also noted.

4.2 Results

4.2.1 Environmentally Sensitive Areas and Other Landscape Features

Queensland EPA mapping (EPA, 2007a) identifies the following ESAs that are transected or lie adjacent to the proposed residue pipeline:

- Mount Stowe State Forest;
- Calliope Conservation Park; and
- Endangered REs.

Alignment 1 borders a section of Mount Stowe State Forest that adjoins the western side of Boyles Road, from KP 9.0-13.2. Alignment 3 also dissects a small section of Mount Stowe State Forest from KP 6-6.3. Aerial imagery indicates that Alignment 3 follows an existing cleared corridor of approximately 30 m through this section. Alignment 2 passes underneath a 1.4 km section of the State Forest.

Alignment 1 lies approximately 0.5-1 km to the east of Calliope Conservation Park from KP 7.8-10.0. At its closest point (KP 7.9), it passes about 330 m west of the north-eastern corner of the park. The Calliope River Road runs between the alignment and the park. Alignment 2 passes underneath a 1.9 km section of the park.

The proposed residue pipeline transects and / or lies adjacent to one mapped area of endangered RE from KP 8.7-12.5. This RE is discussed in more detail in **Section 4.2.2**.

Alignment 1 lies adjacent to a small creek that passes just east of Boyles Road from KP 10.3-11.5. As Alignment 3 runs immediately east of the road reserve, it lies within the creek along a substantial proportion of this section.

4.2.2 Vegetation Communities / Regional Ecosystems

The field survey identified nine REs that are transected or lie immediately adjacent to the proposed residue pipeline (**Table T1**). These generally corresponded with RE mapping by Environmental Protection Agency (**Figure F3**). Of the 20 tertiary sites assessed:

- Three sites matched the existing RE mapping (Sites 1J, 9J, 10J);
- Eleven sites contained vegetation characteristic of one of the REs mapped within a mixed RE polygon (Sites 1A, 5A, 6A, 7A, 9A, 2J, 3J, 4J, 5J, 7J, 11J);

- Three sites contained vegetation patches that are too small to be discerned in 1:100 000 RE mapping (Sites 2A, 3A, 4A); and
- Three sites contained vegetation characteristic of nearby vegetation polygons within the 10 km buffer (Sites 8A, 6J, 8J).

Most apparent inaccuracies relate to the scale of the Queensland Herbarium RE mapping (1:100 000) not detecting small remnant patches or small-scale variation within larger remnants. Two of the three sites containing vegetation characteristic of nearby polygons are Eucalypt woodlands dominated by *Corymbia citriodora* (Lemon-scented Gum). These sites (8A and 6J) correspond most closely to RE 11.11.3. The third site (8J) has an emergent canopy of Lemon-scented Gum, but has a dense mid-storey of mixed vine thicket species typical of RE 11.11.18. **Table T1** provides descriptions, legislative status and site locations for all REs recorded during the field survey.

EPBC Act listed communities

The proposed residue pipeline transects the edges of two communities regarded as Endangered under the EPBC Act.

Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism (RE 11.11.18) was recorded in a small patch near the junction of Boyles Road and Spring Valley Road at KP 8.15-8.3 (Site 8J). The community lies immediately to the west of the existing cleared area of Boyles Road. It is estimated that approximately 0.45 ha lies within the road reserve, based on available aerial imagery and GIS data. Substantial disturbance is evident within a 10 m corridor adjacent to Boyles Road, including previous clearing, logging and vehicular traffic. Areas further west are relatively undisturbed. An emergent layer of Lemon-scented Gum is present. This community is mapped as RE 11.3.4 in EPA mapping, but lies on a colluvial footslope that supports vegetation characteristic of metamorphic soils (Landzone 11). Although RE 11.11.18 is not mapped in this polygon, it is identified as a component of numerous nearby polygons in EPA mapping.

Semi-evergreen vine thicket on alluvial plains (RE 11.3.11) was recorded on the north-western side of the existing cleared area of Boyles Road at KP 12.8-12.9. This small community of about 0.8 ha is associated with a small creek. The creek and the road are likely to have promoted this fire-sensitive community by providing protection from fire. Some weeds are present, but the community is in relatively good condition. An emergent layer of *Eucalyptus moluccana* (Gum-topped Box) is present. EPA mapping identifies this community as RE 11.3.26 (Gum-topped Box woodland on alluvial plains). While this species dominates the emergent layer, the ecologically dominant layer is considered to be the mid-storey of vine thicket species. RE 11.3.11 is not mapped in this polygon, but is identified as a component of nearby polygons in EPA mapping. It is estimated that about half of this community (approximately 0.4 ha) lies within the road reserve, based on available aerial imagery and GIS data.

Endangered REs under VM Act

The two communities listed as Endangered under the EPBC Act are also considered Endangered under the VM Act. No other Endangered communities under the VM Act were recorded along the proposed residue pipeline.

EPA mapping indicates that the proposed residue pipeline transects and / or lies adjacent to one mapped area of Endangered RE from KP 8.7-12.5. This mixed polygon is reported to contain 5% of the Endangered vine thicket community, RE 11.11.18. This RE was not recorded in proximity to the corridor along this section of the alignment (although a small patch was detected at KP 8.15-8.3, as discussed above). This RE may occur in other portions of the polygon, especially in sites protected from fire by steep gullies and rock outcrops.

Of Concern REs under VM Act
The proposed residue pipeline transects two communities listed as Of Concern under the VM Act.

Eucalyptus tereticornis and / or *Eucalyptus* spp. tall woodlands on alluvial plains (RE 11.3.4) were recorded within the proposed alignment in three locations at KP 13.2-13.4, KP 14.5-14.6 and KP 14.9-15.0. All three occurrences are narrow bands of vegetation along small creeks and associated recent alluvial terraces. This RE occupies the majority of the road reserve at each site, as only a small unformed track is present along this section of the alignment.

Other areas of RE 11.3.4 lie adjacent to the alignment. One patch occurs east of the road reserve along Calliope River Road from KP 5.9-6.3. Another area is associated with a small creek that flows just east of Boyles Road from KP 10.3-11.5. Some disturbance is evident in these communities, including previous timber-cutting and weed invasion.

Eucalyptus crebra, E. tereticornis woodland on metamorphics ± interbedded volcanics (RE 12.11.14) was recorded in the proposed alignment from KP 4.4-4.8. This community has affinities with RE 11.11.4, a *Eucalyptus crebra* woodland community in the neighbouring Brigalow Belt Bioregion.

Not Of Concern REs under VM Act
The proposed residue pipeline transects five communities listed as Not of Concern under the VM Act. Communities on metamorphic derived soils include Lemon-scented gum / Narrow-leaved Ironbark woodlands (RE 11.11.3 and RE 12.11.6) and Narrow-leaved Ironbark woodlands (RE 11.11.4 and RE 11.11.15). Disturbance levels in these communities were generally low, except for some limited timber cutting in a few sites. Previous clearing was noted adjacent to the alignment from KP 3.3-4.2, probably associated with a previous railway line. Gum-topped Box woodlands (RE 11.3.26) were recorded on alluvial plains. Disturbance in this community was generally limited to weed invasion, primarily in areas associated with riparian zones.

4.2.3 EVR Flora Species

Database searches identified a total of 25 EVR flora species that may occur in the broader study area (**Table T2**). The field survey recorded preferred habitat for 10 of these EVR species, but targeted surveys failed to detect any EVR species. It is considered unlikely that significant populations of any EVR species occur along the alignment. However, the present survey cannot rule out the existence of populations of EVR species, as not all remnant vegetation was examined.

4.2.4 Regionally Significant Flora Species

The only regionally significant species identified in literature searches for the broader study area is *Graptophyllum spinigerum*. Targeted surveys failed to detect any *Graptophyllum* species.

4.2.5 Aquatic Flora Species

The undulating landscapes traversed by the proposed alignment contain very limited habitat for aquatic flora species. The only wetland habitats observed during the surveys were ephemeral watercourses and small farm dams. Neither habitat is likely to support significant populations of aquatic plants.

4.2.6 Declared Weeds

Four weed species declared under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) were recorded during the survey. These include:

- Lantana (*Lantana camara*) - Class 3;
- Creeping Lantana (*Lantana montevidensis*) - Class 3
- Rubber Vine (*Cryptostegia grandiflora*) - Class 2; and
- Prickly Pear (*Opuntia stricta*) - Class 2.

Several environmental weeds that may prove troublesome during rehabilitation works were also noted, including:

- Thatch Grass (*Hyparrhenia rufa*);
- Guinea Grass (*Megathyrsus maximus*);
- Sabi Grass (*Urochloa mosambicensis*)
- Corky Passionfruit (*Passiflora suberosa*); and
- Coral Berry (*Rivina humilis*).

4.3 Potential Impacts on Flora

4.3.1 Potential Impacts on Environmentally Sensitive Areas and Other Landscape Features

As long as pipeline construction remains within the road reserve along Boyles Road, no direct impacts on Mount Stowe State Forest are expected. As the State Forest is uphill of the road reserve, indirect impacts from sediment and nutrient flows are also unlikely. Gully erosion starting from construction disturbance could migrate into the State Forest unless effective erosion control structures are installed and maintained. Construction and maintenance activities may also introduce and spread weeds without the implementation of effective weed hygiene practices.

From KP 7.8-10.0, the proposed alignment lies 300 m to 1 km from Calliope Conservation Park. It is considered unlikely that pipeline construction will result in any significant impacts on this park, especially as it is separated from the park by Calliope River Road, a sealed thoroughfare.

Alignment 3 transects a section of Mount Stowe State Forest through a previously cleared easement from KP 6-6.3. While this easement is approximately 30 m wide, it is likely that further clearing would be required for the proposed pipeline. Alignment 1 is therefore preferable to Alignment 3 along this section of the route.

Alignment 2 will pass underneath Calliope Conservation Park and Mount Stowe State Forest. The only likely ecological impacts associated with HDD are associated with construction and lay down areas at either end of the drilling corridor. Ideally, entry and exit points and lay down areas should be sited outside the boundaries of the State Forest and Conservation Park. The eastern end of the HDD corridor could be sited within the GPN refinery site. If the eastern end must be placed in the State Forest, it would be desirable to confine disturbance to the cleared 60 m powerline corridor as far as possible. Vegetation to either side of the cleared corridor is remnant Lemon-scented Gum woodland (RE 12.11.6), which is considered Not Of Concern under the VM Act.

Cleared areas at the western end of the HDD corridor are limited to a 60 m corridor along the powerline. The powerline corridor to the east of Boyles Road is further constrained by a large farm dam about 100 m from the road. Vegetation on either side of the powerline corridor is remnant Blue Gum / Narrow-leaved Ironbark woodland (RE 11.11.4a), which is Not Of Concern under the VM Act. The area to the western side of Boyles Road lies within the Mount Stowe State Forest. Vegetation on either side of the powerline corridor in the State Forest is Lemon-scented gum woodland (RE 11.11.3), which is Not Of Concern under the VM Act. More detailed analysis of impacts of the HDD corridor can be developed when dimensions of the entry / exit point disturbance areas are known.

From KP 10.3-11.5, Alignment 1 lies immediately upslope of a small creek that passes just east of Boyles Road. As long as pipeline construction remains within the road reserve along Boyles Road, no direct impacts on this creek are expected. However, installation and maintenance of effective erosion and sediment control structures are likely to be required to mitigate indirect impacts such as erosion and increased sediment and nutrient inputs. As Alignment 3 runs immediately east of the road reserve, it is likely to have direct impacts on the creek and is therefore a less ecologically desirable option than Alignment 1.

4.3.2 Potential Impacts on Vegetation Communities / REs

Table T3 provides a summary of lengths and areas of remnant vegetation impacted by the proposed pipeline. The proposed pipeline corridor transects or lies immediately adjacent to 11.15 km of remnant vegetation, including 0.25 km of Endangered RE, 0.8 km of Of Concern RE and 10.1 km of Not of Concern RE. Assuming all of this length was fully vegetated and required clearing to the full 30 m width, a total of 33.45 ha of remnant vegetation would be cleared.

To evaluate the impact of this scale of clearing, the cleared area of each RE has been compared to the total extent of that RE within an area extending 5 km from the proposed alignment corridor (referred to as the 10 km buffer). These proportions are presented in **Table T3**. Based on these calculations, the total clearing area of 33.5 ha represents about 0.46% of the total area of these REs within the 10 km buffer.

As the pipeline passes along partially to wholly cleared road reserves along Boyles Road and an unnamed road (from approximately KP 8.2-13.2 and KP 14.4-16.4), the extent of remnant vegetation actually within the proposed pipeline corridor is substantially less than 33.45 ha. This section comprises 5.75 km of the total 11.15 km of remnant vegetation along the corridor. Although it was not possible to assess exact proportions of cleared areas using GPS survey techniques, it is estimated that 50-75% of the road reserve is already cleared or heavily disturbed. If 50% of the required corridor area within the road reserve was already cleared, the total clearing required for a 30 m corridor along the alignment would drop to approximately 23.6 ha.

Impacts on Endangered REs
The proposed alignment transects the edges of two small patches of Endangered vine thicket communities (**Figure F4**). Both patches lie immediately to the west or north of the existing cleared area along Boyles Road. Based on based on available aerial imagery and GIS data, maximum areas that would be cleared by the proposed pipeline are 0.4 ha of RE 11.3.11 and 0.45 ha of RE 11.11.18. These represent only 1.08% of the extent of RE 11.3.11 and 0.12% of RE 11.11.18 within the 10 km buffer.

If construction can be limited to the existing road clearing and the road reserve to the east / south, clearing of these communities could be avoided. Potential impacts would then be limited to indirect impacts such as altered water, sediment and nutrient flows, introduction and spread of weeds and accidental damage from machinery.

Impacts on Of Concern REs
The proposed alignment will transect three small bands of alluvial Blue Gum woodlands (RE 11.3.4), requiring up to 1.2 ha of clearing (**Figure F4**). This represents only 0.48% of the total extent of this RE within the 10 km buffer. All three occurrences are along the section within the road reserve, so careful siting of the pipeline in these locations can probably reduce this area considerably. Further reductions could be achieved by reducing the width of clearing for pipeline construction within these short sections of the route.

The alignment also lies adjacent to two areas of RE 11.3.4, from KP 5.9-6.3 and KP 10.3-11.5. Both patches lie immediately east of the road reserve. As long as the alignment is retained within the road reserve, minimal clearing of these communities should be required. Potential impacts would then be limited to indirect impacts such as altered water, sediment and nutrient flows, introduction and spread of weeds and accidental damage from machinery.

The proposed alignment dissects about 0.4 km of Ironbark woodland (RE 12.11.14) from KP 4.4-4.8 (**Figure F4**). Construction of the pipeline may require clearing of up to 1.2 ha, which represents about 0.49% of the extent of this RE within the 10 km buffer. It may be possible to avoid or reduce clearing of this RE by moving this section of the alignment about 50 m north, into an existing cleared area beside the railway easement.

Impacts on Not of Concern REs
The proposed alignment transects or lies adjacent to approximately 10.1 km of other Not Of Concern REs. This will require up to 30.3 ha of clearing, comprising about 0.47% of the total extent of these REs in the 10 km buffer. As discussed earlier, the actual clearing levels will be substantially less than this figure, as 50-75% of the road reserve along Boyles Road and an unnamed road has been previously cleared.

Along much of one section of the proposed alignment from 13.2-15.6, the road reserve contains the only remaining remnant vegetation within a large expanse of cleared pasture (**Figure F4**). This narrow remnant provides a narrow corridor of connectivity between two large remnant vegetation blocks. Impacts on this vegetated corridor could be minimised by moving this section of the alignment 50 m to the east and south, into non-remnant pasture.

4.3.3 Reversible versus Non-reversible Impacts

Once the residue pipeline has been constructed, there is potential to allow tree and shrub vegetation to naturally re-establish over all but the area immediately over the pipeline. Keeping a 3 m strip on either side of each pipeline free of trees and shrubs may be all that is necessary to protect the pipe from potential root damage and facilitate ongoing pipeline inspection and necessary maintenance. As such, subject to land management practises, it is expected that over the medium term (10-50 years) significant portions of the residue pipeline construction

footprint will naturally regenerate. For example, if 24 m of the clearing width is allowed to regenerate, it is possible that the area of land cleared for pipeline construction will be reduced by up to 80% within 10-50 years.

When the pipeline is decommissioned, the corridor will be rehabilitated in compliance with Australian Standard 2885 and the Code of Environmental Practice - Onshore Pipelines (APIA, 1995). Unless the corridor continues to be managed in a manner that inhibits natural regrowth, the impacts associated with clearing for construction and maintenance of the pipeline are considered to be reversible within all vegetation communities.

4.3.4 Potential Impacts on EVR Flora Species

Targeted searches did not detect any EVR flora species. Although it is possible that isolated individuals of EVR species may be present, it is considered improbable that significant populations exist within the corridor and immediate vicinity. The proposed development is therefore unlikely to have any significant impacts on EVR flora species.

4.3.5 Potential Impacts Associated With Weeds

Construction and maintenance of the residue pipeline has the potential to introduce new weeds and spread existing weeds.

Of particular significance to landholders will be the potential to introduce and spread declared and other agricultural weeds, including those already present within parts of the study corridor. Introduction and spread of declared weeds can render land less productive and in some cases can have serious health impacts on livestock and people. Construction and maintenance activities for the residue pipeline also have the potential to spread environmental weeds into ecosystems that are currently in natural condition.

Declared weeds should be controlled throughout the construction, operational and decommissioning phases of the project. It is recommended that environmental weeds, such as Guinea Grass (*Panicum maximum*), Thatch Grass (*Hyparrhenia rufa*), Sabi Grass (*Urochloa mosambicensis*), Corky Passionfruit (*Passiflora suberosa*) and Coral Berry (*Rivina humilis*) are also managed, particularly during the construction phase and subsequent rehabilitation works. Rehabilitation would also benefit from control of other exotic grasses; however, landholders may request that these species are retained for grazing purposes.

Good weed hygiene practices should be adopted to minimise the introduction or spread of declared, agricultural and environmental weeds along the alignment. Recommendations aimed at controlling the introduction and spread of weed species are provided in **Section 6.2**.

4.3.6 Comparative Impacts of Three Alignment Options

Alignment 2 has the potential to avoid most surface impacts from KP 0-9.3 by the use of HDD techniques. Within this section, Alignment 1 transects or lies adjacent to Of Concern RE from KP 4.4-4.8, Endangered RE from KP 8.15-8.3 and a further 2 km of Not Of Concern remnant vegetation. However, Alignment 2 will be subject to extra impacts associated with construction activities at entry / exit points and lay down areas. These impacts cannot be assessed until more detailed information about proposed HDD construction is available.

Alignment 3 is considered to be less ecologically desirable than Alignment 1 as it is likely to have greater impacts at the following locations:

- From KP 6.0-6.4, it transects Mount Stowe State Forest (along a 30 m wide powerline easement);

- From KP 8.3-13.1, it runs just east of the road reserve along Boyles Road, impacting on remnant vegetation;
- From KP 10.3-11.5, it follows a small creek that supports Of Concern vegetation (RE 11.3.4); and
- From KP 13.1-17.4, it leaves the road reserve, which will result in two disturbance corridors through this area (rather than confining disturbance to the road reserve).

5 FAUNA ASSESSMENT

5.1 Fauna Assessment Methods

The fauna assessment consisted of two stages: a desktop study, followed by a field assessment of the proposed residue pipeline alignments. The fauna assessment was conducted by David Fleming (Environmental Scientist) with assistance from HLA ENSR's senior fauna ecologist Dr. Simon Hudson.

5.1.1 Determination of Fauna Species Significance Level

Listed EVR fauna are defined as those taxa listed in the EPBC Act and / or the NC Act as Critically Endangered, Endangered, Vulnerable or Rare.

Regionally Significant fauna are defined as those taxa that have not been listed as EVR fauna under the EPBC Act or NC Act, but have been listed in the relevant Action Plan for their respective taxonomic group as Vulnerable, Rare, Near Threatened, Insufficiently Known or Data Deficient. Relevant Action Plans consulted to determine status were: Sands and New (2000) for butterflies, Wager and Jackson (1993) for freshwater fishes, Tyler (1997) for frogs, Cogger *et al.* (1993) for reptiles, Garnett and Crowley (2000) for birds, Maxwell *et al.* (1996) for monotremes and marsupials, Duncan *et al.* (1999) for bats and Lee (1995) for rodents. Also included in Regionally Significant fauna were those species identified as non-EVR priority taxa by the Fauna Expert Panel Reports for the Brigalow Belt South (EPA, 2002) and South East Queensland Bioregions (EPA, 2004). The study area is located at the interface of the Brigalow Belt South and South East Queensland Bioregions, hence both reports are referred to in this report.

All other native fauna have been designated as Least Concern under the NC Act. This includes those species that have been given extra protection as Migratory and / o

5.1.2 Literature Review and Collection of Database Information

The desktop study involved a review of published material and searches of relevant databases and archives. This assessment was used to document known records for the study area, identify the potential presence of significant fauna species, and assist in targeting areas for field assessment. The desktop components undertaken included:

- Collection and review of existing EPA WildNet data, Birds Australia data and DEW data (EPBC Protected Matters Search) for the area $23^0$36'S to $24^0$6'S and $150^0$54'E to $151^0$24'E;
- Review of existing Queensland Museum data;
- Search of the Directory of Important Wetlands database;
- Review of Brigalow Belt South and South East Queensland Biodiversity Planning Assessments (EPA, 2002; 2004) to identify areas that are recognised as State, Regional or Local Biodiversity Significant or flagged as important for their integrated biodiversity values that are within close proximity to the project area;
- Review of Queensland Herbarium RE mapping for the pipeline alignment to establish those vegetation communities mapped by the EPA at a scale of 1:100,000; and
- Examination of aerial and satellite imagery to gain an appreciation of potential fauna habitats and of the project's proximity to sensitive areas.

The following texts were also reviewed: Cogger (2000), Duncan *et al.* (1999), Ehmann (1992), Garnett and Crowley (2002), Greer (2005), Johnson (2003), Menkhorst and Knight (2004), Morcombe (2003), Robinson (1998), Strahan (1995), Wilson (2005a), Wilson and Swan (2003) and Wilson and Knowles (1988).

A precautionary approach has been adopted throughout this assessment. Any species that could potentially occur within the study area as identified through ecological databases and the habitat assessment, coupled with knowledge of the fauna by HLA ENSR's senior fauna ecologist, have been assumed to occur in the study area. The presence or otherwise of a particular fauna species within the pipeline alignment can only be confirmed by detailed targeted field surveys.

5.1.3 Field Fauna Study

Two separate field assessments of the proposed alignments were conducted over a total of 4.5 days from 21 to 23 June 2007 and from 14 to 15 August 2007. No fauna trapping methods such as Elliott trapping, pit fall trapping, hair tube sampling or harp trapping were employed during these assessments. Rather, field surveys targeted habitat assessments that involved walk-through assessments of selected sites. Representative habitats along the alignments were selected for inspection. The selection of these sites was based on the following:

- Occurrence of forested patches and other fauna habitats (such as riparian corridors and wetlands) determined from aerial photography and satellite imagery;
- Preferred habitat for EVR and Regionally Significant fauna identified from the database searches, RE mapping and aerial photography; and
- Occurrence of Endangered and Of Concern REs listed under the VM Act and Endangered Ecological Communities listed under the EPBC Act. These were identified through the latest Queensland Herbarium mapping.

A total of 20 habitat assessment sites were visited along the proposed alignments. Data sheets for these sites are provided in **Appendix C**, and sites are mapped in **Figure 2b**.

The aim of the field study was to assess the following:

- The presence of suitable habitat for significant fauna species and the likely presence of significant fauna species;
- Habitat types / features;
- Habitat integrity;
- Habitat connectivity; and
- Significance of habitats.

Assessments of the above attributes were supplemented by opportunistic and dedicated searches for fauna and fauna signs at each site. Survey techniques employed at each site involved:

- Audio identification (e.g. bird and frog calls);
- Dedicated searches under rocks, logs, bark and leaf litter for reptiles;
- Dedicated searches of likely faunal hotspots such as riparian vegetation and sources of water (e.g. dams, creeks);

- Dedicated searches for animal signs (e.g. scats and tracks) and where possible, laboratory analysis of scat from predators; and
- Opportunistic observations.

5.1.4 Interpretation and Documentation

Using the habitat assessment and field observation data, refinements were made to the list of EVR fauna species that were identified as potentially occurring along within the study area during the desktop study. Likely impacts on these species were analysed based on the known ecology of each species.

5.2 Fauna Results

A review of fauna databases identified a large number of fauna species that have been recorded from, or that may potentially utilise habitat, within the wider area. A total of 581 fauna species were identified, comprising 17 butterflies, 61 fish, 25 amphibians, 104 reptiles, 287 birds and 83 mammals. During the field assessment, 53 fauna species were recorded, comprising 1 amphibian, 3 reptiles, 42 birds and 7 mammals (**Table T4**).

5.2.1 Fauna Habitats

Based on field habitat assessments and RE mapping, seven broad fauna habitat types were identified as present within the proposed alignment. **Table T5** describes each habitat, identifies the corresponding RE (if any) and gives approximate KPs where it transects the proposed route.

Alignment 1
The proposed alignment leaves the proposed refinery site which is located at the fringes of a heavily industrialised corridor from Gladstone to Yarwun. The proposed alignment then runs in a generally south-westerly direction through a rural / agricultural landscape characterised by large remnant vegetation patches, including State Forest reserves. This largely vegetated landscape provides habitat for a number of significant fauna species (i.e. EVR and Regionally Significant) and a wide range of Common fauna and Migratory birds.

Initially, the alignment closely follows an existing railway corridor to the north of the Mount Stowe State Forest. The alignment traverses Ironbark woodlands and occasional fringing riparian vegetation along drainage lines and gullies. Habitat is provided for EVR species such as Yakka Skink (*Egernia rugosa*), Brigalow Scaly-foot (*Paradelma orientalis*), Square-tailed Kite (*Lophoictinia isura*), Black-chinned Honeyeater (*Melithreptus gularis*), Powerful Owl (*Ninox strenua*) and Northern Quoll (*Dasyurus hallucatus*). This area also provides habitat for a large number of listed Migratory forest birds and Regionally Significant species, including frogs, reptiles, birds and mammals.

The alignment then follows the road reserve of Calliope River Road south of Yarwun township. The road reserve is characterised by a thin strip of mature trees adjacent to paddocks with isolated trees and patches of remnant vegetation (including riparian woodland) within rural residential properties. A small number of creeks and drainage lines with fringing riparian vegetation are also crossed by the alignment. Due to the close proximity and connectivity with the State Forest, vegetation traversed by the alignment provide habitat for EVR species such as Short-necked Worm-skink (*Anomalopus brevicollis*), Yakka Skink and Northern Quoll and a variety of Regionally Significant species including Brown Treecreeper (*Climacteris picumnus*), Northern Brown Bandicoot (*Isoodon macrourus*), Agile Wallaby (*Macropus agilis*) and numerous possum and glider species. A number of listed Migratory forest birds are also expected to utilise riparian vegetation as migratory pathways.

At the intersection of Spring Valley Road and Boyle's Road the alignment enters woodland communities dominated by Lemon-scented Gum and Narrow-leaved Red Ironbark. A small patch of semi-evergreen vine thicket vegetation was found to occur adjacent to the alignment corridor on the western side of Boyle's Road (at KP8.15-8.3). The denser understorey vegetation provides potential habitat for EVR species, including Black-breasted Button-quail (*Turnix melanogaster*) and Short-necked Worm-skink. Another patch of vine thicket vegetation occurs in the southern portion of the study area at approximately KP 12.8-12.9.

From KP 8.1 to 13.2, the alignment is located within the road reserve of Boyle's Road adjacent to Mount Stowe State Forest. Habitats traversed are largely remnant woodland communities and some fringing riparian vegetation along drainage lines and gullies. The Lemon-scented Gum and Ironbark woodlands provide habitat for EVR species such as Yakka Skink, Brigalow Scaly-foot, Square-tailed Kite, Northern Quoll and Large-eared Pied Bat and a number of Regionally Significant bird and mammal species. Fringing riparian vegetation (located at KP 10.9, 12 and 12.9) provides additional habitat for EVR and Regionally Significant species which prefer a dense ground cover, such as Yakka Skink and Black-chinned Honeyeater. Other EVR species utilising fringing riparian vegetation include Short-necked Worm-skink and Black-chinned Honeyeater. The Squatter Pigeon (*Geophaps scripta scripta*), listed as Vulnerable under the EPBC Act, is more likely to occur in open habitats such as the interface of remnant vegetation and cleared areas.

The alignment leaves Boyle's Road at KP 13.2 and continues down the road reserve of an unnamed road. From KP 13.2 to KP 15.6, the alignment crosses a largely cleared paddock that separates large remnant vegetation blocks to the north-east (within Mount Stowe State Forest) and to the south-west (within private tenures). The road reserve is characterised by a thin, 30-50 m wide strip of woodland that provides a vegetated linkage between these large remnant blocks. The road reserve, therefore, is likely to provide movement opportunities for highly mobile EVR species such as Squatter Pigeon and Black-chinned Honeyeater and a number of listed Migratory bird species.

At KP 15.6 the alignment enters a large patch of remnant Ironbark woodland on undulating lowland hills. This vegetation is in relatively good condition and provides habitat for EVR species such as Yakka Skink and Northern Quoll and a variety of Regionally Significant species including Brown Treecreeper, Northern Brown Bandicoot, Agile Wallaby and numerous possum and glider species. A minor creek with fringing riparian vegetation is crossed at KP 17.5 adjacent to the high voltage power line easement. This creek has been degraded by adjacent works along the easement and is heavily infested with Lantana. Nevertheless, it provides habitat for EVR species such as Short-necked Worm-skink and a number of Migratory forest bird species.

The alignment crosses the electricity easement and traverses further Ironbark woodland before entering the proposed residue dam site.

Alignment 2

The Alignment 2 option involves drilling under the Mount Stowe State Forest and Calliope Conservation Park following an existing electricity easement. Therefore, the impact areas will be largely restricted to the entry and exit points and pipe lay down areas (yet to be determined). The easement is generally cleared of woody vegetation for an approximate width of 30 m. In general, vegetation communities surrounding the easement are composed of Narrow-leaved Red Ironbark and Lemon-scented Gum woodland with a sparse mid-layer and grassy understorey. Potential habitat is provided for EVR species such as Short-necked Worm-skink, Yakka Skink, Square-tailed Kite, Powerful Owl and Northern Quoll and a variety of Regionally Significant species including Brown Treecreeper and Northern Brown Bandicoot.

A small farm dam is located within the electricity easement to the east of KP 9.3 and is considered an important landscape feature for fauna. The dam was quite low at the time of the surveys, but it is likely to provide a suitable wetland habitat for a variety of common waterfowl and amphibians during the wetter months of the year. The dam is also likely to provide a valuable dry season water source for other fauna residing within the adjacent Ironbark woodland habitat.

Alignment 3
Although Alignment 3 is relatively similar to the Alignment 1 route, the habitats traversed by this alignment are slightly different in terms of structure and condition. From approximately KP 5.0 to KP 6.9, it follows an existing cleared easement through areas of riparian woodland, Lemon-scented Gum and Ironbark woodland and non-remnant vegetation. Despite the cleared area within the easement, the riparian woodland is likely to provide habitat for a variety of significant and common fauna species. From KP 6.9 to the intersection of Boyle's Road and Spring Valley Road, the alignment crosses generally cleared pastures. A number of isolated trees remain within the paddock and a small drainage line is crossed (adjacent to KP 7.9).

The Alignment 3 option continues just east of the road reserve along Boyle's Road from KP 8.3 to KP 13.1. Habitats along this alignment are generally of lesser quality than the adjacent State Forest in terms of structural complexity and for fauna refuge values. This is probably caused by historical land use practices within rural residential properties, such as logging of old trees, raking of ground debris and low intensity ground fires. A small creek was found to encroach within the Alignment 3 corridor at a number of locations (e.g. from KP 10.3-11.5). This creek contained fringing riparian vegetation and may provide habitat for EVR species such as Short-necked Worm-skink, Yakka Skink, Squatter Pigeon and Little Pied Bat.

The Alignment 3 option leaves Boyle's Road at KP 13.1 and turns southwards, where it crosses a small creek and riparian woodland within a largely cleared paddock. The alignment continues across remnant and non-remnant woodlands on undulating hills before terminating at the proposed residue dam. This portion of the Alignment 3 option was not able to be assessed during the field study due to access constraints. However, based on RE mapping, these vegetation communities are considered to provide potential habitat for EVR species such as Squatter Pigeon, Yakka Skink, Black-chinned Honeyeater, Square-tailed Kite and Northern Quoll and a variety of Regionally Significant and listed Migratory species.

5.2.2 EVR Fauna Species

A total of 48 EVR fauna species listed under the EPBC Act and / or NC Act have been previously recorded from the wider study area or have geographic ranges that overlap the wider study area. These include 1 invertebrate, 1 fish, 15 reptiles, 21 birds and 10 mammals (**Table T6**). Of these species, 21 are listed under both the EPBC Act and NC ACT, 4 are listed under the EPBC Act only and 23 are listed under the NC Act only. **Table T6** lists these EVR fauna species, together with their preferred habitat and an indication as to whether this habitat is present within the proposed alignment. Based solely on the desktop review of habitat preference, 13 of these 48 listed EVR species could potentially utilise habitats within the proposed alignments.

No EVR fauna species were recorded along the pipeline alignment during the field assessment.

5.2.3 Other Fauna Species of Conservation Significance

A further 71 fauna species of Regional Significance were identified, including 2 fish, 10 frogs, 13 reptiles, 19 birds and 26 mammals. **Table T7** lists these Regionally Significant fauna, together with their preferred habitat and an indication as to whether this habitat is present within the

proposed alignment. Based solely on the desktop review of habitat preference, 57 of these 71 Regionally Significant species could potentially utilise habitats within the proposed alignments.

Four Regionally Significant fauna species were recorded along the proposed alignments, including the Copper-backed Broodfrog (*Pseudophyrne raveni*), Fine-spotted Mulch Skink (*Glaphyromorphus punctulatus*), Australian Bustard (*Ardeotis australis*) and Barking Owl (*Ninox connivens*). The Copper-backed Broodfrog and Fine-spotted Mulch Skink are considered non-EVR Priority Taxa in the SEQ Fauna Expert Panel Report (EPA, 2004), the Barking Owl is considered a non-EVR Priority Taxa in the SEQ and BBS Fauna Expert Panel Reports (EPA, 2004; 2002) and the Australian Bustard is considered Near Threatened in the Action Plan for Australian Birds (Garnett and Crowley, 2002).

An additional 113 bird species listed under the EPBC Act as Migratory and / or Marine protected species were identified as previously recorded from the wider study area, or with geographic ranges that overlap the wider study area. These include species listed under the Japan – Australia Migratory Bird Agreement (JAMBA), the China – Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention on the Conservation of Migratory Species. Fifty-one of these were listed as both Migratory and Marine Protected species and 36 as Marine only. Whilst these are not EVR fauna, they are EPBC Act protected species that may utilise local habitats on a seasonal basis, or marine species that may overfly or otherwise utilise the wider area.

These species are listed in **Table T8**, together with their preferred habitat and an indication as to whether this habitat is present within the proposed alignment. Based solely on the desktop review of habitat preference, 53 of these 113 listed Migratory and / or Marine protected species could potentially utilise habitats within the proposed alignments.

5.2.4 Common Fauna Species

All habitats (even cleared and degraded land) provide habitat for a range of common native fauna species. Remnant vegetation provides higher habitat values and thus generally supports a higher diversity and abundance of species. The desktop study and field surveys indicate that the study area is utilised by a large number of common fauna species. A total of 388 native fauna species were identified as potentially present by the database searches (excluding EVR and Regionally Significant fauna species, and omitting obviously marine-restricted species such as whales and sea snakes). These included 15 butterflies, 28 fish, 14 amphibians, 66 reptiles, 237 birds (including the 113 species listed as Migratory and / or Marine Protected Species under the EPBC Act) and 28 mammals (of which 27 are bats).

Common fauna species recorded during the field survey included 4 reptiles, 42 birds and 5 mammals. A complete list of fauna recorded during the field assessment is included in Table T4.

5.2.5 Introduced Fauna Species

Twenty-five introduced species have been recorded within the wider area, including 2 fish, 1 amphibian, 5 birds and 10 mammals.

Three introduced species were detected along the proposed alignment. European Rabbit (*Oryctolagus cuniculus*) burrows and scats, Cane Toad (*Bufo marinus*) adults and Pig (*Sus scrofa*) tracks were observed within the study area.

Mosquitoes are known to occur along the length of the alignment, particularly in the vicinity of water bodies including wetlands and watercourses listed in **Table T5**. The potential to create new mosquito breeding grounds is discussed in **Section 5.3.3**.

5.2.6 Aquatic Fauna Species

Review of the Queensland Museum and WildNet fish databases identified 28 fish species recorded from watercourses in the wider study area. Only two of these are exotic: Mosquitofish (*Gambusia holbrooki*) and Guppy (*Poecilia reticulata*).

No EVR fish species were identified as occurring in the region. Two species are Regionally Significant, including Agassiz's Glassfish (*Ambassis agassizii*) and Jungle Perch (*Kuhlia rupestris*). Neither species are likely to be present in creeks along the alignment. Other aquatic EVR species identified as potentially occurring within the wider area include the Salt-water Crocodile (*Crocodylus porosus*) and Fitzroy River Turtle (*Rheodytes leukops*).

The Fitzroy River Turtle is a freshwater tortoise found only within the Fitzroy River and its tributaries, mainly around Rockhampton. This species is listed as Vulnerable under both the EPBC Act and NC Act. It favours areas of creeks and rivers that have clear, shallow and fast flowing water with gravel, rock or sand substrate. It is dependent on riffle zones, especially during times of low flow (Tucker *et al.*, 2001). This species is unlikely to occur within the study area.

Salt-water crocodiles are found across northern Australia in fresh and salt-water habitats. In Queensland, they are found mainly in coastal waters between Rockhampton and Cape York and throughout the Gulf of Carpentaria. However, Salt-water Crocodiles have been sighted as far south as the Boyne River, south of Gladstone. Although the Salt-water Crocodile lives mainly in the tidal reaches of rivers, it is also common in freshwater lagoons, swamps and beaches. This crocodile also occurs in inland waterways hundreds of kilometres from the sea. The Salt-water crocodile is listed as a Migratory and Marine species under the EPBC Act and is listed as Vulnerable in Queensland under the NC Act. Habitat for this species does not occur within the study area.

5.3 Potential Impacts on Fauna

5.3.1 Potential Impacts on Fauna in General

With successful implementation of appropriate environmental management controls as recommended in **Section 6.3**, any potential impacts on fauna species and habitat are likely to be limited to direct impacts associated with the clearing of vegetation and construction of the proposed pipeline. The pipeline construction will require some clearing of vegetation, and this generally equates to a loss of potential fauna habitat. In relation to common fauna species, this is unlikely to result in a significant long-term impact, as similar habitats are available in areas adjacent to the proposed alignment, and common species would utilise these habitats.

Nevertheless, some potential impacts would remain, and these include the following:

- Removal of habitat such as mature vegetation, hollow-bearing trees and fallen logs, and therefore loss of nesting, refuge and foraging resources;
- Disturbance to seasonal and permanent wetlands;
- Disturbance to fauna movement corridors and dry season fauna refugia (predominantly associated with creeks, seasonal wetland / waterway areas and the vegetated corridor from KP 13.2-15.6);
- Disturbance to rocky outcrops which provide shelter for many reptiles and small mammals;
- Unearthing of burrowing fauna species during construction; and
- Potential to fall into open trenches during construction of the residue pipeline.

Removal of mature vegetation, tree hollows and fallen timber

In general, removal of mature vegetation reduces feeding resources and shelter for native fauna species. Additionally, construction of linear infrastructure (such as roads and pipelines) through mature vegetation can result in further fragmentation of habitat patches and negative impacts from 'edge effects'. Edge effects generally refer to a combination of ecological processes that occurs at the interface of mature vegetation and disturbed areas. Edge effects generally reduce the habitat quality of mature vegetation for a range of native fauna, particularly those sensitive to disturbance.

Clearing for the proposed pipeline is not considered to be a significant impact on local fauna populations, including EVR fauna species. Although up to 33.5 ha of remnant vegetation may be cleared under the proposed Alignment 1 option, the route generally traverses the edge of remnant vegetation patches or within disturbed infrastructure corridors (e.g. railway easements, road reserves, power line easements). Therefore, clearing for the pipeline within many areas may be limited to previously disturbed areas and is unlikely to significantly impact on fauna or contribute to habitat fragmentation.

The Alignment 2 option is likely to require less clearing than the Alignment 1 option, as HDD will cause no surface impacts along the majority of the route. However, Alignment 2 will be subject to extra impacts associated with construction activities at entry / exit points and lay down areas. These impacts cannot be assessed until more detailed information about proposed HDD construction is available.

The amount of mature vegetation to be cleared under the Alignment 3 option is roughly similar to the Alignment 1 option. However, it is likely to cause greater fragmentation by clearing vegetation to the east of the existing road reserve along Boyles Road from KP 8.2-13.2 and clearing beside the powerline easement from KP 6.0-6.3. It will also require some clearing of riparian woodland along a small creek from KP 10.3-11.5; however, as long as pipeline construction remains within the road reserve along Boyle' Road, no direct impact on the creek are expected.

A major potential impact on fauna is the loss of hollow-bearing trees. A large number of Australian vertebrate fauna species are dependent on tree hollows for shelter and nesting, including parrots, owls, possums, gliders and bats (Gibbons and Lindenmayer, 2002). Mature trees with hollows are a limited resource in many of the rural and grazed lands of Queensland where widespread clearing has removed much of the mature vegetation. Hollows suitable for fauna generally only occur in trees over 100 years in age. Large hollow-bearing trees are especially important habitat in strips of vegetation along watercourses or road reserves in

otherwise cleared land. Even single or widely scattered mature hollow-bearing trees can be important habitat for mobile fauna such as hollow-roosting bats (Lumsden and Bennet, 2003).

In general, there is a low density of hollow-bearing trees within surveyed sites along the proposed alignment corridor with most observed within riparian vegetation and within the State Forest. The retention of hollow-bearing trees should be considered a priority during construction of the pipeline.

Fallen logs and dead timber on the ground provide shelter and habitat for a broad range of small ground-dwelling fauna including native rodents, dasyurid marsupials, bandicoots, lizards, snakes, frogs, and some birds. Fallen timber may be used as shelter (either underneath timber or within hollow logs) and also as a source of food in the form of invertebrates sheltering under the logs. Large fallen logs also provide essential protection for fauna against bushfire. Loss or removal of fallen timber severely reduces the abundance and diversity of small ground-dwelling fauna. Impacts from removal of dead timber will reduce over time as additional dead tree limbs and fallen trees accumulate, but are likely to result in loss or reduction of fallen timber-dependent species in the short to medium term.

The density of small fallen logs and dead timber within the proposed pipeline varied considerably depending upon age of vegetation, land management practices and fire regime. However, large fallen logs and dead timber were scarce at most sites and absent altogether in others. Additional habitat for ground-dwelling fauna can be created in the short term by relocating dead and cleared timber into adjacent patches during construction, provided that an excessive bushfire hazard is not created.

Disturbance to seasonal and permanent wetlands

The proposed alignments occur within the catchment of the Port Curtis Wetlands, which are listed in the Directory of Important Wetlands in Australia. A number of EVR bird species that are potentially present within the proposed alignment are reliant on these wetlands as habitat (e.g. Australian Painted Snipe and Cotton Pygmy-Goose), as are a wide range of protected Migratory and Marine birds. These EVR birds utilise rank vegetation (rushes, sedges and grasses) around the edge of wetlands as habitat.

Apart from riparian areas, the only wetlands observed during the surveys were associated with small farm dams. These dams may provide seasonal habitat for a range of amphibians and waterbirds and provide an important water source during the dry season. Alignment 2 may impact on a farm dam to the east of KP 9.3, depending on the HDD construction footprint.

A major potential impact regarding wetland habitats are considered to be changes to hydrology, either by changes in the quantity and / quality of freshwater in-flow or by constructions that prevent or restrict normal flow regimes (Olsen and Weston, 2004). Other issues include changes in turbidity and sedimentation associated with construction. In the absence of appropriate design and mitigation measures, the proposed residue pipeline has the potential to affect the hydrology within wetlands in the study area in the form of changes in topography affecting inflow (i.e. cutting or via imported fill material) and via downstream impacts. Provided that adequate erosion and sediment control devices are in place prior to the commencement of works, the pipeline is unlikely to significantly impact on downstream habitats.

Disturbance to movement corridors and dry season fauna refugia

The study area is characterised by large patches of relatively intact remnant vegetation surrounded by agricultural uses (e.g. cattle grazing). Strips of retained riparian vegetation (i.e. fringing riparian open forest and riparian woodland) provide essential connections between vegetated patches within pasturelands. Riparian vegetation also provides connections for fauna dependent upon dense vegetation within more open eucalypt woodlands. Watercourses provide a source of water and are often the only fresh water available during the dry season.

This in turn provides a refuge for many fauna species. As such, the various watercourses transected by the alignment corridor and their associated riparian vegetation (i.e. at KP 4.3, 10.9, 12.0, 12.9 and 14.9) are important movement corridors and refugia for a range of fauna, assisting dispersal of populations and persistence in a dry and fragmented landscape. Vegetation clearing at crossings should be minimised as much as practicable and restriction of fauna movement along watercourses should be minimised.

Another potential movement corridor follows the proposed alignment along the road reserve from 13.2-15.6. This corridor contains the only remaining remnant vegetation within a large expanse of cleared pasture (**Figure F4**) and may allow highly mobile species to move between the large blocks of remnant vegetation to the north and south. Impacts on this vegetated corridor could be minimised by moving this section of the alignment 50 m to the east and south, into non-remnant pasture.

Unearthing of burrowing fauna species during construction
There is significant potential for direct impact on some burrowing fauna species by being unearthed during construction of the pipeline. While many larger and more mobile fauna such as birds, macropods and larger reptiles are likely to move away from the disturbance resulting from construction, smaller burrowing fauna (especially nocturnal species) are likely to remain under the surface and therefore risk being dug up and injured or killed. A broad range of burrowing fauna including frogs, lizards, snakes and small mammals are potentially present along the entire length of the alignment. EVR species vulnerable to being unearthed include small reptiles such as Ornamental Snake and Brigalow Scaly-foot.

Trench fall: the potential trap created by the open pipeline trench
To facilitate the laying of the residue pipeline, an open trench will be required. The open trench provides a temporary barrier to fauna movement and there is potential for ground-dwelling fauna to fall into the trench and become trapped and exposed to overheating, dehydration, predation and / or drowning. Fauna entrapment within pipeline trenches has been recognised as a key environmental issue by the Australian Pipeline Industry Association (APIA) Code of Environmental Practice (APIA, 2005).

Published information from other Australian pipeline projects has demonstrated that pipeline trenches can trap a high diversity and abundance of ground-dwelling animals (including EVR species), particularly reptiles, frogs and small mammals, with the potential for very high levels of mortality (Ayers and Wallace, 1997, Woinarski *et al.*, 2000, Doody *et al.*, 2003, Wilson and Swan, 2004 and Wilson, 2005b). To help reduce potential impacts from trench fall, the length of open trench should be the minimum practicable at any one time.

5.3.2 Potential Impacts on EVR Fauna

Of the 13 EVR fauna species identified as potentially utilising preferred habitat within the proposed alignments (**Table T6**), 6 have the potential to be impacted by the proposed construction of the residue pipeline due to potential effects on preferred habitat (**Table T9)**. These include three reptiles, one bird, one mammal and one bat. Each EVR species identified as potentially utilising habitat within the proposed alignment is individually discussed in **Appendix D** and potential impacts on these species are described. Mitigation recommendations required to avoid or minimise potential impacts on these species are detailed in **Table T10** and are summarised in **Section 6.3**.

A number of EVR fauna species identified as potentially occurring within the proposed alignments are species that are nomadic, highly mobile or occupy very large home ranges. These include Squatter Pigeon, Cotton Pygmy-goose, Red Goshawk and Square-Tailed Kite. Given the relatively small amount of remnant vegetation to be cleared by Alignment 1 compared to the area over which individuals of these species range, no significant impact is likely upon

these species. A further reduction in clearing of remnant vegetation can be achieved by the Alignment 3 option, which tunnels under Mt. Stowe State Forest. Some additional vegetation may require clearing for the entry / exit points and lay down areas; however, these details were not available for this study.

Several other EVR fauna species have the potential to be directly impacted if they are present within the alignments in woodland habitats, riparian vegetation and semi-evergreen vine thickets. These include Brigalow Scaly-foot, Yakka Skink and Short-necked Worm Skink. A combination of Alignment 3 and Alignment 1 is the preferred option as these routes may reduce the amount of habitat to be cleared and are generally contained within previously disturbed areas (e.g. powerline easement, road reserve). In addition, mitigation measures as outlined in **Table T10** should be implemented to further reduce potential impacts on these species from trenchfall.

5.3.3 Potential to Create New Mosquito and Cane Toad Breeding Habitat

The proposed construction works have the potential to alter hydrological regimes, causing water to be retained in environments amenable to breeding. This may create additional breeding sites for pest species such as mosquitoes and Cane Toads. Cane toads and mosquitoes will breed in almost any permanent or temporary standing water and mosquitoes will also breed in artificial containers of water. Assuming the mitigation measures recommended in **Section 6.3** are successfully implemented, there is limited potential to increase breeding sites for these pests.

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6 MITIGATION AND REHABILITATION RECOMMENDATIONS

6.1 Alignment Specific Recommendations

The following recommendations are provided to minimise ecological impacts along specific sections of the alignment:

- Conduct further investigations into the feasibility and potential ecological impacts of the proposed HDD route from the GPN refinery site to KP 9.3 of the primary alignment, if this option is to proceed further;
- From KP 9.0-13.2, minimise impacts of clearing and disturbance on Mount Stowe State Forest west of the road reserve;
- From KP 8.15-8.3, ensure clearing and disturbance do not impact on the Endangered vine thicket community (RE 11.11.18) west of the existing road clearing;
- From KP 12.8-12.9, ensure clearing and disturbance do not impact on the Endangered vine thicket community (RE 11.3.11) north-west of the existing road clearing;
- From KP 4.4-4.8, move the alignment 50 m northwards to avoid Of Concern Ironbark woodland (RE 12.11.14);
- From KP 5.9-6.3, minimise impacts of clearing and disturbance on Of Concern Blue Gum / Ironbark woodlands (RE 11.3.4) east of the road reserve;
- From KP 10.3-11.5, minimise impacts of clearing and disturbance on the small creek and Of Concern Blue Gum / Ironbark woodlands (RE 11.3.4) east of the road reserve;
- From KP 13.2-15.6, move the alignment 50 m eastwards and southwards to avoid a narrow corridor of remnant vegetation that connects two large remnant blocks; and
- Minimise the width of corridor clearing at KP 13.2-13.4, KP 14.5-14.6 and KP 14.9-15.0 to minimise impacts on Of Concern Blue Gum / Ironbark woodlands (RE 11.3.4).

6.2 Mitigation and Rehabilitation Recommendations for Flora

The following general mitigation and rehabilitation measures are recommended to help avoid and minimise the potential impacts on flora:

- The corridor impacted for residue pipeline construction within all areas of remnant vegetation should be minimised and should not exceed 30 m;
- Clearing of remnant vegetation areas should be avoided for the purposes of siting construction camps and where possible, vehicle access tracks;
- Clearing boundaries within remnant vegetation areas should be clearly marked in the field;

- Along the residue pipeline, vegetative wastes resulting from clearing should, where practicable, be re-spread over the easement following construction. This will further encourage regrowth and minimise weed infestations;
- Subject to easement requirements and landholder preferences, trees and shrubs should be allowed to naturally regenerate on those parts of the cleared pipeline corridor that are not required to be kept tree free for pipeline protection and maintenance purposes;
- Mulching of vegetative wastes is not preferable from a fauna habitat perspective as variation of fauna habitat niches is significantly reduced. Large scale burning of vegetative wastes should also be avoided. Rather, the timber should be stick raked into piles and left to provide animal habitat and to assist in revegetation and erosion control. If landholders are strongly opposed to stick rake piles, mulching is the next preferable method of dealing with vegetative wastes;
- All vehicles should contain spark arresters on diesel engines. A fire extinguisher and personnel trained in fire fighting are to be on-hand during welding operations to minimise damage caused by accidental fires;
- Topsoil should be removed and stockpiled prior to construction. Ensure stockpiles are limited to 2 m in height and have appropriate sediment and erosion controls. Topsoil should be re-spread across rehabilitation areas as soon as possible following disturbance (preferably within 12 months);
- A re-seeding plan should be developed based on soil types and existing local vegetation characteristics and landholder preferences along the alignment;
- Following construction, disturbed areas should be seeded with those species identified in the re-seeding plan;
- If available (and subject to landholder preferences), local provenance native seed should be used for regeneration seeding following construction in all disturbed areas. If local provenance seed cannot be collected or purchased, native grass seed from other parts of central Queensland should be purchased from commercial operators and respread in these locations;
- Vegetation re-establishment should be monitored during and post-construction. Key flora indicators should include percentage groundcover of desirable species. A suitable target may be 50% of the desirable species cover occurring on adjoining undisturbed areas within 24 months. Desirable species may include native groundcover species where these are already present or pasture grasses where these are currently present or requested by the landholder;
- Construction should be undertaken in the dry season wherever possible;
- Clearing width should be minimised at watercourse crossings and in areas with Of Concern vegetation (RE 11.3.4 and RE 12.11.14);
- Care should be taken to ensure hydrological characteristics are not altered and appropriate soil and erosion management is implemented in and adjacent to riparian areas;
- Drainage should be reinstated at watercourse crossings immediately following completion of construction;
- Design, install and maintain effective erosion and sediment control structures during construction and operation (especially near wetlands, watercourses and steep areas);

- Monitoring of weed infestations within disturbed areas should occur at least monthly during construction and then quarterly for a period of two years following construction. Appropriate weed control measures should be applied. Following the two year period, the frequency of monitoring should be reconsidered dependent on the success of control measures and the level of infestations;
- A Weed Management Plan that addresses the construction, rehabilitation and operation phases of the project should be prepared prior to construction. This Plan should include hygiene protocols to minimise the likelihood of introduction and spread of environmental, agricultural and declared weeds; and
- All vehicles and plant should have certification that they are weed-free prior to their initial commencement of works.

6.3 Mitigation and Rehabilitation Recommendations for Fauna

Thirteen EVR species have been identified as potentially occurring within the proposed alignments. Of these, seven species are considered to be highly mobile species (EPA, 2004) and are unlikely to be significantly impacted by the construction of the residue pipeline. The remaining six species may be impacted by the proposed construction works in the form of habitat loss (i.e. mature vegetation, shelter), loss of foraging resources and / or trench fall. To avoid or minimise these impacts, recommended mitigation measures are provided in **Table T10**.

The potential impacts of the construction works have also been identified for common fauna (**Section 5.3.1**). Where appropriate, mitigation and rehabilitation recommendations to avoid or minimise potential impacts on common fauna are also provided in **Table T10**.

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7 APPROVALS REQUIRED IN RELATION TO FLORA AND FAUNA

7.1 Australian Government Policy, Legislation and Guidelines

The EPBC Act protects the environment, particularly in relation to matters of National Environmental Significance. It streamlines national environmental assessment and approvals processes, protects Australian biodiversity and integrates management of important natural and cultural places.

Under the EPBC Act, assessment and approval is required for actions that are likely to have a significant impact on Commonwealth listed EVR flora and fauna species and threatened ecological communities. DEW provides guidelines to assist in determination of whether or not impacts should be considered to be significant.

No EVR flora or fauna species listed under the EPBC Act were recorded within the proposed corridors. It is considered unlikely that any significant populations of EVR species occur within the corridors. Two small patches of vine thicket communities that are listed as Endangered under the EPBC Act occur adjacent to the cleared area along Boyles Road. As long as clearing and disturbance does not extend further west or north of the existing clearing along these sections, no direct impacts on these communities are expected. Subject to the successful implementation of the mitigation recommendations provided in **Section 6**, no EPBC listed flora species, fauna species or vegetation communities are considered likely to be significantly impacted by the proposal. However, due to the presence of listed ecological communities, it is recommended that an EPBC referral is submitted to DEW to determine whether the proposed action requires approval under the EPBC Act.

7.2 State Policy, Legislation and Guidelines

The NC Act provides for the conservation of wildlife and habitat for the whole of Queensland. The EPA administers this act. The *Nature Conservation (Wildlife) Regulation 1994* lists the plants and animals considered presumed extinct, endangered, vulnerable, rare, common, international and prohibited. It discusses their significance and states the declared management intent and the principles to be observed in any taking and use for each group.

No EVR flora or fauna species listed under the NC Act were recorded within the proposed corridors. Subject to the successful implementation of the mitigation recommendations provided in **Section 6**, no NC Act listed flora or fauna species are considered likely to be significantly impacted by the proposal.

The Queensland VM Act provides a legislative framework for managing and assessing clearing of remnant vegetation on freehold and leasehold land. The Department of Natural Resources and Water (DNRW) administers this Act. The conservation status of vegetation communities is based on the remaining extent of REs within identified Bioregions. Three conservation categories are recognised under the Act. These are:

- Endangered: where there is either less than 10% of the pre-clearing extent remaining, or 10% - 30% of its pre-clearing extent remaining if the remnant is less than 10 000 hectares;
- Of concern: where there is either 10-30% pre-clearing extent remaining, or more than 30% remaining if the remnant is less than 10 000 hectares; and

- Not of Concern: where there is over 30% pre-clearing extent remaining and remnant is greater than 10 000 hectares.

Based on the recommendations contained in this report, construction of the proposed corridor is likely to require clearing of up to 1.3 ha of Of Concern RE and 30.3 ha of Not Of Concern RE. There are requirements for landholders to obtain permits under the VM Act for any proposed clearing of Endangered, Of Concern or Not of Concern REs. This generally includes development of a Property Vegetation Management Plan for the properties that will be subject to clearing.

8 CONCLUSION

Constraints identified along the proposed alternate residue pipeline alignment included:

- Mount Stowe State Forest adjoining the alignment from KP 9.0-13.2;
- Small patches of Endangered vegetation (RE 11.11.18 and RE 11.3.11) adjoining the existing cleared area of Boyles Road at KP 8.15-8.3 and KP 12.8-12.9;
- Small creek and Of Concern vegetation (RE 11.3.4) adjoining the alignment from KP 10.3-11.5;
- Narrow corridor of remnant vegetation along the alignment from KP 13.2-15.6;
- Small strips of Of Concern vegetation (RE 11.3.4) transected by the alignment at KP13.2-13.4, KP 14.5-14.6 and KP 14.9-15.0;
- Of Concern vegetation (RE 12.11.14) transected by the alignment from KP 4.4-4.8; and
- Not of Concern communities transected or adjacent to about 10.1 km of the alignment.

Field surveys did not detect any EVR flora or fauna species, but recorded potential habitat for 10 EVR flora species and 13 EVR fauna species. The alignment also contains potential habitat for 57 fauna species of Regional Significance. Provided suitable mitigation measures are implemented during construction and maintenance activities, no significant impacts on these species are considered likely.

During the field surveys, two other alignments were examined. HDD from the refinery site to KP 9.3 (Alignment 2) is likely to limit surface impacts to entry and exit points and associated lay down areas. Detailed assessment of impacts associated with this proposal requires further information on construction, including dimensions of disturbance areas, which were not available at the time of preparation of this report. An alternative alignment that lies mostly outside road reserves was also investigated (Alignment 3), but is considered to have generally greater impacts than the primary alignment. Therefore, from an ecological perspective, Alignment 1 is the preferred option for the majority of the residue pipeline route, while Alignment 2 may be the preferred option from KP 0-9.3, depending upon assessment of the proposed entry / exit points.

Specific mitigation measures recommended to minimise ecological impacts include:

- Conduct further investigations into the feasibility and potential ecological impacts of the proposed HDD route from the Gladstone Nickel Project to KP 9.3 of the primary alignment;
- Ensure clearing and disturbance does not impact on adjacent Endangered vegetation at KP 8.15-8.3 and KP 12.8-12.9;
- Minimise indirect impacts of clearing and disturbance on vegetation adjoining Mount Stowe State Forest from KP 9.0-13.2;
- Minimise impacts of clearing and disturbance on Of Concern vegetation at KP 5.9-6.3, 10.3-11.5, KP 13.2-13.4, KP 14.5-14.6 and KP 14.9-15.0; and
- From KP 13.2-15.6, move the alignment 50 m eastwards and southwards to avoid a narrow corridor of remnant vegetation that connects two large remnant blocks.

Provided that mitigation measures recommended in this report are followed, significant ecological impacts of the construction and maintenance of the proposed residue pipeline are likely to be limited to the direct impact of clearing up to 33.5 ha of remnant vegetation. As portions of the proposed alignment are already partially cleared, actual clearing requirements will be substantially less, estimated to be in the order of 20-25 ha.

9 REFERENCES

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