Warrell Creek to Nambucca Heads

Grey-headed Flying Fox – Operational Habitat Monitoring

Roads and Maritime Services | 2019

NSW GOVERNMENT

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Document control

Report name	Warrell Creek to Nambucca Heads - Grey-headed Flying Fox – Operational Habitat Monitoring	
Date	February 2019	
Document version	Revision 1	Summer 2018 Stage 2A monitoring report
	Revision 2	Autumn 2018 Stage 2A monitoring report.
	Revision 3	Winter 2018 Stage 2A and Stage 2B monitoring report
	Revision 4	Spring 2018 Stage 2A and Stage 2B monitoring report
	Revision 5	Summer 2019 Stage 2B monitoring report

Contents

1. Introduction

Grey-headed Flying Fox habitat monitoring is a requirement of the approved Warrell Creek to Nambucca Heads Flying-fox management plan and the Ecological Monitoring Program.

The aim of the monitoring program is to;

1. monitoring of identified revegetation/rehabilitation areas to ensure the establishment /restoration of seedlings and plants. These areas could be areas cleared in grey-headed flying fox habitat for temporary ancillary facilities, access tracks, watercourse crossings etc;

2. monitoring both revegetation/rehabilitation areas and other habitat areas adjacent to the Project to manage invasion of noxious and environmental weeds;

3. monitoring water quality (contamination, isolation, etc) for notable changes due to the Project, to manage impacts on foraging and roosting habitat.

4. monitoring notable changes to groundwater and ponded surface water regimes to manage impacts on foraging and roosting habitat.

Quarterly monitoring of the quality of the habitat adjacent to the Project for up to one year after the opening of the Project to traffic unless otherwise agreed with P&I, EPA and DoEE.

2. Purpose of this report

The purpose of this report is to provide the monitoring data for aspects 1 and 2 of the monitoring program. Aspects 3 and 4 are monitored as part of the construction and operational surface and ground water monitoring program and reported separately following the collection, analysis and assessment of water quality data.

Due to the staged opening of the project the Grey-headed Flying Fox habitat monitoring will be undertaken as follows:

Season	Stage 2A (Chainage 47,700 to 61,300)	Stage 2B (Chainage 41,700 to 47,700)
Summer 2017/2018		
Autumn 2018		
Winter 2018		
Spring 2018		
Summer 2018/2019		
Autumn 2019		

At the end of each monitoring cycle an annual report will be produced for each section. i.e. Stage 2A annual report will be produced at the end of spring 2018. Stage 2B will be produced at the end of autumn 2019.

The results of monitoring are provided in the Appendices.

Appendix 1: Summer 2018 Stage 2A monitoring report

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28 March 2018
Ref No: 2692-1090

Roads and Maritime Service
24 Albert Drive
WARRELL CREEK NSW 2447

Attention: Mr Kris Hincks

Dear Kris

WC2NH GHFF Habitat Monitoring – First quarterly monitoring 2018

Introduction

This report presents the results of the first quarterly monitoring for 2018 of Grey-Headed Flying-fox (GHFF) habitat adjacent to the Warrell Creek to Nambucca Heads Highway Upgrade (WC2NH) Project. Quarterly monitoring will be undertaken between chainage 47 700 and 61 300 (Stage 2A) for up to one year after the opening of the Project to traffic.

The *Warrell Creek to Nambucca Heads Flying-fox Management P*lan (Sinclair Knight Merz, 2017) recognised that the quality of vegetation adjacent to the Project area could be detrimentally affected by invasion of noxious and environmental weeds. A main goal identified for management during operation of the Project is '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'* (Sinclair Knight Merz, 2017).

Methodology

The monitoring of Grey-headed Flying-fox habitat includes the following components:

1. Monitoring of identified revegetation/rehabilitation areas to ensure the establishment/restoration of seedlings and plants. These areas could be areas cleared in GHFF habitat for temporary ancillary facilities, access tracks, watercourse crossings etc.

2. Monitoring both revegetation/rehabilitation areas and other habitat areas adjacent to the Project to manage invasion of noxious and environmental weeds.

For brevity, component 1 is henceforth referred to as 'rehabilitation site monitoring', and component 2 is referred to as 'weed monitoring'.

The field survey was undertaken on 25-27 February 2018 by GeoLINK ecologists Grant McLean and Garon Staines.

Further detail on the two monitoring components is provided below.

Rehabilitation Site Monitoring

The locations of the GHFF habitat areas requiring revegetation/rehabilitation are shown in **Table 1** below. Monitoring of these areas aimed to assess the effectiveness of rehabilitation of GHFF habitat areas cleared during the construction of the Project.

Table 1 Location of GHFF Habitat Rehabilitation Sites

Habitat type	*Location*	*Area Type*
Open Blackbutt	CH: 59450 East	15c ancillary compound
Open Blackbutt	CH: 60800 East	Old Coast Rd Temporary Deviation

The following data was recorded for each location:

- Date and time of monitoring.
- Weed abundance and composition.
- Evidence of management and control of noxious and environmental weeds.
- Evidence of any progressive revegetation/rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation.
- Evidence of native plant establishment of seedlings.
- Identification of any of the GHFF food tree plants referred to in Appendix B of the brief.

Four fixed photo points were also established at these rehabilitation sites (refer to **Table 2**).

Table 2 Locations of Fixed Photo Points for Rehabilitation Sites

Photo Point ID	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*
1RS	497441, 6610257
2RS	497279, 6610248
3RS	497229, 6610231
4RS	496438, 6609098

Weed Monitoring

The Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval defined GHFF habitat as habitat consisting of:

- Swamp Mahogany/Paperbark Swamp Forest
- Flooded Gum Moist Open Forest.
- White Mahogany/Grey Gum/Ironbark Moist Open Forest
- Mixed Floodplain Forest
- Blackbutt Open Forest.

All instances of the above plant communities occurring along the outside of the Project clearing corridor were targeted in the field survey. Within 2 metres of the cleared edge of these habitat areas the following data was recorded in relation to weeds:

- Date and time of monitoring.
- Weed abundance and composition.
- Evidence of management and control of noxious and environmental weeds.

Weed abundance was measured using modified Braun-Blanquet cover classes between 1 and 5: 1(<5%), 2 (6-25%), 3 (26-50%), 4 (51-75%), and 5 (76-100%).

Weed monitoring sites were classified as per the categories in Table 3. Priority weed sites for management were identified based on species present and the percentage cover.

Table 3 Weed Monitoring Site Classification

Noxious/Environmental Weed Cover (%)	*Weed Site Classification*
0-10	NA
11-39	Low
40-69	Medium
70-100	High

Fixed photo points were also established adjacent to representative areas of GHFF habitat to monitor weeds. Locations of these fixed photo points are shown in Table 4.

Table 4 Locations of Fixed Photo Points

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*Notes on photo direction*
1E	491906, 6598292	looking north
1W	492671, 6600507	looking north
2E	492372, 6599033	looking northeast
2W	496675, 6609675	looking north
3E	492778, 6600567	looking southwest
3W	496494, 6609010	looking south
4E	494575, 6605139	looking northeast
4W	496131, 6608279	looking north
5E	494960, 6606206	looking south
5W	495668, 6607684	looking north
6E	495433, 6607052	looking northeast
6W	494890, 6606346	looking southwest
7E	496240, 6608213	looking west
7W	494355, 6604185	looking north
8E	496724, 6609444	looking south

Results

Rehabilitation Site Monitoring

Surveys of rehabilitation sites were undertaken on 8 March by GeoLINK ecologist Jess O'Leary.

The results of the rehabilitation site monitoring are detailed in Table 5 along with photos from the four photo points that were established. Plantings at these sites are either young or have not been undertaken (in the case of the rehabilitation site at the 15c ancillary compound). Subsequent monitoring events will provide more useful data for assessing the success of these rehabilitation sites.

Table 5 Rehabilitation Site Monitoring

	Rehabilitation Site		
	Old Coast Rd Temporary Deviation		*15c ancillary compound*
	CH: 60800 West	*CH: 60800 East*	*CH: 59450 East*
Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)	Photo Point RS1: 497441, 6610257 Photo Point RS2: 497279, 6610248	Photo Point RS4: 496438, 6609098	Photo Point RS3: 497229, 6610231
Date and time	8/03/2018 – 9:00 am – 12:00 pm		
Weed Abundance and Composition	No weed infestations were observed within the newly landscaped area.	No weed infestations were observed within trimmed, topsoiled and hydroseeded batter.	Not applicable as this area is yet to be rehabilitated still part of the active construction site.
Evidence of management and control of noxious and environmental weeds	Not applicable - site recently finished and landscaped, no weeds present at the time of monitoring.	Not applicable - site recently finished and landscaped, no weeds at the time of monitoring.	As above.
Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation	It appears that the site was topsoiled and landscaped at the same time. Therefore, there was no observed progressive revegetation or successional stages of rehabilitation.	It appears that the site was topsoiled and landscaped at the same time. Therefore, there was no observed progressive revegetation or successional stages of rehabilitation.	As above.
Evidence of native establishment of seedlings and plants	Semi established native plant species have been planted as part of rehabilitation landscaping. Very minimal seed germination was observed at the time of monitoring other than the hydroseeded grass cover crop.	No establishment of native species at the time of monitoring.	As above.
Identification of any of the GHFF food tree plants referred to in Appendix B of the brief	Landscape plantings have included species, as identified within Appendix B. Natural regeneration of native species is not yet developed enough to allow for accurate identification of species. Plants planted as part of landscape planting include Water Gum (*Tristaniopsis laurina*).	No landscape plantings had been undertaken at the time of monitoring. No obvious establishment of native species from the topsoil seed bank at the time of monitoring.	As above.
Photo Points	 Photo Point RS1 – view to the south	 Photo Point RS4 - view to the west (no peg installed)	 Photo Point RS3 - view to the east, no rehabilitation works started at time of monitoring.

	Rehabilitation Site		
	Old Coast Rd Temporary Deviation		15c ancillary compound
	CH: 60800 West	CH: 60800 East	CH: 59450 East
	 Photo Point RS1 – view to the north-east  Photo Point RS2 – view to the south-west		 Site reference photo view to the west looking towards Photo Point #3, no rehabilitation works started at time of monitoring.

Weed Monitoring

Surveys of GHFF habitat areas were undertaken 25-27 February 2018 by GeoLINK ecologists Grant McLean and Garon Staines.

Occurrence of noxious and/or environmental weeds was recorded at 28 sites within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and are listed in Table 6. Photographs of GHFF habitat areas taken from fixed photo points are shown in Table 7**.**

Nineteen noxious and environmental weed species were recorded in the field surveys. Lantana (*Lantana camara*), Salvinia (*Salvinia molesta*) and Blackberry (*Rubus fruticosus*) were recorded onsite and are listed as priority weed species for the North Coast of NSW. They must not be imported into the State or sold.

Lantana, Broad-leaved Paspalum (*Paspalum mandiocanum*) and Camphor Laurel (*Cinnamomum camphora*) were recorded within GHFF habitat areas at the highest density, and were also the dominant weed species in those GHFF areas that recorded a 'Medium' weed infestation level (refer to **Table 6**).

One weed occurrence area (site 25) was considered to have a high weed management priority and nine areas were considered to have a medium weed management priority (sites 5, 16, 18, 22, 23, 24, 26, 27 and 28). These areas should be targeted during weed management works.

Table 6 Sites of Noxious and/or Environmental Weeds

Site No.	*Chainage (side of highway heading north)*	*Weeds Present (Cover Class*)*	*GHFF Habitat Type (Plant Community)*	*Weed Infestation Level^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
1	49790 - 50100 (west)	Setaria (*Setaria sphacelata*) (2), Annual Ragweed (*Ambrosia artemisiifolia*) (1)	Swamp Forest - Swamp Mahogany / Paperbark	Low	Majority of weed infestation concentrated on batter edge. Blue Water Lily (on swamp fringe) 40% cover in concentrated areas of open water.	None – initial monitoring event	Low
2	51010 - 51165 (west)	Salvinia (*Salvinia molesta*) (within open water area – approx. chainage 51020) (2)	Swamp Forest - Swamp Mahogany / Paperbark	Low	Very minor Flax-leaf Fleabane (*Conyza bonariensis*), Broad-leaved Paspalum (*Paspalum mandiocanum*) and Annual Ragweed on fauna fence edge Salvinia is listed as a priority weed species for the North Coast of NSW. It must not be imported into the State or sold.	None – initial monitoring event	Low (although Salvinia is a WONS this species would have minimal impact on GHFF habitat value).
3	53750 - 53840 (west)	Broad-leaved Paspalum (2), Annual Ragweed (1), White Passionflower (*Passiflora subpeltata*) (1), Paddy's Lucerne (*Sida rhombifolia*) (1), Purple-top (*Verbena bonariensis*) (1)	Moist Open Forest - White Mahogany - Grey Gum	Low		None – initial monitoring event	Low
4	54115 - 54150 (west)	Broad-leaved Paspalum (2), Lantana (*Lantana camara*) (1)	Open Forest - Blackbutt	Low	Setaria, Flax-leaf Fleabane and Purple-top present in very low abundance Lantana is listed as a priority weed species for the North Coast of NSW. It must not be imported into the State or sold.	None – initial monitoring event	Low
5	54480 - 54530, (west)	Broad-leaved Paspalum (3), Lantana (1), Wild Tobacco (*Solanum mauritianum*) (1),	Open Forest - Blackbutt	Medium		None – initial monitoring	Medium

		Flaxleaf Fleabane (1)				event	
6	55220 - 55260 (west)	Setaria (1)	Open Forest - Blackbutt	Low		None – initial monitoring event	Low
7	56160 - 56360 (west)	Broad-leaved Paspalum (2), Setaria (1), Lantana (1)	Open Forest - Blackbutt	Low	Lantana present in low abundance on fringe	None – initial monitoring event	Low
8	57370 – 57450 (west)	Lantana (2)	Open Forest - Blackbutt	Low		None – initial monitoring event	Low
9	58440 - 58550 (west)	Broad-leaved Paspalum (2), Lantana *(*1)	Flooded Gum Moist Open Forest	Low		None – initial monitoring event	Low
10	58850 – 58940 (west)	Lantana (1)	Open Forest - Blackbutt	Low		None – initial monitoring event	Low
11	59200 - 59250, (west)	Broad-leaved Paspalum (1)	Open Forest - Blackbutt	Low		None – initial monitoring event	Low
12	59700 - 59740 (west)	Broad-leaved Paspalum (2)	Open Forest - Blackbutt	Low		None – initial monitoring event	Low
13	59780 - 59810 (west)	Broad-leaved Paspalum (2)	Flooded Gum Moist Open Forest	Low		None – initial monitoring event	Low
14	60400 - 60540,	Broad-leaved Paspalum (2), Morning	Open Forest -	Low	Some sections without GHFF	None – initial	Low

	60640 – 60665 (west)	Glory (*Ipomoea indica*) (1), Rhodes Grass (*Chloris gayana*) (1)	Blackbutt		habitat (old hardstand area and stockpile site).	monitoring event	
15	61240 – 61260 (east)	Lantana (1)	Open Forest - Blackbutt	Low		None – initial monitoring event	Low
16	59780 - 59850 59550 - 59590 59200 - 59260 59000 - 59080 58470 – 58550 58050 - 58110 57650 - 57770 57210 - 57250 (east)	Lantana (3), Broad-leaved Paspalum (1), Blue Billy-goat Weed (*Ageratum houstonianum*) (1)	Flooded Gum Moist Open Forest	Medium	Lantana cover >25% to >50% in some gullies	None – initial monitoring event	Medium
17	56100 – 56420 (east)	Broad-leaved Paspalum (3), Lantana (2)	Open Forest - Blackbutt Flooded Gum Moist Open Forest	Low	Mostly intact native canopy but more scattered trees around big house in north. Lower weed cover in south,	None – initial monitoring event	Low
18	56420 – 56580 (east)	Broad-leaved Paspalum (4), Lantana (2)	Open Forest - Blackbutt	Medium	Very weedy understorey in north around big house. Very weedy north section.	None – initial monitoring event	Medium
19	55630 – 56080 (east)	Lantana (1), Broad-leaved Paspalum (1), Setaria (1)	Open Forest Blackbutt	Low		None – initial monitoring event	Low
20	52980 – 53040 (east)	Lantana (1), Mile a Minute (*Ipomoea cairica*) (1), Groundsel Bush (*Baccharis halimifolia*) (1), Annual Ragweed (1), Setaria (1)	Swamp Forest - Swamp Mahogany / Paperbark	Medium		None – initial monitoring event	Medium
21	49830 - 50220 (east)	Vasey Grass (*Paspalum urvillei*) (2), Setaria (1)	Swamp Forest - Swamp Mahogany / Paperbark	Low	Mel quin open forest in good condition including understorey except for some sections with blue water lily and some minor incursions of weedy grasses along fence.	None – initial monitoring event	Low

22	49560 – 49670 (east)	Broad-leaved Paspalum (4), Lantana (1)	Moist Open Forest - White Mahogany - Grey Gum	Medium		None – initial monitoring event	Medium
23	49030 - 49070 (east)	Broad-leaved Paspalum (5), Camphor Laurel (*Cinnamomum camphora*) (1)	Flooded Gum Moist Open Forest	High	Scattered native overstorey of Hard Quandong, Foambark, Broad-leaved Paperbark, with few shrubs and groundcover dominated by Broad-leaved Paspalum.	None – initial monitoring event	Medium
24	48430 - 48550 (east)	Broad-leaved Paspalum (5)	Moist Open Forest - Flooded Gum	High	Scattered overstorey of flooded gum, guioa, Mel quin, but lack of shrub layer and ground cover dominated by bl paspalum	None – initial monitoring event	Medium
25	48260 – 48380 (east)	Lantana (5), Broad-leaved Paspalum (2), Mile a Minute (1), Winter Senna (Senna septemtrionalis) (1).	Moist Open Forest - Flooded Gum	High	Mostly intact overstorey dominated by flooded gum with some river oak on edge creek. Understorey dominated by weeds mostly Lantana.	None – initial monitoring event	High
26	47800 – 47832 (east)	Lantana (2), Wild Tobacco (2), Setaria (1), White Passionflower (1)	Open Forest Blackbutt	Medium		None – initial monitoring event	Medium
27	47510 – 47530 (east)	Broad-leaved Paspalum (3), Camphor Laurel (2), Purple Top (2), Wild Tobacco (2)	Moist Open Forest – White Mahogany – Grey Gum	Medium		None – initial monitoring event	Medium
28	47450 – 47490 (east)	Camphor Laurel (2), Broad-leaved Paspalum (2), Lantana (2), Blackberry (*Rubus fruticosus*) (1), Narrow-leaved Privet (*Ligustrum sinense*) (1)	Moist Open Forest - White Mahogany - Grey Gum	Medium	Blackberry is listed as a priority weed species for the North Coast of NSW. It must not be imported into the State or sold.	None – initial monitoring event	Medium.

* Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%; ^ Refer to **Table 3**

Table 7 Fixed Photo Points

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
1E	491906, 6598292	
1W	492671, 6600507	

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
2E	492372, 6599033	
2W	496675, 6609675	

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
3E	492778, 6600567	
3W	496494, 6609010	

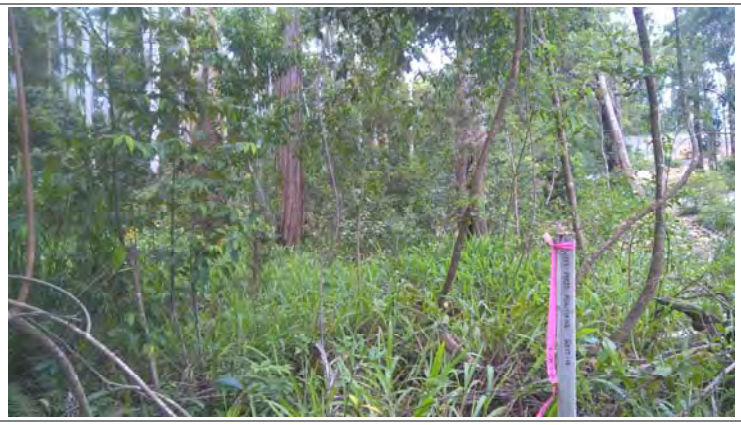
Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
4E	494575, 6605139	
4W	496131, 6608279	

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
5E	494960, 6606206	
5W	495668, 6607684	

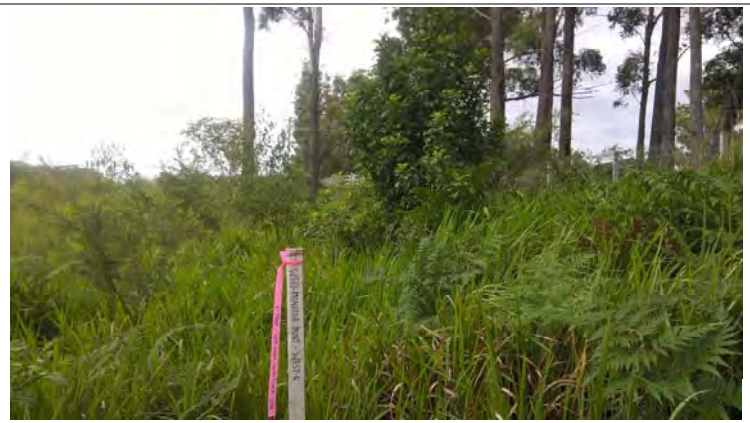
Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
6E	495433, 6607052	
6W	494890, 6606346	

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
7E	496240, 6608213	
7W	494355, 6604185	

Photo Point ID (number + side of alignment heading north: E=east, W=west)	*Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)*	*February 2018 photograph*
8E	496724, 6609444	

Recommendations

The following recommendations are provided based on the outcomes of the GHFF habitat monitoring:

Site 25 comprises an understorey dominated by Lantana. Site 16 encompasses eight discrete small areas of Flooded Gum Moist Open Forest generally in association with small low-lying gullies. In these areas infestations of Lantana are prominent, with some gullies recording densities of >25% to >50% cover. With the potential for Lantana to alter community structure and inhibit regeneration, sites 25 and 16 are important target areas to avoid any degradation to GHFF habitat.

Sites with dense Broad-leaved Paspalum (sites 5, 17, 18, 22, 23, 24 and 27) should be considered a somewhat lower priority for management than sites 25 and 16 for the following reasons:

- There may be a lower likelihood of weed management success (it is difficult to remove this species successfully from degraded communities that have a suitable semi-shaded understorey environment); and
- Being an understorey weed species that occurs in disturbed environments and edges, Broad-leaved Paspalum has a low potential to alter either the structure or regeneration potential, and hence the quality of relatively intact GHFF habitat.

Future monitoring should aim to identify any significant increase in the density of the exotic vines Morning Glory (*Ipomoea indica*) and Mile-a-minute (*Ipomoea cairica*) both of which have the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat.

Please contact the undersigned if require any further information.

Yours sincerely
GeoLINK

Jessica O'Leary
Ecologist

References

Sinclair Knight Merz (2017). *Warrell Creek to Nambucca Heads Upgrade of the Pacific Highway; Flying-fox Management Plan.* Report to Roads and Maritime Services.

Issue Log

UPR	*Description*	*Date issued*	*Issued By*
2692-1090	First issue	28/03/2018	JOL

Appendix A

GHFF Weed Survey Areas and Weed Infestation Levels (February 2018)

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- High
- Medium

Vegetation

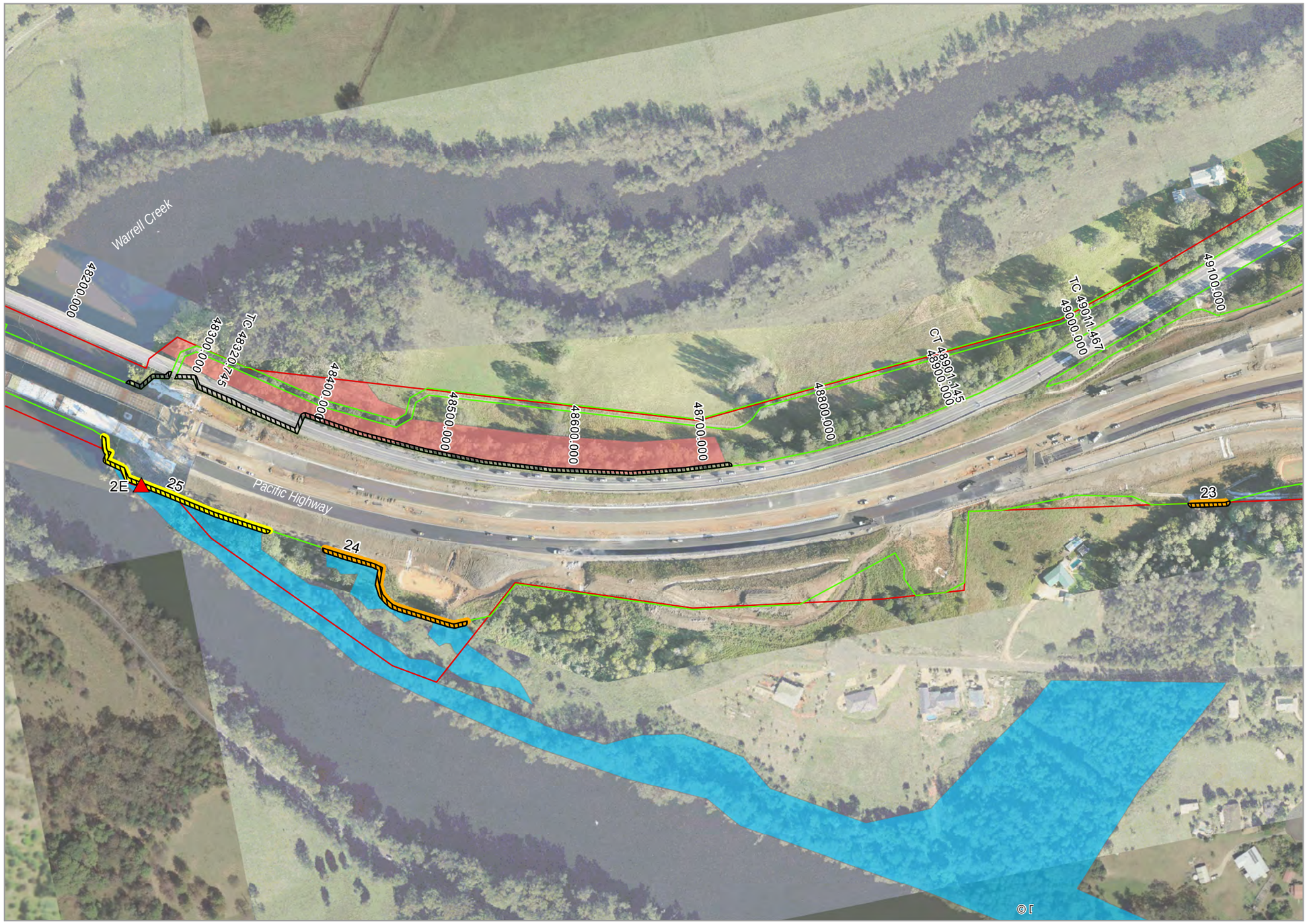
- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany - Grey Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- High
- Medium

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany - Grey Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany - Grey Gum
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

GeoLINK environmental management and design

WC2NH GHFF Habitat Monitoring – First Quarterly 2018
2692-1091

SHEET 3 OF 17

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

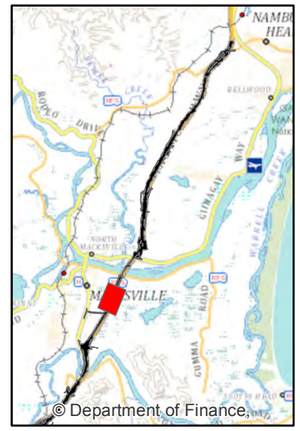
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Vegetation

- Mixed Floodplain Forest (EEC)
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

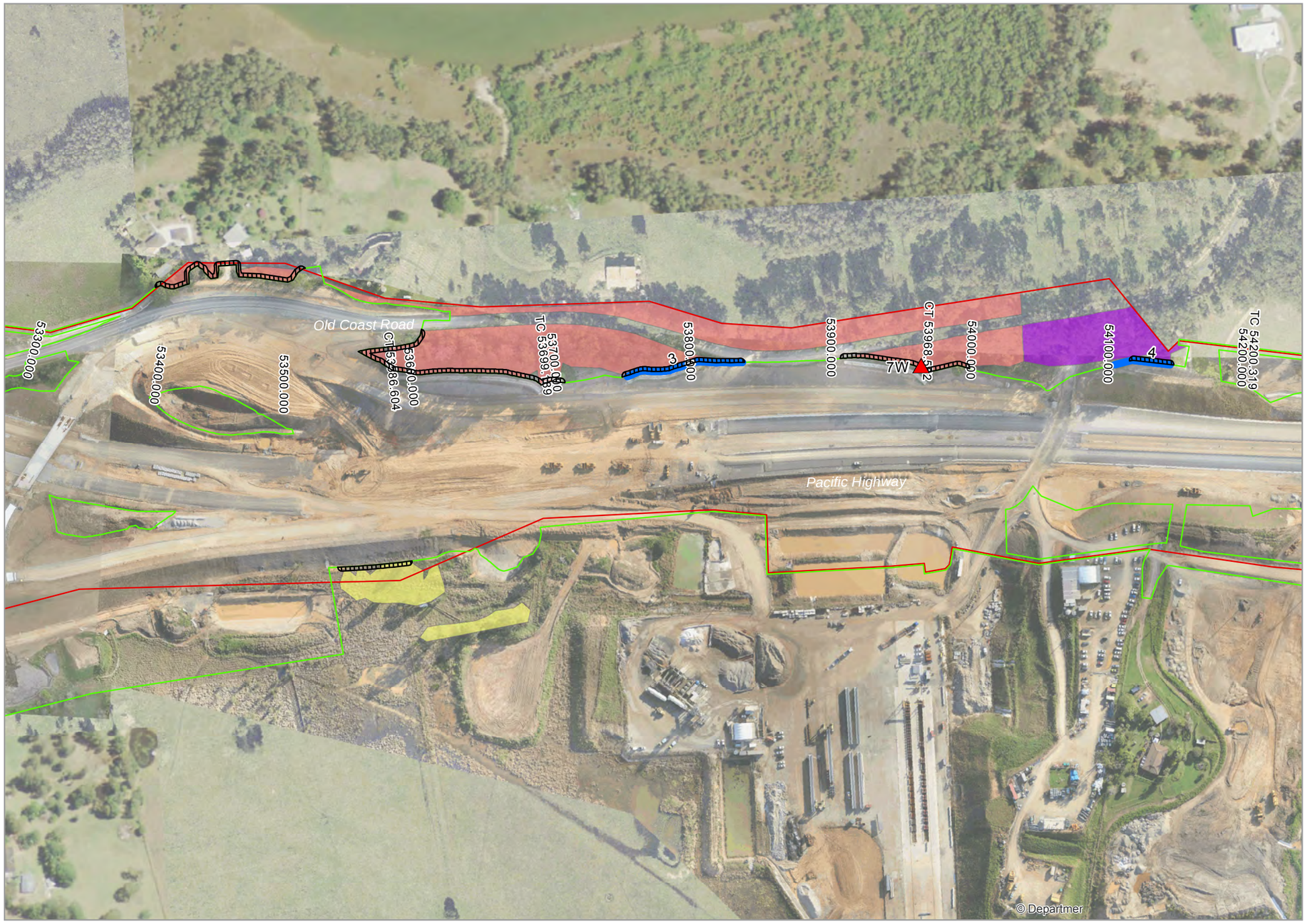
- Moist Open Forest - White Mahogany - Grey Gum
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

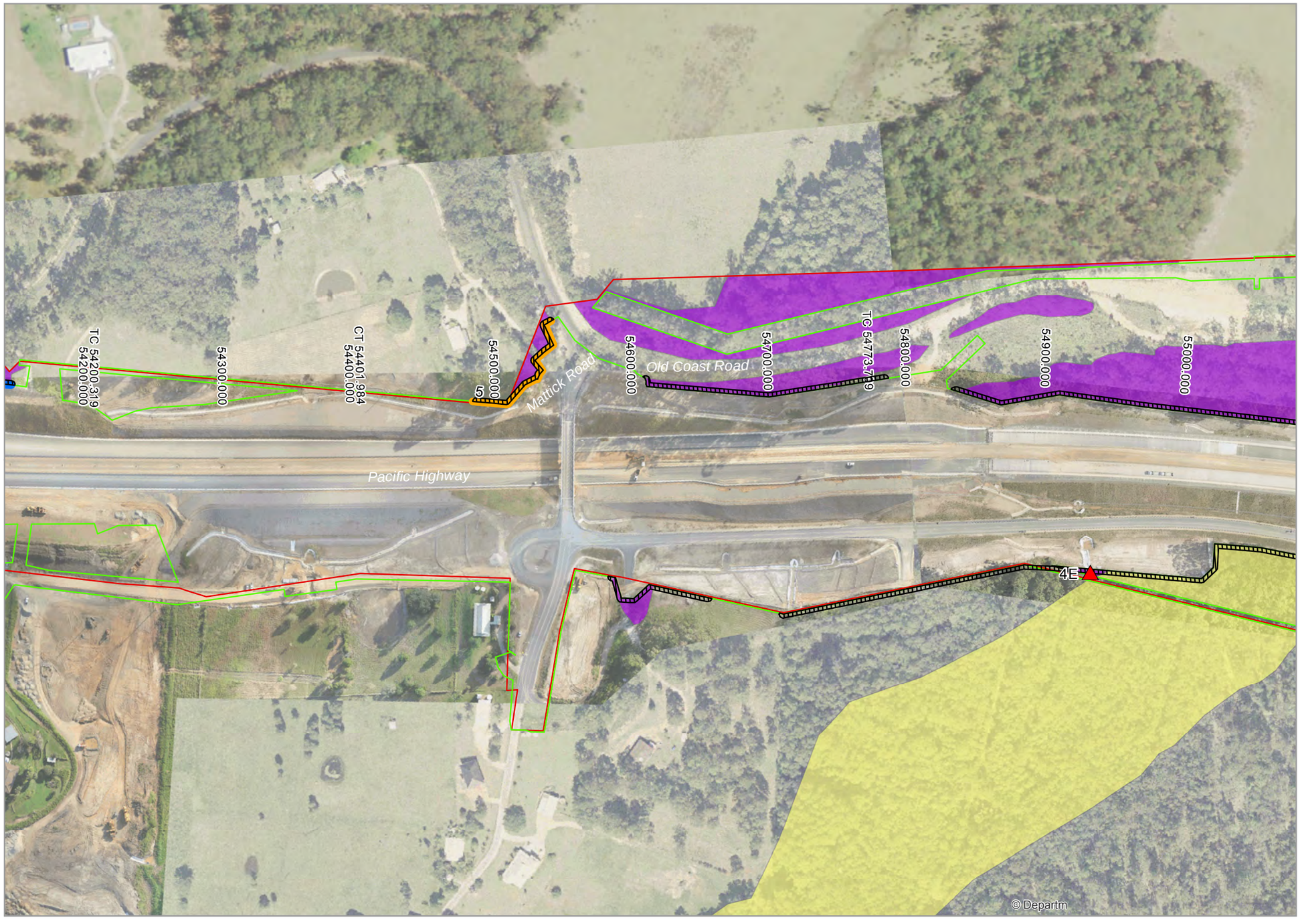
- Moist Open Forest - White Mahogany - Grey Gum
- Open Forest - Blackbutt
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

- Open Forest - Blackbutt
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
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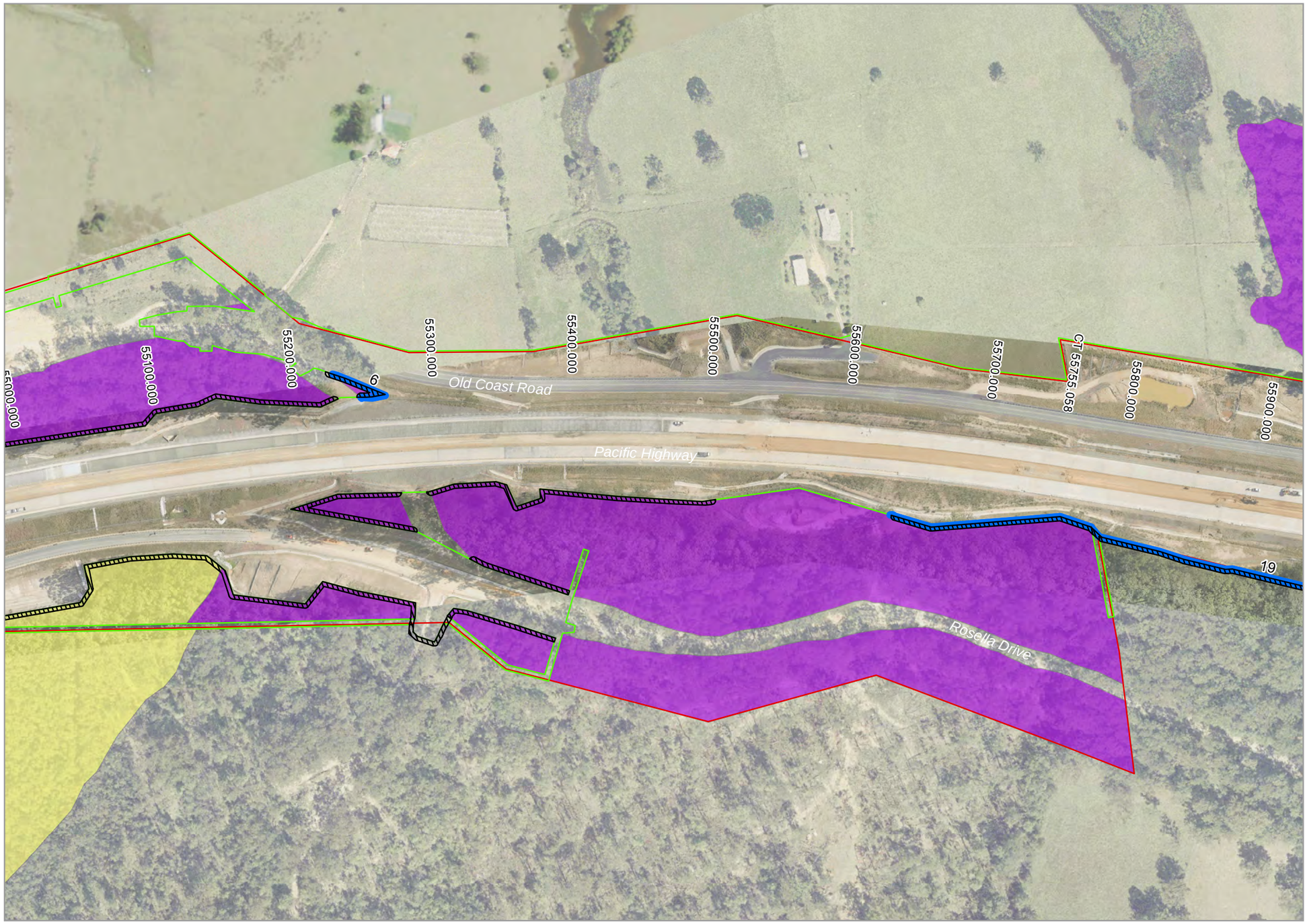

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

- Open Forest - Blackbutt
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

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WC2NH GHFF Habitat Monitoring – First Quarterly 2018
2692-1091

GHFF Weed Survey Areas and Weed Infestation Levels

SHEET 10 OF 17

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
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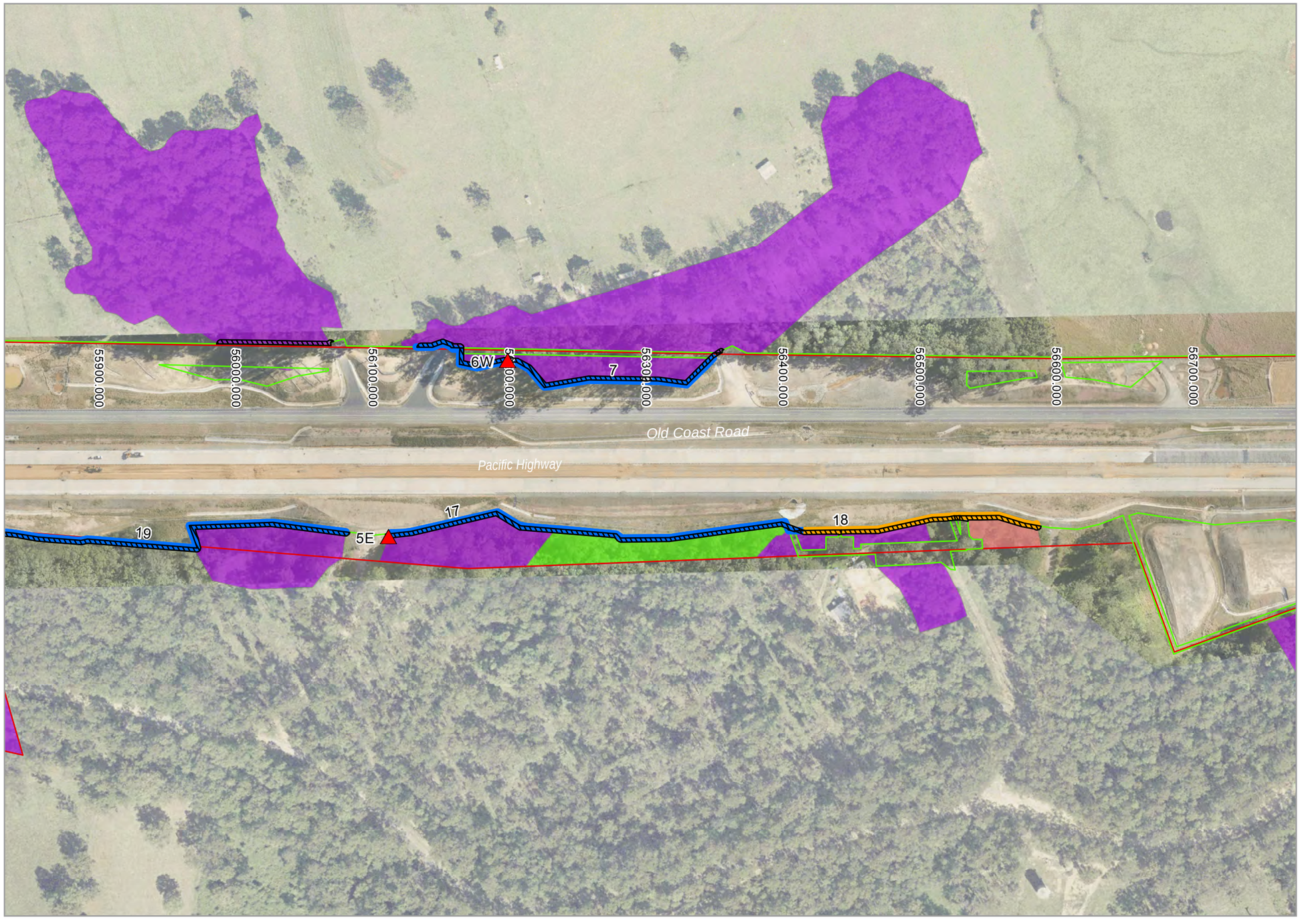


LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

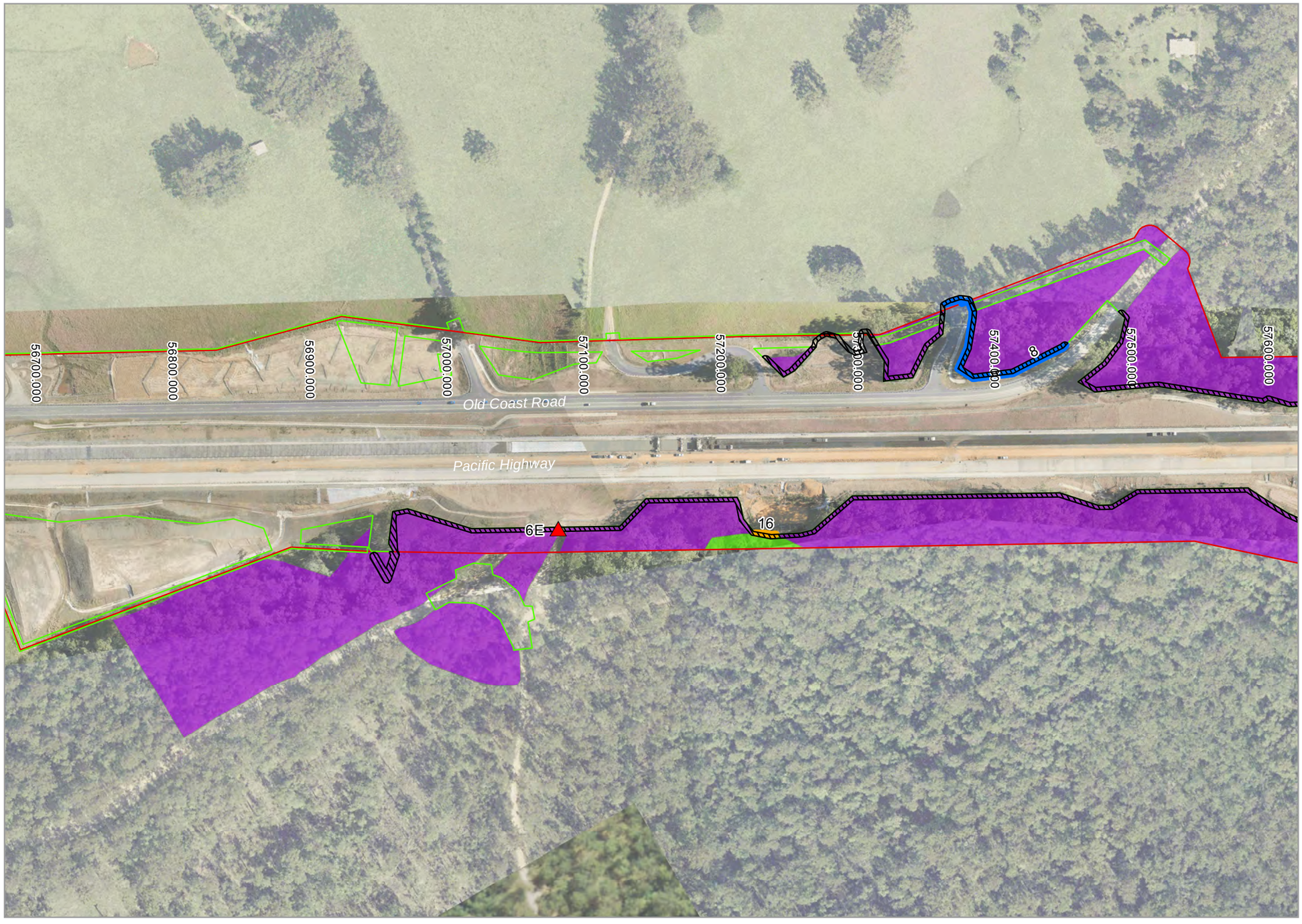
- Moist Open Forest - Flooded Gum
- Moist Open Forest - White Mahogany - Grey Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: GJM Date: 27/03/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

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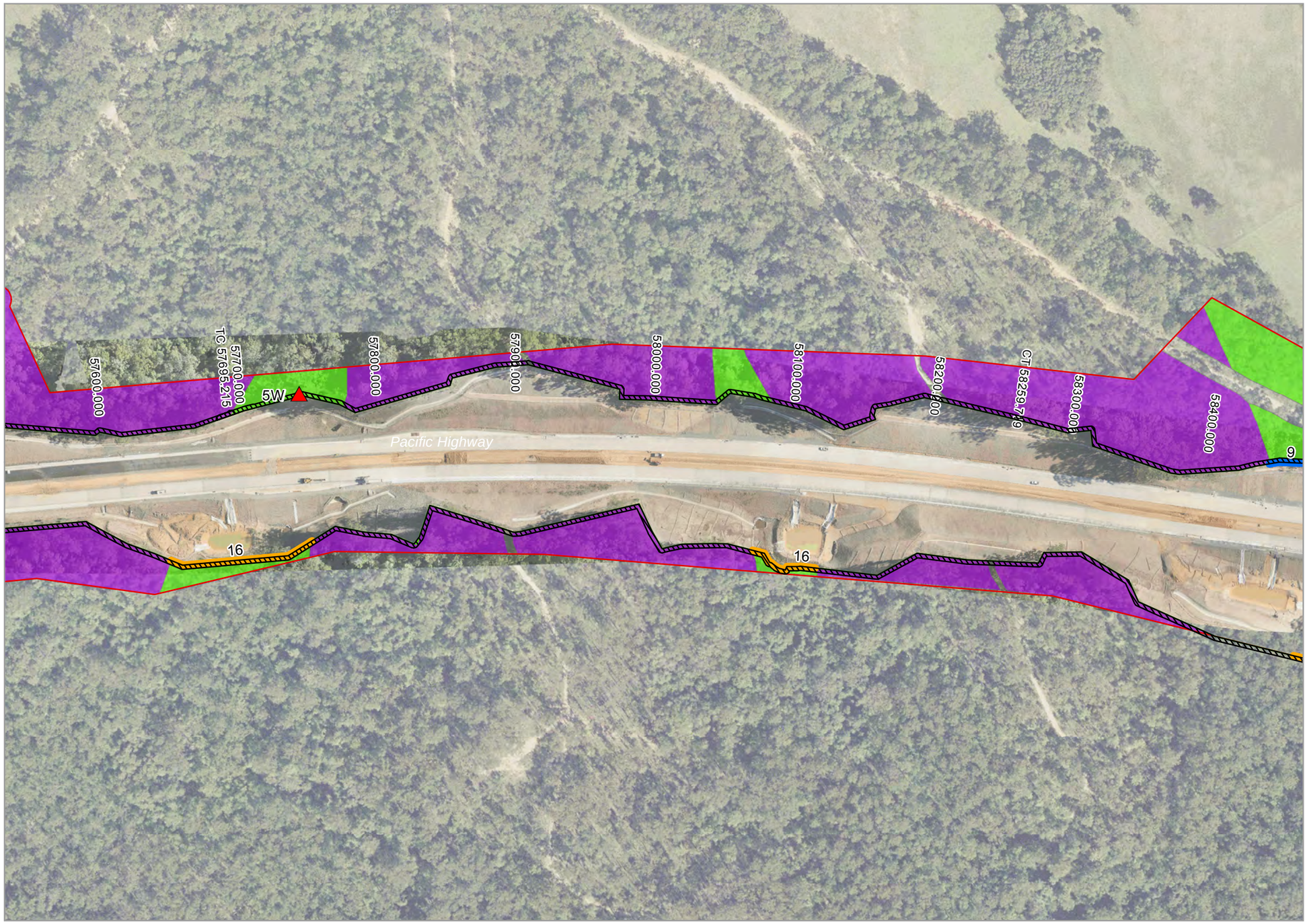

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GeoLINK environmental management and design

WC2NH GHFF Habitat Monitoring – First Quarterly 2018
2692-1091

GHFF Weed Survey Areas and Weed Infestation Levels

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Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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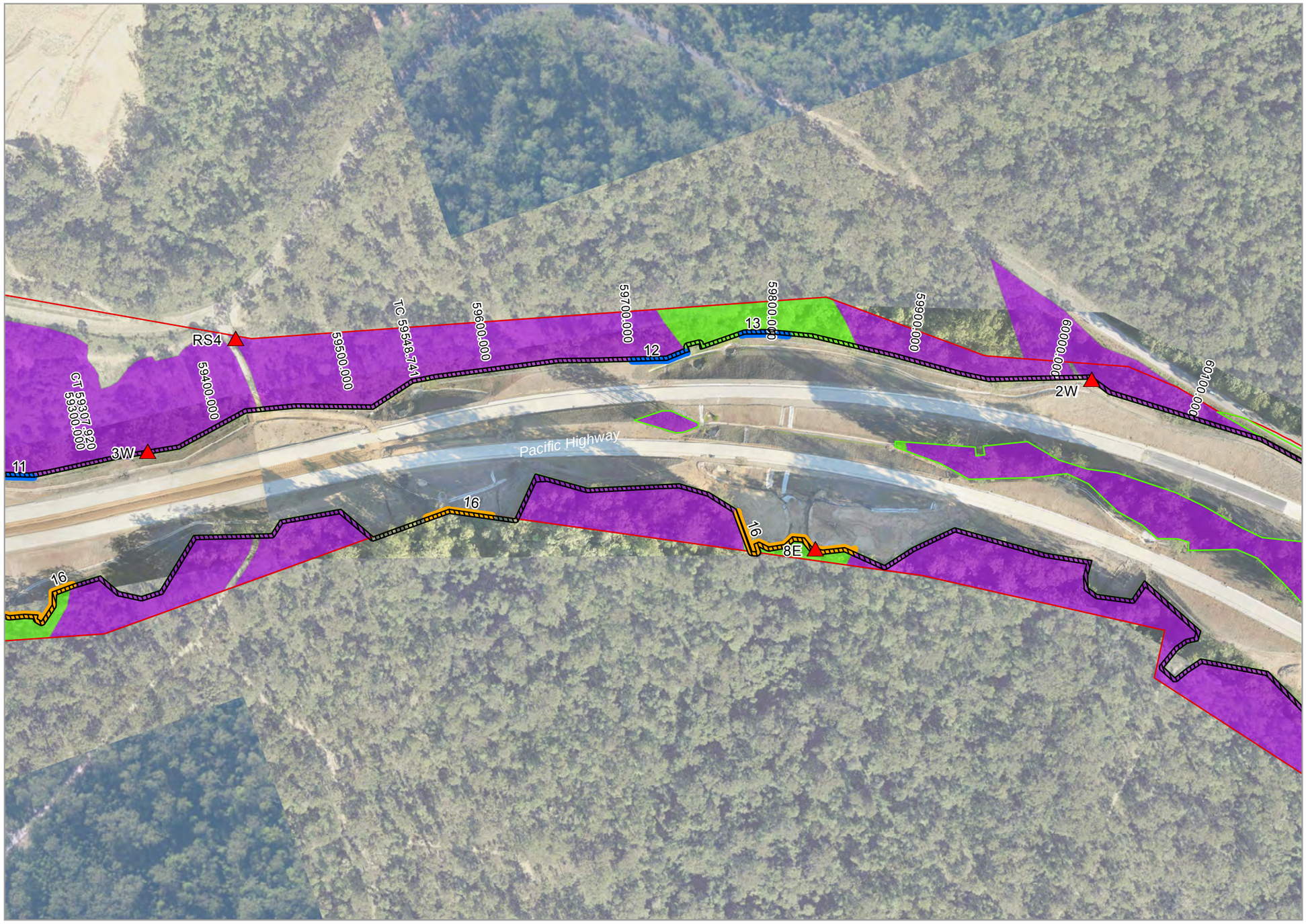

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Medium
- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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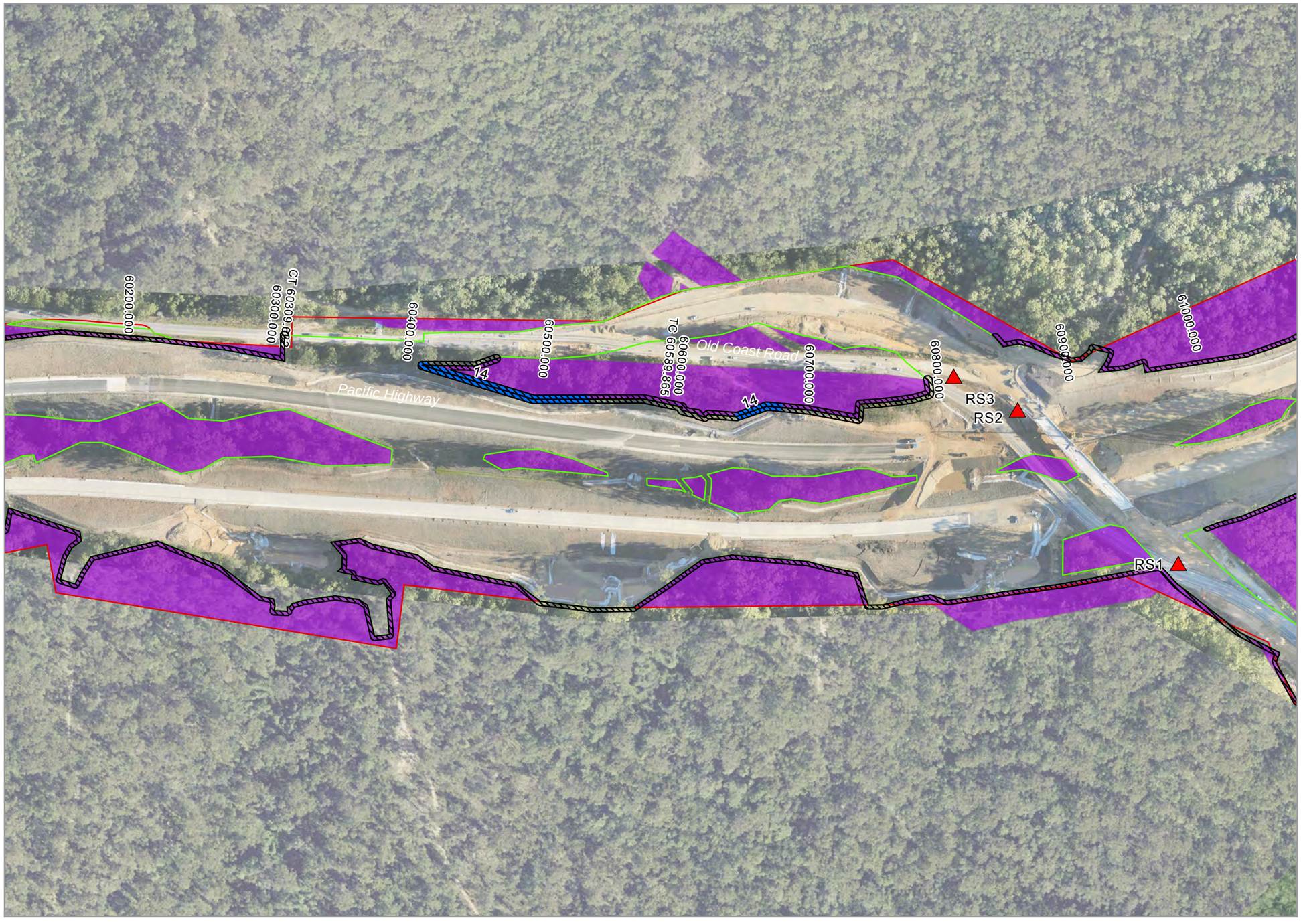

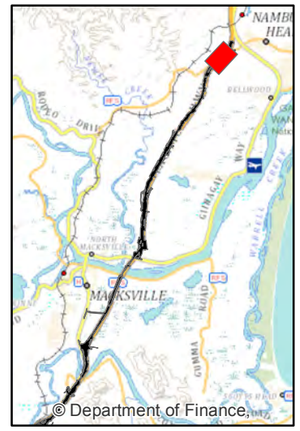

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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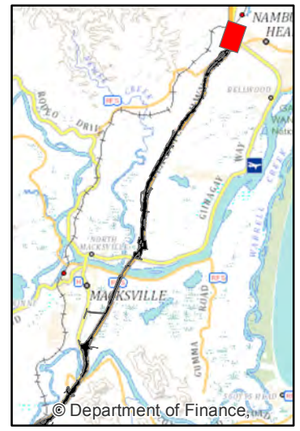

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Infestation Level

- Low

Vegetation

- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Appendix 2: Autumn 2018 Stage 2A monitoring report

GeoLINK environmental management and design

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08 June 2018
Ref No: 2692-1121

Roads and Maritime Service
124 Albert Drive
DONNELLYVILLE NSW 2447

Attention: Mr Kris Hincks

Dear Kris

WC2NH GHFF Habitat Monitoring – Autumn 2018

Introduction

This report presents the results of the second quarterly habitat monitoring event (Autumn 2018) of Grey-Headed Flying-fox (GHFF) habitat adjacent to Stage 2A section of the Warrell Creek to Nambucca Heads Highway Upgrade (WC2NH) project. Quarterly GHFF habitat monitoring is required at Stage 2A (chainage 47700 and 61300 – refer to **Appendix A**) for up to one year after the opening of this section of WC2NH to traffic.

The *Warrell Creek to Nambucca Heads Flying-fox Management P*lan (Sinclair Knight Merz, 2017) recognised that the quality of vegetation adjacent to the Project area could be detrimentally affected by invasion of noxious and environmental weeds. A main goal identified for management during operation of the Project is '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'* (Sinclair Knight Merz, 2017).

Methodology

The monitoring of Grey-headed Flying-fox habitat includes the following components:

1. Monitoring of identified revegetation/ rehabilitation areas to ensure the establishment/ restoration of seedlings and plants. These areas could be areas cleared in GHFF habitat for temporary ancillary facilities, access tracks, watercourse crossings, etc.

2. Monitoring both revegetation/ rehabilitation areas and other habitat areas adjacent to the Project to manage invasion of noxious and environmental weeds.

For brevity, component 1 is henceforth referred to as 'rehabilitation site monitoring', and component 2 is referred to as 'weed monitoring'.

Field surveys were undertaken by GeoLINK ecologists Jessica O'Leary, Frank Makin and Garon Staines on:

- 22 May 2018 between 7.00 am to 4.00 pm.
- 23 May 2018 between 7.30 am to 2.30 pm.

Rehabilitation Site Monitoring

The locations of the GHFF habitat areas requiring revegetation/ rehabilitation are listed in **Table 1**. Monitoring of these areas aimed to assess the effectiveness of rehabilitation of GHFF habitat areas cleared during the construction of the Project.

Table 1 Location of GHFF Habitat Rehabilitation Sites

Habitat type	*Location*	*Site*
Open Blackbutt	CH: 59450 East	15c ancillary compound
Open Blackbutt	CH: 60800 East	Old Coast Rd Temporary Deviation

The following data was recorded for each location:

- Date and time of monitoring
- Weed abundance and composition
- Evidence of management and control of noxious and environmental weeds
- Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation
- Evidence of native plant establishment of seedlings
- Identification of any of the GHFF food tree plants referred to in **Appendix B**.

Photos were also taken at the four fixed photo points associated with the rehabilitation sites (refer to **Table 2**).

Table 2 Locations of Fixed Photo Points for Rehabilitation Sites

Photo Point ID	*Photo Point GPS Coordinates**	*Corresponding Rehabilitation Site*
1RS	497441, 6610257	Old Coast Rd Temporary Deviation
2RS	497279, 6610248	Old Coast Rd Temporary Deviation
3RS	497229, 6610231	Old Coast Rd Temporary Deviation
4RS	496438, 6609098	15c ancillary compound

** UTM eastings, northings; Zone 56J*

Weed Monitoring

The Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval defined GHFF habitat as habitat consisting of:

- Swamp Mahogany/ Paperbark Swamp Forest
- Flooded Gum Moist Open Forest
- White Mahogany/ Grey Gum/ Ironbark Moist Open Forest
- Mixed Floodplain Forest
- Blackbutt Open Forest.

All instances of the above plant communities occurring along the outside of the Project clearing corridor were targeted during the field surveys. Within two metres of the cleared edge of these habitat areas the following data was recorded in relation to weeds:

- Date and time of monitoring
- Weed abundance and composition
- Evidence of management and control of noxious and environmental weeds.

Weed abundance was measured using modified Braun-Blanquet cover classes between 1 and 5: 1 (<5%), 2 (6-25%), 3 (26-50%), 4 (51-75%), and 5 (76-100%).

Weed monitoring sites were classified as per the categories in **Table 3**. Priority weed sites for management were identified based on species present and the percentage cover.

Table 3 Weed Management Priority Site Classification

Noxious/Environmental Weed Cover (%)	*Weed Management Priority Classification*
0-10	NA
11-39	Low
40-69	Medium
70-100	High

Photos were also taken at the fixed photo points established during the Summer 2018 weed monitoring. Locations of the fixed photo points are listed in **Table 4**.

Table 4 Locations of Fixed Photo Points

*Photo Point ID**	*Photo Point GPS Coordinates^*	*Notes on Photo Direction*	*Vegetation Type*	*Corresponding Weed Infestation (where relevant)*
1E	491906, 6598292	Looking north	Moist Open Forest - White Mahogany - Grey Gum	W28
1W	492671, 6600507	Looking north north-east	Swamp Forest - Swamp Mahogany / Paperbark	W1b
2E	492372, 6599033	Looking north-east	Moist Open Forest - Flooded Gum	W25
2W	496675, 6609675	Looking north-east	Open Forest - Blackbutt	-
3E	492778, 6600567	Looking south-west	Swamp Forest - Swamp Mahogany / Paperbark	W21
3W	496494, 6609010	Looking south	Open Forest - Blackbutt	-

Photo Point ID*	Photo Point GPS Coordinates^	Notes on Photo Direction	Vegetation Type	Corresponding Weed Infestation (where relevant)
4E	494575, 6605139	Looking north north-east	Swamp Forest - Swamp Mahogany / Paperbark	-
4W	496131, 6608279	Looking north-east	Moist Open Forest – Flooded Gum	W9
5E	494960, 6606206	Looking south south-west	Open Forest - Blackbutt	W17
5W	495668, 6607684	Looking north-east	Moist Open Forest – Flooded Gum	
6E	495433, 6607052	Looking north	Open Forest - Blackbutt	-
6W	494890, 6606346	Looking south south-west	Open Forest - Blackbutt	W7
7E	496240, 6608213	Looking west	Moist Open Forest – Flooded Gum	W16
7W	494355, 6604185	Looking north	Moist Open Forest - White Mahogany - Grey Gum	-
8E	496724, 6609444	Looking south south-west	Moist Open Forest – Flooded Gum	W16

** number + side of alignment heading north: E=east, W=west.*

^ UTM eastings, northings; Zone 56J.

Results and Discussion

Rehabilitation Site Monitoring

The results of the rehabilitation site monitoring are provided in **Table 5**. Photos from the four fixed photo points are shown in **Appendix C**. Plantings and/or seeding at these sites are either young or have not been undertaken (in the case of the rehabilitation site at the 15c ancillary compound).

Native seed germination is now evident at the Old Coast Rd Temporary Deviation (CH60800) with a number of native species recorded growing from the native seed mix applied on both sides of the highway alignment. Subsequent monitoring events will provide more useful data for assessing the success of these rehabilitation sites.

Table 5 Rehabilitation Site Monitoring

	Rehabilitation Site		
	Old Coast Rd Temporary Deviation		***15c ancillary compound***
	CH: 60800 West	***CH: 60800 East***	***CH: 59450 East***
Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)	Photo Point RS1: 497441, 6610257 Photo Point RS2: 497279, 6610248	Photo Point RS4: 496438, 6609098	Photo Point RS3: 497229, 6610231
Date and time	22/05/2018 – 2:30 pm – 3:30 pm		
Weed Abundance and Composition	No weed infestations were observed within the newly landscaped area.	No weed infestations were observed within trimmed, topsoiled and hydroseeded batter.	Not applicable as this area is yet to be rehabilitated.
Evidence of management and control of noxious and environmental weeds	Not applicable - site recently finished and landscaped, no weeds present at the time of monitoring.	Not applicable - site recently finished and landscaped, no weeds at the time of monitoring.	As above.
Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation	It appears that the site was topsoiled and landscaped at the same time. Therefore, there was no observed progressive revegetation or successional stages of rehabilitation.	It appears that the site was topsoiled and landscaped at the same time. Therefore, there was no observed progressive revegetation or successional stages of rehabilitation.	As above.
Evidence of native establishment of seedlings and plants	Semi established native plant species have been planted as part of rehabilitation landscaping. Native seed germination is now evident with several native species growing across the rehabilitated area. These species appear to be from the Bush land Reconstruction seed mix. Native regeneration species account for <2% cover with maximum plant height to 35 cm.	Some encroachment (<1% cover) from the edge of the cleared area was recorded with Bracken Fern (*Pteridum esculentum*) and Blady Grass (*Imperata cylindrica*) beginning to recolonise the disturbed area. Very minor (<1%) native regeneration of bushland reconstruction hydroseed mix are regenerating to maximum height of 20 cm.	As above.

	Rehabilitation Site		
	Old Coast Rd Temporary Deviation		15c ancillary compound
	CH: 60800 West	CH: 60800 East	CH: 59450 East
	Identifiable species include: ■ Dusky Coral Pea (*Kennedia rubicunda*) ■ Purple Coral Pea (*Hardenbergia violacea*) ■ Pink Kunzea (*Kunzea capitata*) ■ Hickory Wattle (*Acacia falcata*) ■ Green Wattle (*Acacia irrorata*) ■ White Sally Wattle (*Acacia floribunda*) ■ Austral indigo (*Indigofera australis*) ■ Goodenia sp. likely heterophylla. The hydroseeded grass cover crop has died off.	Identifiable species include: ■ Dusky Coral Pea (*Kennedia rubicunda*) ■ Purple Coral Pea (*Hardenbergia violacea*) ■ Green Wattle (*Acacia irrorata*) ■ White Sally Wattle (*Acacia floribunda*). The hydroseeded grass cover crop has died off.	
Identification of any of the GHFF food tree species (refer to Appendix B)	Landscape plantings have included species, as identified within **Appendix B**. Natural regeneration of native species identified does not yet consist of any GHFF food tree species as referred to in **Appendix B**.	No landscape plantings had been undertaken at the time of monitoring. It appears that no landscape plantings are proposed for this area of the Old Coast Road temporary deviation rehabilitation. Natural regeneration of native species identified does not yet consist of any GHFF food tree species as referred to in **Appendix B**.	As above.

Weed Monitoring

Occurrence of noxious and/or environmental weeds was recorded at 29 sites within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and are listed in **Table 6**. Photographs of GHFF habitat areas taken from the fixed photo points are shown in **Appendix C.**

Only very minor changes to weed densities and composition were observed during the Autumn (May) 2018 monitoring event compared to the Summer (February) 2018 monitoring event. This was expected given the cool and dry weather conditions experienced in the weeks lead up to the Autumn survey (i.e. low growth conditions). Observed changes include

- Weed site 16 has been downgraded in some sections from medium to low infestation level and weed management priority due to a reduction in per cent of foliage cover of Lantana. Weed sites 6 and 15 have similarly been downgraded from low to NA due to a reduction in foliage cover of Lantana.
- Two weed infestations located at weed sites 16 and 19 recorded a higher ranking of weed cover. Specifically, medium cover Lantana infestations were recorded at chainage 55960 – 56080 (site 16) and chainage 60300 – 60400 (site 19).

A total of 19 noxious and environmental weed species were recorded. Lantana (*Lantana camara*), Salvinia (*Salvinia molesta*) and Blackberry (*Rubus fruticosus*) were recorded on-site and are listed as priority weed species for the North Coast of NSW under the *Biosecurity Act 2015*. The primary management duty for these is they '*must not be imported into the state or sold*'.

Lantana, Broad-leaved Paspalum (*Paspalum mandiocanum*) and Camphor Laurel (*Cinnamomum camphora*) were recorded within GHFF habitat areas at the highest density, and were also the dominant weed species in those GHFF areas that recorded a 'Medium' weed infestation level (refer to **Table 6**).

One weed site (site 25) was considered to have a high weed management priority, while 11 weed sites were considered to have a medium weed management priority (sites 5, 16 {part}, 18, 19 {part}, 20, 22, 23, 24, 26, 27 and 28). These areas should be targeted during weed management works.

No obvious changes were recorded between the Summer and Autumn fixed photo point monitoring sites (refer to **Appendix C**).

No increase in density of the exotic vines Morning Glory (*Ipomoea indica*) and Mile-a-minute (*Ipomoea cairica*) were recorded during the Autumn 2018 habitat monitoring. Both of these species have potential to inhibit native regeneration and smother the canopy of intact GHFF habitat.

Table 6 Abundance and Composition of Noxious and/or Environmental Weeds Sites

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
Date and time	▪ 22 May 2018 between 7.00 am to 4.00 pm. ▪ 23 May 2018 between 7.30 am to 2.30 pm.							
1a	48400 to 48700	Lantana (2)	Moist Open Forest - White Mahogany - Grey Gum	NA	Low	Not recorded during Summer although 10-25% cover of Lantana within this area	Weed control has not yet commenced	Low
1b	49790 - 50100 (west)	Setaria (*Setaria sphacelata*) (2), Annual Ragweed (*Ambrosia artemisiifolia*) (1)	Swamp Forest - Swamp Mahogany / Paperbark	Low	Low	Majority of weed infestation concentrated on batter edge. Blue Water Lily (on swamp fringe) 40% cover in concentrated areas of open water.	Weed control has not yet commenced	Low
2	51010 - 51165 (west)	Salvinia (*Salvinia molesta*) (within open water area – approx. chainage 51020) (2)	Swamp Forest - Swamp Mahogany / Paperbark	Low	Low	Very minor Flax-leaf Fleabane (*Conyza bonariensis*), Broad-leaved Paspalum (*Paspalum mandiocanum*) and Annual Ragweed on fauna fence edge Salvinia is listed as a priority weed species for the North Coast of NSW. It must not be imported into the State or sold.	Weed control has not yet commenced	Low (this species would have minimal impact on GHFF habitat value).

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
3	53750 - 53840 (west)	Broad-leaved Paspalum (2), Annual Ragweed (1), White Passionflower (*Passiflora subpeltata*) (1), Paddy's Lucerne (*Sida rhombifolia*) (1), Purple-top (*Verbena bonariensis*) (1)	Moist Open Forest - White Mahogany - Grey Gum	Low	Low		Weed control has not yet commenced	Low
4	54115 - 54150 (west)	Broad-leaved Paspalum (2), Lantana (*Lantana camara*) (1) Winter Senna (1)	Open Forest - Blackbutt	Low	Low	Setaria, Flax-leaf Fleabane and Purple-top present in very low abundance Lantana is listed as a priority weed species for the North Coast of NSW. It must not be imported into the State or sold.	Weed control has not yet commenced	Low
5	54480 - 54530, (west)	Broad-leaved Paspalum (3), Lantana (1), Wild Tobacco (*Solanum mauritianum*) (1), Flaxleaf Fleabane (1)	Open Forest - Blackbutt	Medium	Medium	-	Weed control has not yet commenced	Medium
6	55220 - 55260 (west)	Setaria (1)	Open Forest - Blackbutt	Low	NA	Weed infestation level has been downgraded due to reduction of	Weed control has not yet commenced	NA

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
						foliage cover of Lantana during May monitoring period.		
7	56160 - 56360 (west)	Broad-leaved Paspalum (2), Setaria (1), Lantana (1)	Open Forest - Blackbutt	Low	Low	Lantana present in low abundance on fringe	Weed control has not yet commenced	Low
8	57370 – 57450 (west)	Lantana (1), Broad-leaved Paspalum (1)	Open Forest - Blackbutt	Low	Low	-	Weed control has not yet commenced	Low
9	58440 - 58550 (west)	Broad-leaved Paspalum (2), Lantana (1)	Flooded Gum Moist Open Forest	Low	Low	-	Weed control has not yet commenced	Low
10	58850 – 58940 (west)	Lantana (1)	Open Forest - Blackbutt	Low	Low	-	Weed control has not yet commenced	Low
11	59200 - 59250, (west)	Broad-leaved Paspalum (1)	Open Forest - Blackbutt	Low	Low	-	Weed control has not yet commenced	Low
12	59700 - 59740 (west)	Broad-leaved Paspalum (2)	Open Forest - Blackbutt	Low	Low	-	Weed control has not yet commenced	Low
13	59780 - 59810 (west)	Broad-leaved Paspalum (2)	Flooded Gum Moist Open Forest	Low	Low	-	Weed control has not yet commenced	Low
14	60400 - 60540, 60640 –	Broad-leaved Paspalum (2), Morning Glory	Open Forest - Blackbutt	Low	Low	Some sections without GHFF habitat (old hardstand area and	Weed control has not yet commenced	Low

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
	60665 (west)	(*Ipomoea indica*) (1), Rhodes Grass (*Chloris gayana*) (1), Winter Senna (*Senna septemtrionalis*) (1), Blue Billygoat (1)				stockpile site).		
15	61240 – 61260 (east)	Lantana (1)	Open Forest - Blackbutt	Low	NA	Weed infestation level has been downgraded due to reduction of foliage cover of Lantana (<2%) during May monitoring period.	Weed control has not yet commenced	NA
16	60570 - 60600	Lantana (3), Broad-leaved Paspalum (1), Blue Billy-goat Weed (*Ageratum houstonianum*) (1)	Flooded Gum Moist Open Forest	Medium	Low	All chainage sections have been downgraded to low (10 – 25% cover) (in May) from medium (in February) levels of Lantana. With the exception of one newly recorded section, between 60300 and 60400, where the infestation level of Lantana is Medium.	Weed control has not yet commenced	Low
	60300 - 60400			NA	Medium Lantana			Medium
	60040 - 60060			NA	Low			Low
	59780 - 59850			Medium	Low			Low
	59550 - 59590			Medium	Low			Low
	59200 - 59260			Medium	Low			Low
	59000 - 59080			Medium	Low			Low

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
	58470 – 58550			Medium	Low			Low
	58050 - 58110			Medium	Low			Low
	57650 - 57770			Medium	Low			Low
	57210 - 57250 (east)			Medium	Low			Low
17	56100 – 56420 (east)	Broad-leaved Paspalum (3), Lantana (2)	Open Forest - Blackbutt Flooded Gum Moist Open Forest	Low	Low	Mostly intact native canopy but more scattered trees around big house in north. Lower weed cover in south.	Weed control has not yet commenced	Low
18	56420 – 56580 (east)	Broad-leaved Paspalum (4), Lantana (2)	Open Forest - Blackbutt	Medium	Medium	Very weedy understorey in north around big house. Very weedy north section.	Weed control has not yet commenced	Medium
19	55960 - 56080	Lantana (2), Broad-leaved Paspalum (2), Setaria (1)	Open Forest Blackbutt	Low	Medium	The northernmost 100 m of this survey area has been upgraded to a medium infestation level of Lantana and Broad-leaved Paspalum	Weed control has not yet commenced	Medium
	55630 – 56080 (east)			Low	low			Low
20	52980 – 53040 (east)	Lantana (1), Mile a Minute (*Ipomoea cairica*) (1), Groundsel Bush (*Baccharis*	Swamp Forest - Swamp Mahogany / Paperbark	Medium	Medium	-	Weed control has not yet commenced	Medium

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
		halimifolia) (1), Annual Ragweed (1), Setaria (1)						
21	49830 - 50220 (east)	Vasey Grass (*Paspalum urvillei*) (2), Setaria (1)	Swamp Forest - Swamp Mahogany / Paperbark	Low	Low	Broad-leaved Paperbark open forest in good condition including understorey except for some sections with Blue Water Lily and some minor incursions of weedy grasses along fence.	Weed control has not yet commenced	Low
22	49560 – 49670 (east)	Broad-leaved Paspalum (4), Lantana (1)	Moist Open Forest - White Mahogany - Grey Gum	Medium	Medium	-	Weed control has not yet commenced	Medium
23	49030 - 49070 (east)	Broad-leaved Paspalum (5), Camphor Laurel (*Cinnamomum camphora*) (1)	Flooded Gum Moist Open Forest	High	High	Scattered native overstorey of Hard Quandong, Foambark, Broad-leaved Paperbark, with few shrubs and groundcover dominated by Broad-leaved Paspalum.	Weed control has not yet commenced	Medium
24	48430 - 48550 (east)	Broad-leaved Paspalum (5)	Moist Open Forest - Flooded Gum	High	High	Scattered overstorey of Flooded Gum, Guioa, Broad-leaved Paperbark, but lack of shrub layer and ground cover dominated by Broad-	Weed control has not yet commenced	Medium

Weed Site No.	Chainage (side of highway)	Autumn 2018 Weed Composition (Cover Class*)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^	Autumn 2018 Weed Abundance^	Comments	Evidence of Management and Control	Weed Management Priority
						leaved Paspalum		
25	48260 – 48380 (east)	Lantana (5), Broad-leaved Paspalum (2), Mile a Minute (1), Winter Senna (*Senna septemtrionalis*) (1).	Moist Open Forest - Flooded Gum	High	High	Mostly intact overstorey dominated by Flooded Gum with some River Oak on edge creek. Understorey dominated by weeds mostly Lantana.	Weed control has not yet commenced	High
26	47800 – 47832 (east)	Lantana (2), Wild Tobacco (2), Setaria (1), White Passionflower (1)	Open Forest Blackbutt	Medium	Medium	-	Weed control has not yet commenced	Medium
27	47510 – 47530 (east)	Broad-leaved Paspalum (3), Camphor Laurel (2), Purple Top (2), Wild Tobacco (2)	Moist Open Forest – White Mahogany – Grey Gum	Medium	Medium	-	Weed control has not yet commenced	Medium
28	47450 – 47490 (east)	Camphor Laurel (2), Broad-leaved Paspalum (2), Lantana (2), Blackberry (*Rubus fruticosus*) (1), Narrow-leaved Privet (*Ligustrum sinense*) (1)	Moist Open Forest - White Mahogany - Grey Gum	Medium	Medium	Blackberry is listed as a priority weed species for the North Coast of NSW. It must not be imported into the State or sold.	Weed control has not yet commenced	Medium

** Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%; ^ Refer to **Table 3***

Recommendations and Conclusions

Weed sites 25, 16, 19, 20, 26 and 28 are important target weed management areas to reduce degradation to GHFF habitat. At these sites, there is the potential for Lantana to alter community structure and inhibit regeneration.

Weed sites with dense Broad-leaved Paspalum (sites 5, 18, 22, 23, 24 and 27) should be considered a somewhat lower priority for management than sites comprising medium infestations of Lantana for the following reasons:

- There may be a lower likelihood of weed management success (it is difficult to remove this species successfully from degraded communities that have a suitable semi-shaded understorey environment); and
- Being an understorey weed species that occurs in disturbed environments and edges, Broad-leaved Paspalum has a low potential to alter either the structure or regeneration potential, and hence the quality of relatively intact GHFF habitat.

Future monitoring should continue to identify any significant increase in the density of the exotic vines (including Morning Glory and Mile-a-minute) which have the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat.

Please contact the undersigned if require any further information.

Yours sincerely
GeoLINK

Jessica O'Leary
Ecologist

References

Sinclair Knight Merz (2017). *Warrell Creek to Nambucca Heads Upgrade of the Pacific Highway; Flying-fox Management Plan.* Report to Roads and Maritime Services.

Issue Log

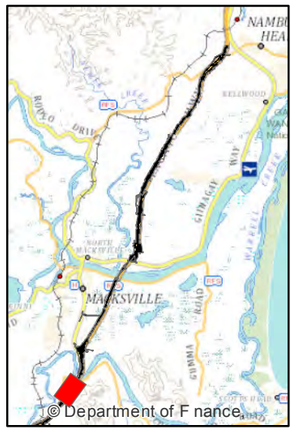
UPR	*Description*	*Date issued*	*Issued By*
2692-1114	First issue (draft)	28/05/2018	David Andrighetto
2692-1116	Second issue (final)	30/05/2018	David Andrighetto
2692-1121	Third issue (amended final)	08/06/2018	David Andrighetto

Appendix A

GHFF Weed Survey Areas and Weed Infestation Levels (Autumn 2018)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- High
- Medium

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany - Grey Gum

0 60

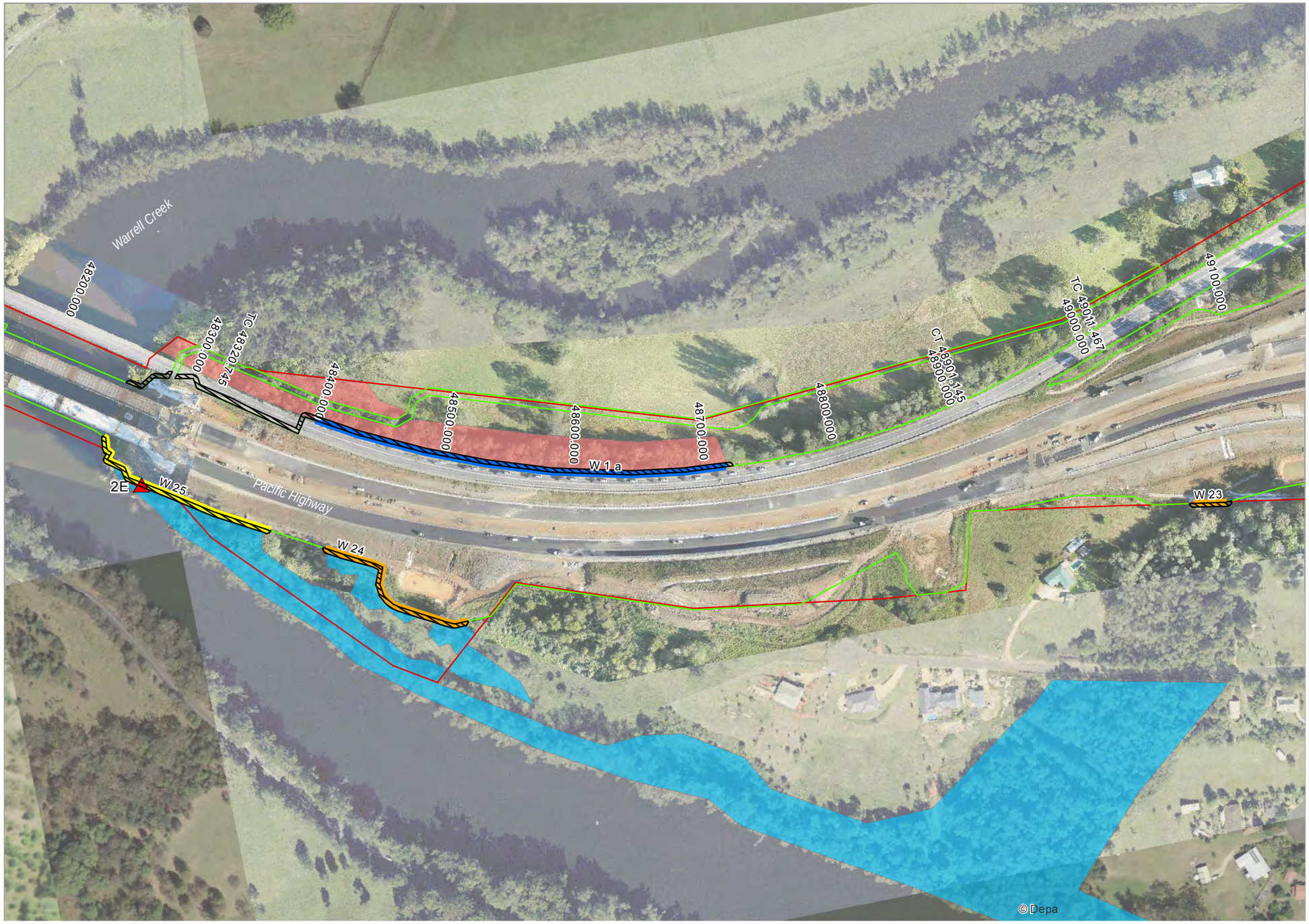
GeoLINK environmental management and design

WC2NH GHFF Habitat Monitoring – Autumn 2018
2692-1121

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- High
- Medium
- Low

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany - Grey Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Medium
- Low

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany - Grey Gum
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

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2692-1121

GHFF Weed Survey Areas and Weed Infestation Levels

SHEET 3 OF 17

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

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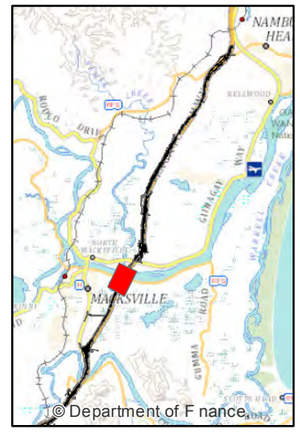

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Vegetation

- Mixed Floodplain Forest (EEC)
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

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Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Management Priority

- Medium

Vegetation

- Moist Open Forest - White Mahogany - Grey Gum
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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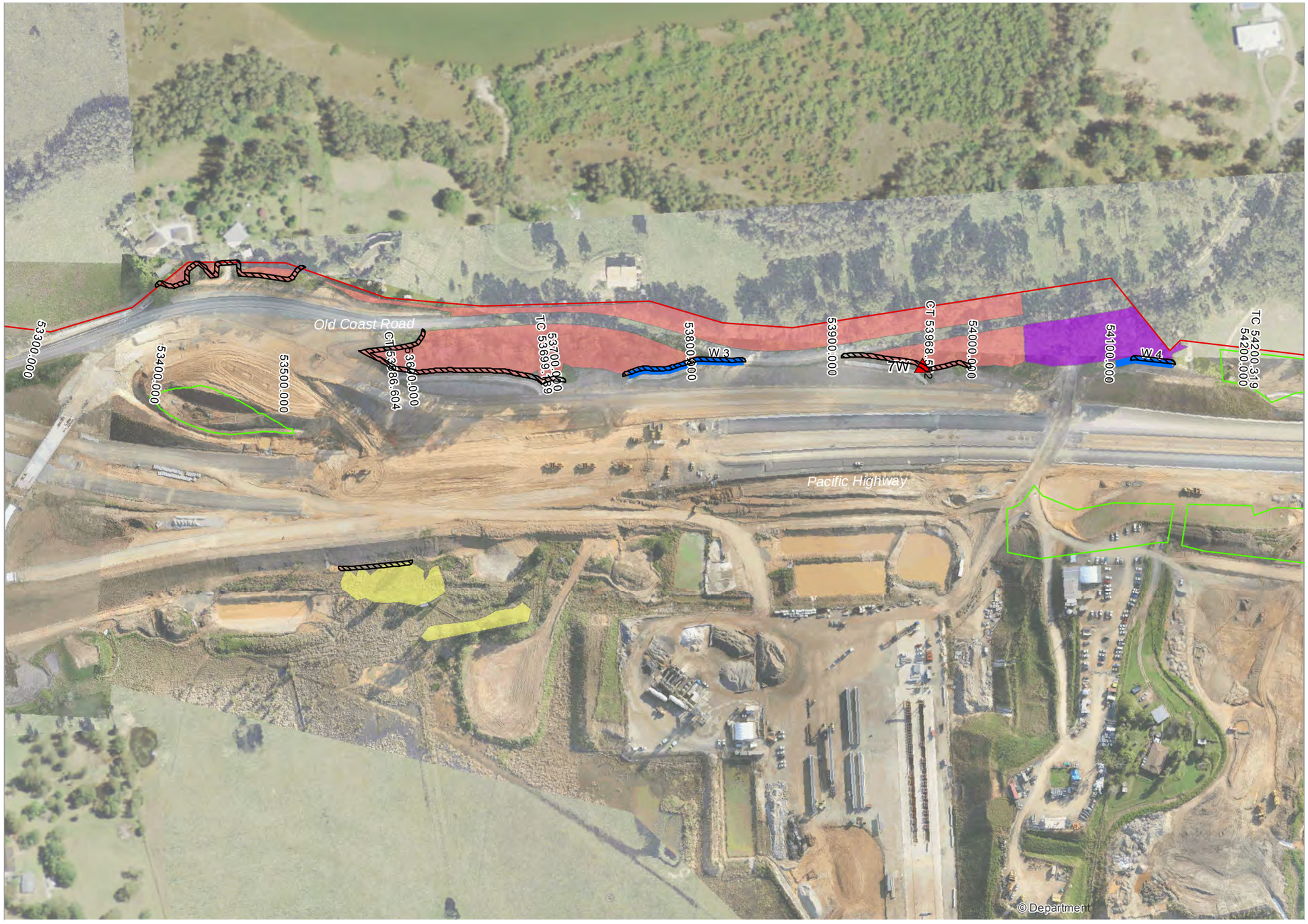

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Moist Open Forest - White Mahogany - Grey Gum
- Open Forest - Blackbutt
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
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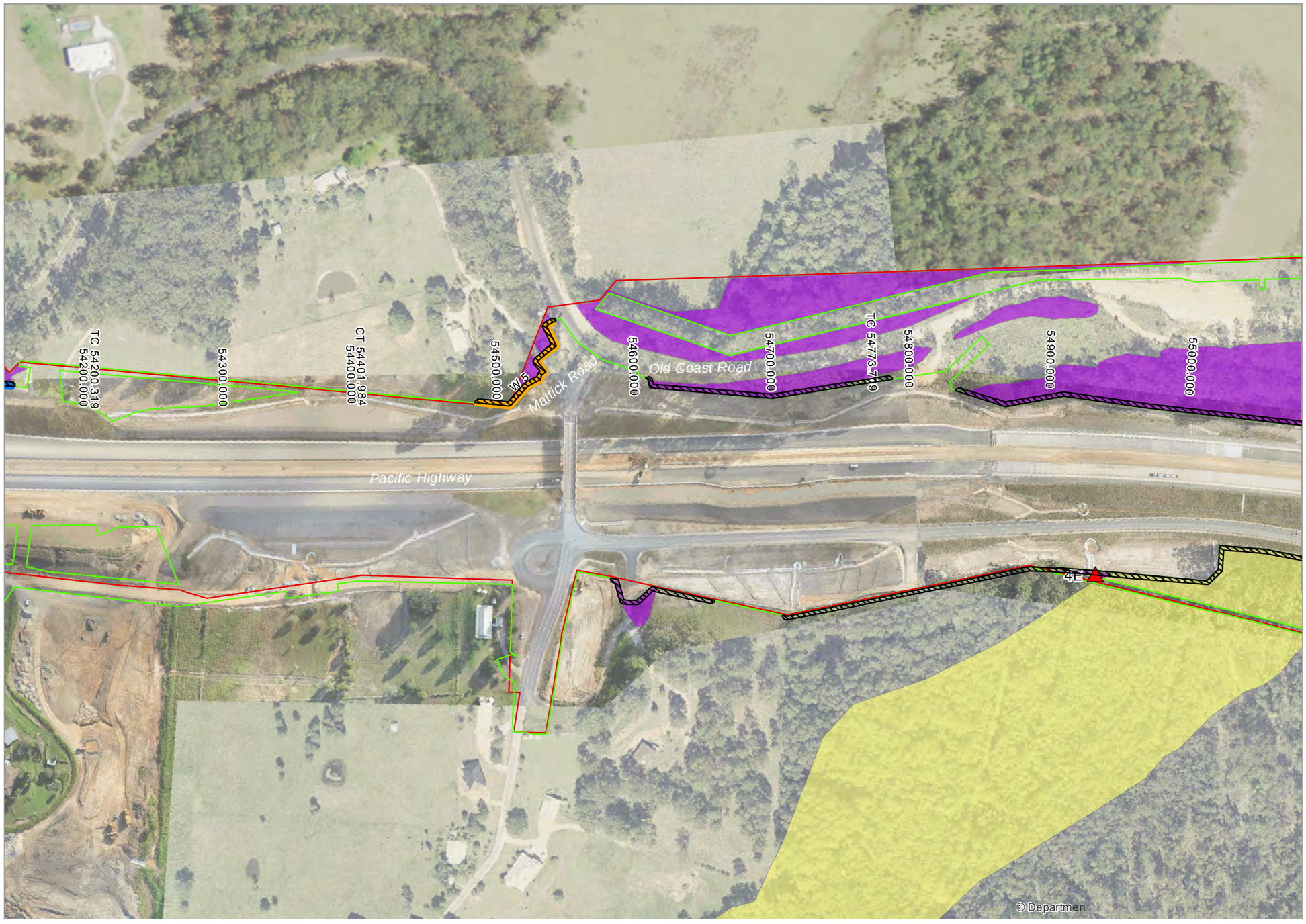

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Medium
- Low

Vegetation

- Open Forest - Blackbutt
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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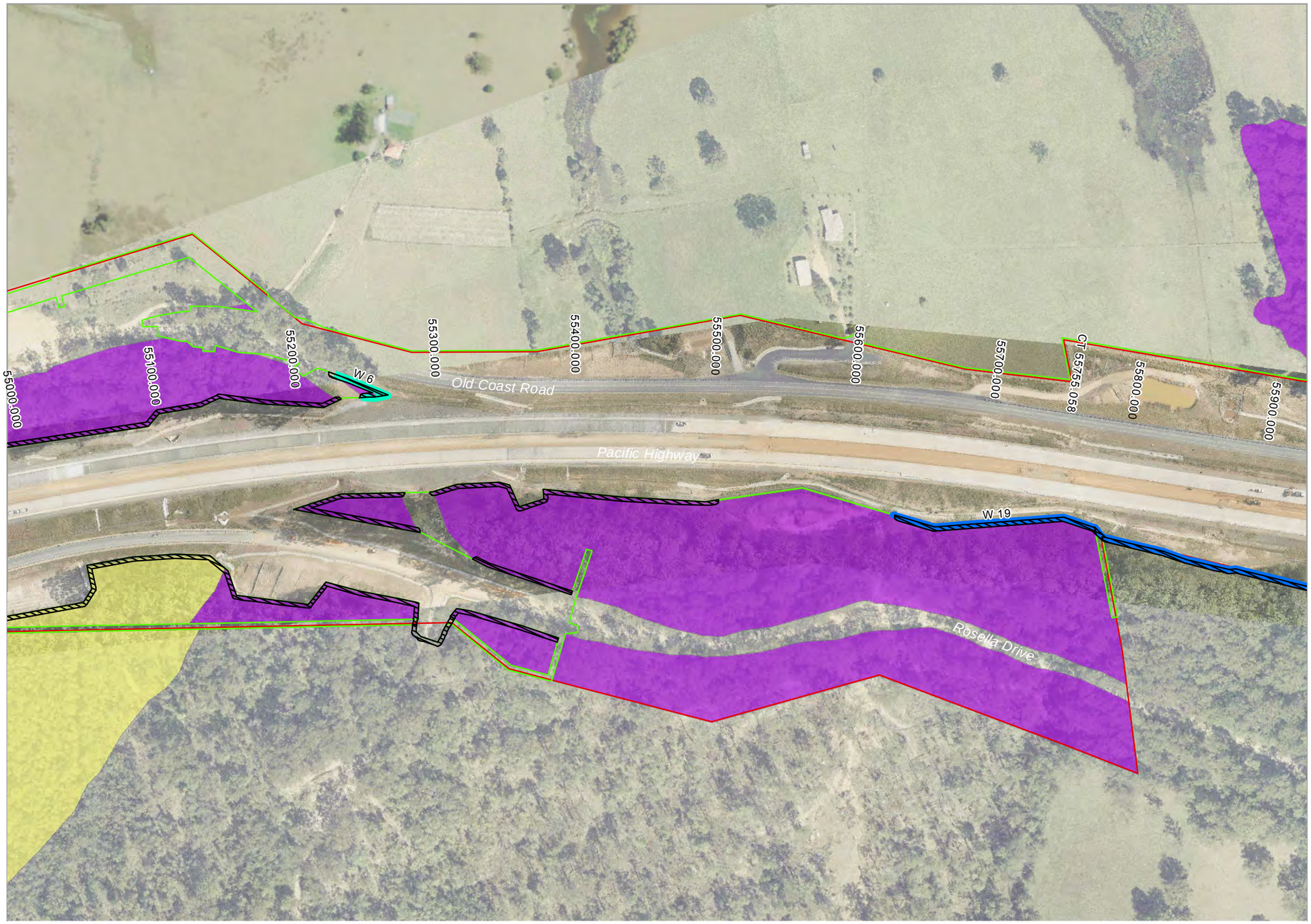

LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Management Priority

- Low
- N/A

Vegetation

- Open Forest - Blackbutt
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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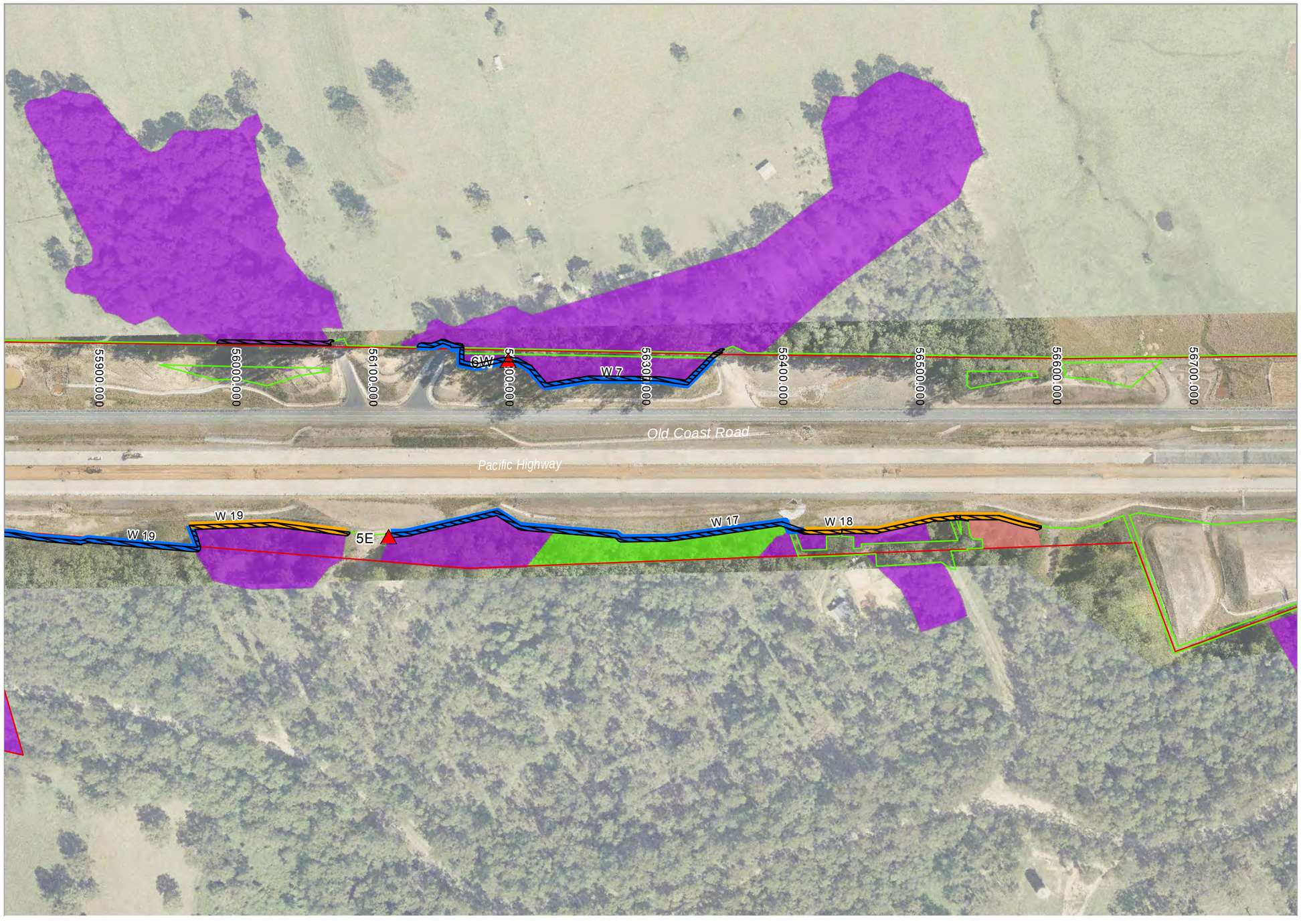

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Medium
- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Moist Open Forest - White Mahogany - Grey Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

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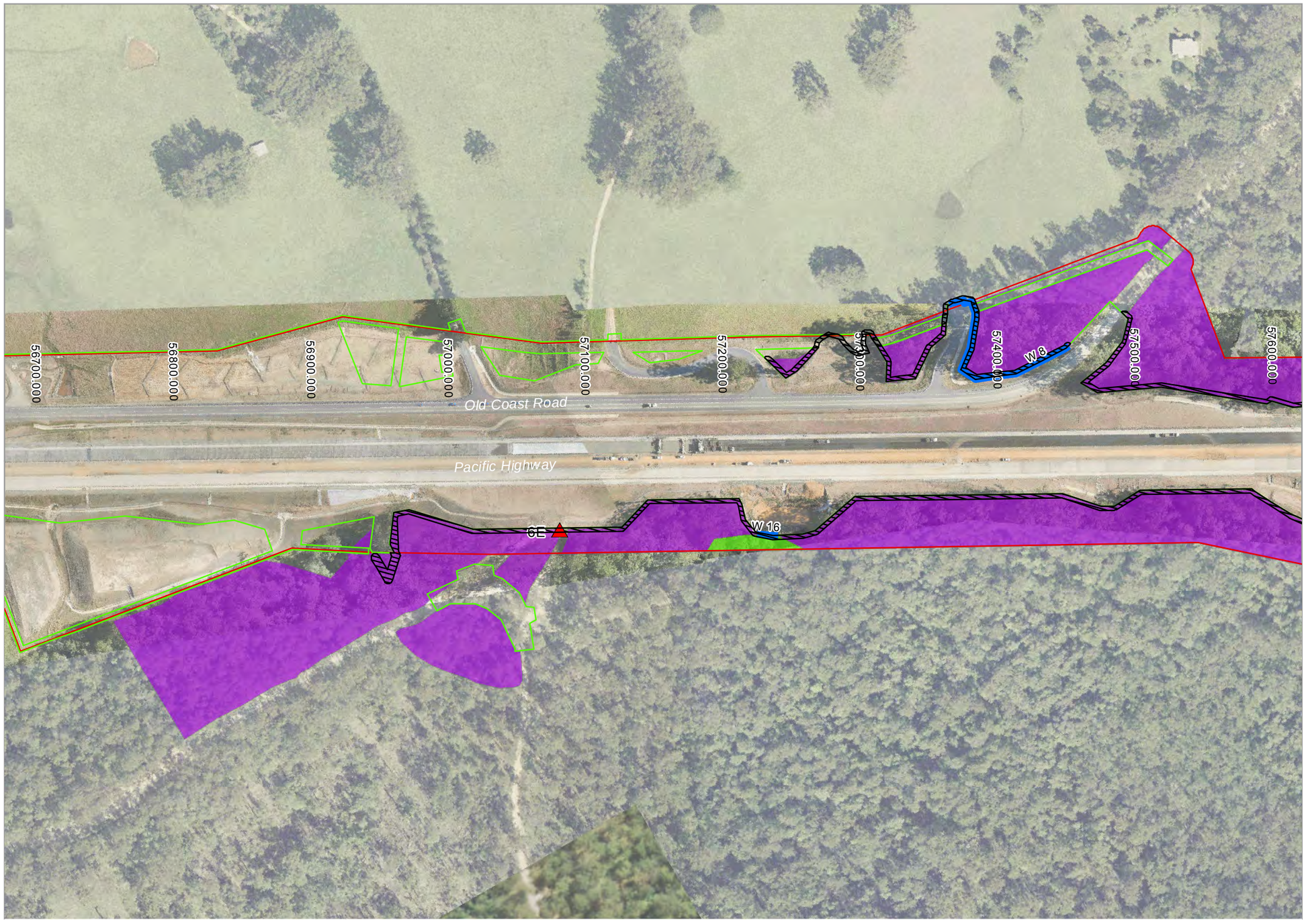

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

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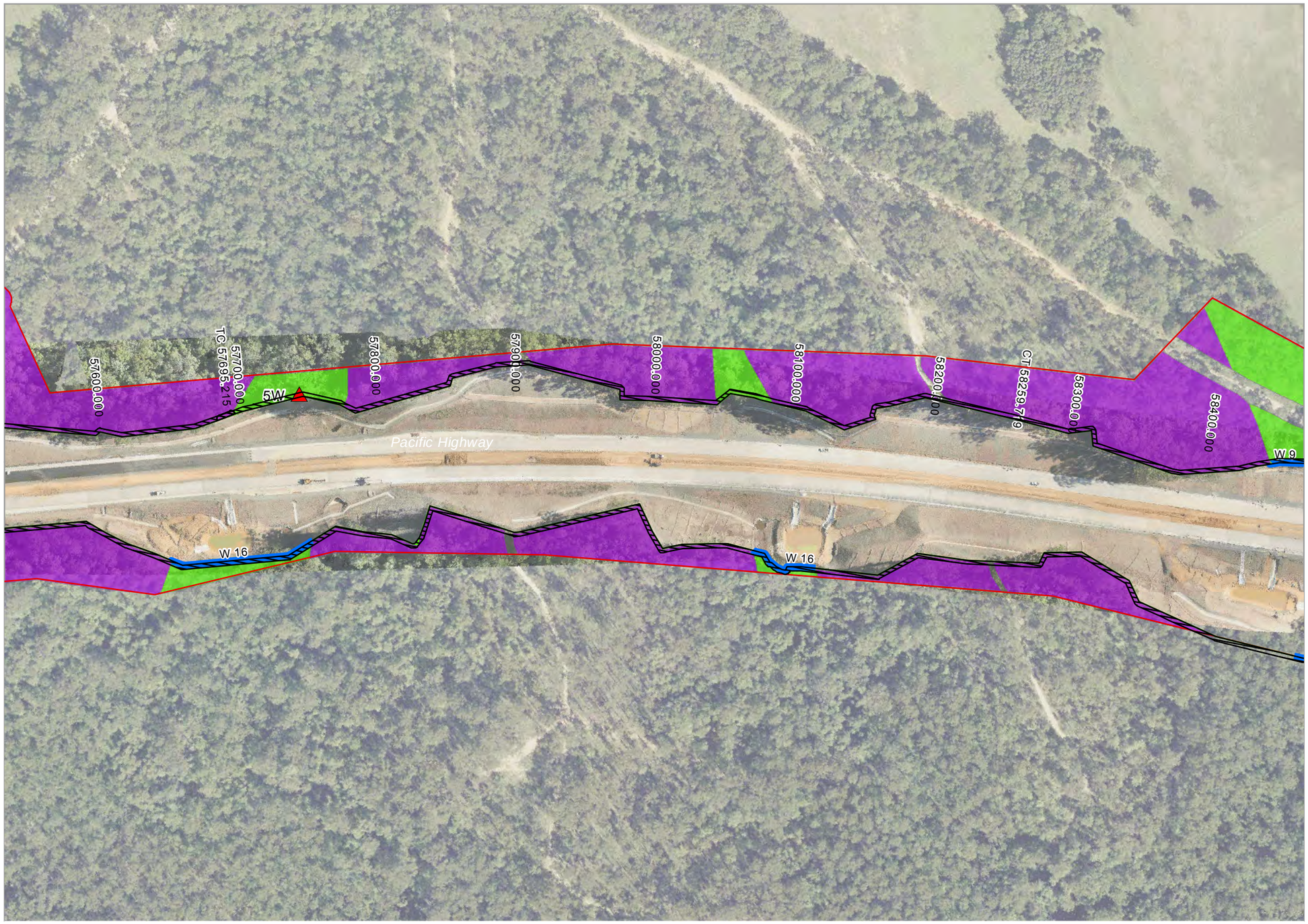
WC2NH GHFF Habitat Monitoring – Autumn 2018
2692-1121

GHFF Weed Survey Areas and Weed Infestation Levels

SHEET 12 OF 17

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

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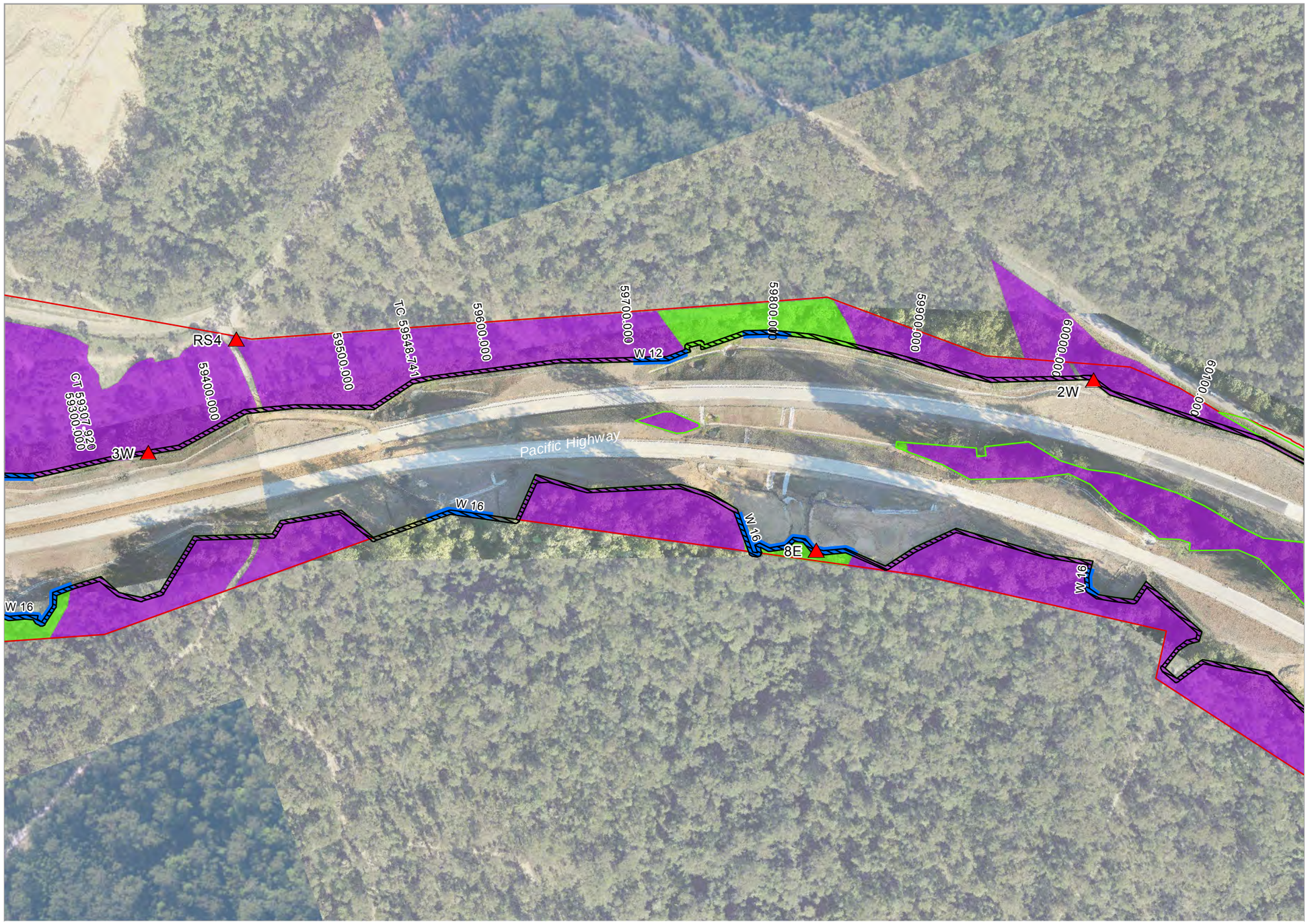

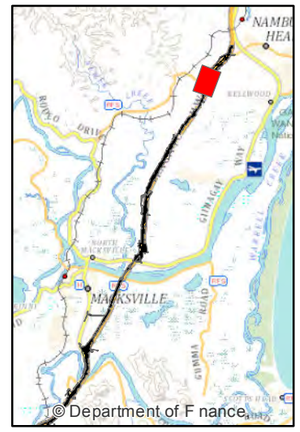

LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Low

Vegetation

- Moist Open Forest - Flooded Gum
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

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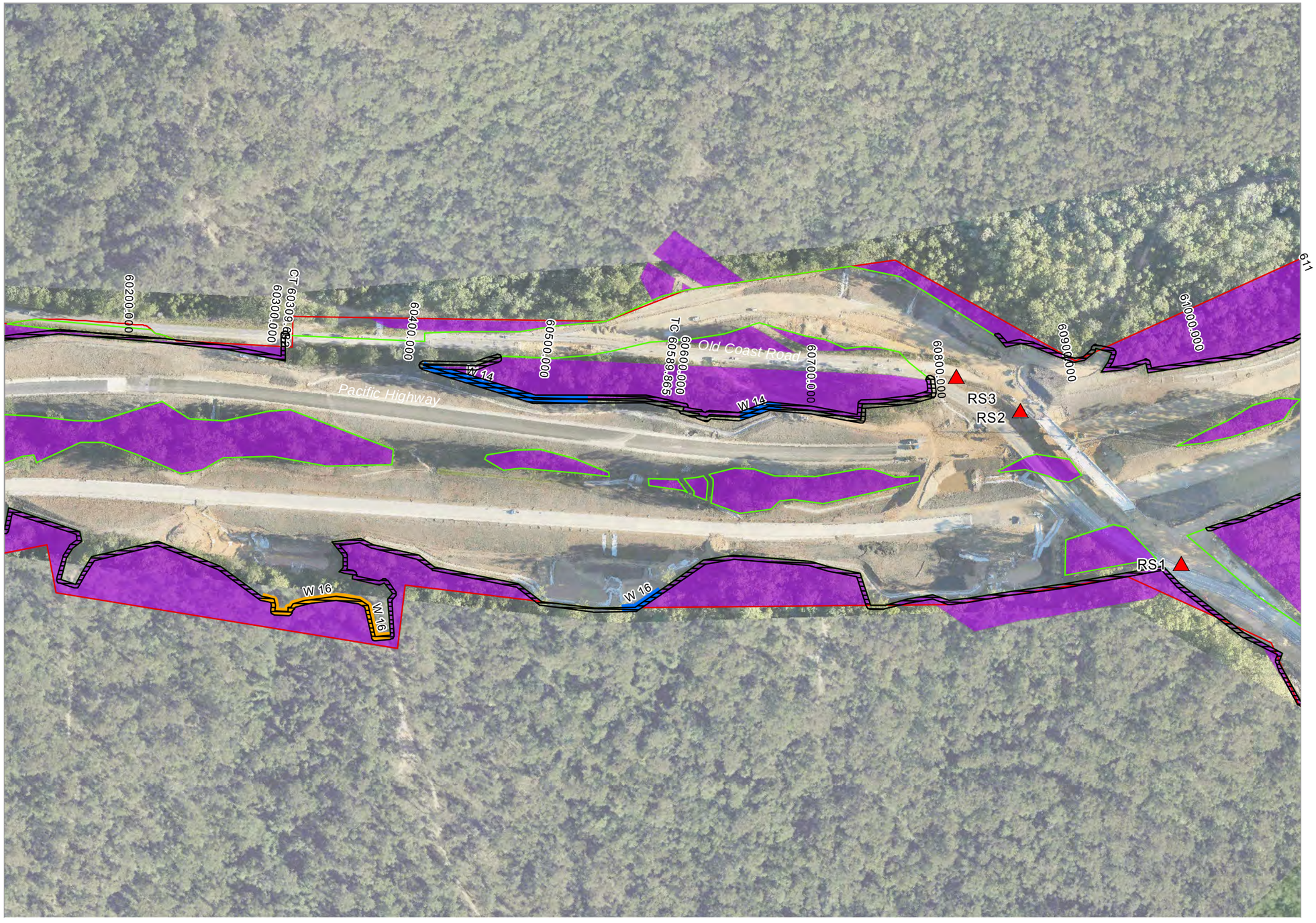
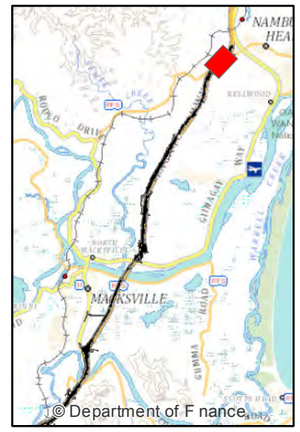




LEGEND

- Project boundary
- Clearing limit
- Fixed photo point
- GHFF weed survey area

Weed Management Priority

- Medium
- Low

Vegetation

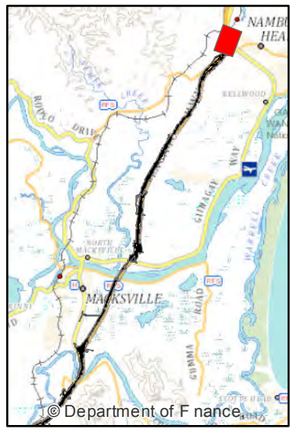
- Open Forest - Blackbutt

0 60

GHFF Weed Survey Areas and Weed Infestation Levels

Information shown is for illustrative purposes only

Drawn by: AB Checked by: JOL Reviewed by: DSA Date: 24/05/2018
Source of base data: DFS&I & AFJV



LEGEND

- Project boundary
- Clearing limit
- GHFF weed survey area

Weed Management Priority

- N/A

Vegetation

- Open Forest - Blackbutt

0 60

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WC2NH GHFF Habitat Monitoring – Autumn 2018
2692-1121

GHFF Weed Survey Areas and Weed Infestation Levels

SHEET 17 OF 17

Appendix B

GHFF Food Trees Species List

GHFF primary food tree species (blossom diet)			
Banksia integrifolia	Coastal Banksia	*Eucalyptus robusta*	Swamp Mahogany
Corymbia gummifera	Red Bloodwood	*Eucalyptus saligna*	Sydney Blue Gum
Corymbia intermedia	Pink Bloodwood	*Eucalyptus siderophloia*	Northern Grey Ironbark
Corymbia maculata	Spotted Gum	*Eucalyptus tereticornis*	Forest Red Gum
Corymbia variegata	Spotted Gum	*Grevillea robusta*	Silky Oak
Castanospermum australe	Black Bean	*Melaleuca quinquenervia*	Broad-leaved Paperbark
Eucalyptus pilularis	Blackbutt	*Syncarpia glomulifera*	Turpentine
GHFF secondary food tree species (blossom diet)			
Angophora costata	Smooth-barked Apple	*Eucalyptus grandis*	Flooded Gum
Angophora floribunda	Rough-barked Apple	*Eucalyptus propinqua*	Grey Gum
Eucalyptus acmenoides	White Mahogany	*Eucalyptus resinifera*	Red Mahogany
GHFF food tree species (fruit diet)			
Acmena smithii	Lilly Pilly	*Hedycarya angustifolia*	Native Mulberry
Alphitonia excelsa	Red Ash	*Livistona australis*	Cabbage Palm
Archontophoenix cunninghamiana	Bangalow Palm	*Maclura cochinchinensis*	Cockspur Thorn
Avicennia marina	Grey Mangrove	*Melia azedarach*	White Cedar
Cissus hypogaluca	Five-leaf Water Vine	*Melodinus australis*	Southern Melodinus
Dendrocnide excelsa	Giant Stinging Tree	*Morinda jasminoides*	Morinda
Dendrocnide photinophylla	Shining-lved Stinging Tree	*Pennantia cunninghamii*	Brown Beech
Diospyros pentamera	Myrtle Ebony	*Pittosporum undulatum*	Sweet Pittosporum
Diploglottis australis	Native Tamarind	*Planchonella australis*	Black Apple
Eucalyptus reticulatus	Blueberry Ash	*Podocarpus elatus*	Plum Pine
Ehretia acuminata	Koda	*Polyosma cunninghamii*	Featherwood
Elaeocarpus obovatus	Hard Quandong	*Rauwenhoffia leichardtii*	Zig Zag Vine
Ficus coronata	Creek Sandpaper Fig	*Rhodamnia argentea*	Malletwood
Ficus fraseri	Sandpaper Fig	*Syzygium australe*	Brush Cherry
Ficus macrophylla	Moreton Bay Fig	*Syzygium corynanthum*	Sour Cherry
Ficus obliqua	Small-leaved Fig	*Syzygium crebrinerve*	Purple Cherry
Ficus rubiginosa	Rusty Fig	*Syzygium luehmanii*	Riberry
Ficus superba	Deciduous Fig	*Syzygium. oleosum*	Blue Lilly Pilly
Ficus watkinsiana	Strangler Fig	*Schizomeria ovata*	Crabapple

Appendix C

Fixed Photo Point Results

Table C1 Rehabilitation Site Photo Points

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*
CH: 60800 West - Photo Point RS1 – view to the south		

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*
CH: 60800 West - Photo Point RS1 – view to the north-east		

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*
CH: 60800 West - Photo Point RS2 – view to the south-west		

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*
CH: 59450 East - Photo Point RS3 - view to the east, no rehabilitation works started at time of monitoring.		

Photo Monitoring Point Location	***Site Rehabilitation Summer Monitoring Event – February 2018***	***Site Rehabilitation Autumn Monitoring Event – May 2018***
CH: 59450 East - Site reference photo view to the west looking towards Photo Point #3, no rehabilitation works started at time of monitoring.		

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*
CH: 60800 East - Photo Point RS4 - view to the west (no peg installed)		

Table C2 Weed Monitoring Fixed Photo Points

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*
1E	491906, 6598292		
1W	492671, 6600507		

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph
2E	492372, 6599033		
2W	496675, 6609675		

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*
3E	492778, 6600567		
3W	496494, 6609010		

*Photo Point ID **	*Photo Point GPS*	*February 2018 photograph*	*May 2018 photograph*
4E	494575, 6605139		
4W	496131, 6608279		

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph
5E	494960, 6606206		
5W	495668, 6607684		

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph
6E	495433, 6607052		
6W	494890, 6606346		

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*
7E	496240, 6608213		
7W	494355, 6604185		

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*
8E	496724, 6609444		

* number + side of alignment heading north: E=east, W=west.

^ UTM eastings, northings; Zone 56J.

Appendix 3: Winter 2018 Stage 2A and Stage 2B monitoring report.

GeoLINK environmental management and design

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ACN 101 084 557

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www.geolink.net.au

3 August 2018
Ref No: 2692-1131

Roads and Maritime Service
124 Albert Drive
DONNELLYVILLE NSW 2447

Attention: Mr Kris Hincks

Dear Kris

WC2NH Stage 2A and 2B GHFF Habitat Monitoring – Winter 2018 (Issue 1)

Introduction

This report presents the habitat monitoring results of Grey-Headed Flying-fox (GHFF) habitat adjacent to the Warrell Creek to Nambucca Heads Highway Upgrade (WC2NH) project for:

- Stage 2A: the third quarterly monitoring event (Winter 2018) within Stage 2A; and
- Stage 2B: the first quarterly monitoring event (Winter 2018) within Stage 2B.

Quarterly GHFF habitat monitoring is required for Stage 2A (chainage 47700 to 61300) and Stage 2B (chainage 41700 to 47700) (refer to **Appendix A**) for up to one year after the opening of these sections of WC2NH to traffic. Quarterly GHFF habitat monitoring is undertaken in accordance with the *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program – Stage 2: Warrell Creek to Nambucca Heads* (Benchmark Environmental Management, 2014).

The *Warrell Creek to Nambucca Heads Flying-fox Management Plan* (Sinclair Knight Merz, 2017) recognised that the quality of vegetation adjacent to the Project area could be detrimentally affected by invasion of noxious and environmental weeds. A main goal identified for management during operation of the Project is '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'* (Sinclair Knight Merz, 2017).

Methodology

The monitoring of Grey-headed Flying-fox habitat includes the following components:

1. Monitoring of identified revegetation/ rehabilitation areas to ensure the establishment/ restoration of seedlings and plants.
2. Monitoring both revegetation/ rehabilitation areas and other habitat areas adjacent to the Project to manage invasion of noxious and environmental weeds.

For brevity, component 1 is henceforth referred to as 'rehabilitation site monitoring', and component 2 is referred to as 'weed monitoring'.

Field surveys were undertaken by GeoLINK ecologists Grant McLean and Frank Makin on:

- 16 May 2018 between 7.30 am to 5.00 pm; and
- 17 May 2018 between 7.30 am to 3.30 pm.

Rehabilitation Site Monitoring

The locations of the GHFF habitat areas requiring revegetation/ rehabilitation are listed in **Table 1** and correspond with Stage 2A of the Project. Monitoring of these areas aims to assess the effectiveness of rehabilitation of GHFF habitat areas cleared during the construction of the Project.

Table 1 Location of GHFF Habitat Rehabilitation Sites

Habitat type	*Location*	*Site*
Open Forest - Blackbutt	CH: 59450 East	15c ancillary compound
Open Forest - Blackbutt	CH: 60800 East	Old Coast Rd Temporary Deviation

The following data was recorded for each location:

- Date and time of monitoring
- Weed abundance and composition
- Evidence of management and control of noxious and environmental weeds
- Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation
- Evidence of native plant establishment of seedlings
- Identification of any of the GHFF food tree plants referred to in **Appendix B**.

Photos were also taken at the four fixed photo points associated with the rehabilitation sites (refer to **Table 2**).

Table 2 Locations of Fixed Photo Points for Rehabilitation Sites

Photo Point ID	*Photo Point GPS Coordinates**	*Corresponding Rehabilitation Site*
RS1	497272, 6610243	Old Coast Road temporary deviation (west)
RS2	497260, 6610256	Old Coast Road temporary deviation (west)
RS3	496443, 6609093	15c ancillary compound
RS4	497440, 6610248	Old Coast Road temporary deviation (east)

** UTM eastings, northings; Zone 56J*

Weed Monitoring

The Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval defined GHFF habitat as habitat consisting of:

- Swamp Forest - Swamp Mahogany/ Paperbark
- Moist Open Forest - Flooded Gum
- Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark
- Mixed Floodplain Forest
- Open Forest - Blackbutt.

All instances of the above plant communities occurring along the outside of the Project clearing corridor were targeted during the field surveys. Within two metres of the cleared edge of these habitat areas the following data was recorded in relation to weeds:

- Date and time of monitoring
- Weed abundance and composition
- Evidence of management and control of noxious and environmental weeds.

Weed abundance for individual species was measured using modified Braun-Blanquet cover classes between 1 and 5: 1 (<5%), 2 (6-25%), 3 (26-50%), 4 (51-75%), and 5 (76-100%). Abundance scores for identified weed sites were classified based on the categories in **Table 3**. Priority weed sites for management were identified based on species present and the percentage cover, prioritising *Biosecurity Act 2015* listed species and weeds with potential to degrade flying-fox foraging habitat values.

Table 3 Weed Abundance Classification for Weed Sites

Noxious/Environmental Weed Cover (%)	*Weed Abundance Classification*
0-10	NA
11-39	Low
40-69	Medium
70-100	High

Fixed photo points were established adjacent to representative areas of GHFF habitat to monitor weeds for Stage 2B. Photos were also taken at the fixed photo points established during the Summer 2018 weed monitoring for Stage 2A. Locations of the fixed photo points are listed in **Table 4**.

Table 4 Locations of Fixed Photo Points

Stage	*Photo Point ID**	*Photo Point GPS Coordinates^*	*Notes on Photo Direction*	*Vegetation Type*	*Corresponding Weed Infestation*
2A	1E	491906, 6598292	Looking north	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	W28
2A	1W	492671, 6600507	Looking north north-east	Swamp Forest - Swamp Mahogany/ Paperbark	W1b
2A	2E	492372, 6599033	Looking north-east	Moist Open Forest - Flooded Gum	W25

Stage	Photo Point ID*	Photo Point GPS Coordinates^	Notes on Photo Direction	Vegetation Type	Corresponding Weed Infestation
2A	2W	496675, 6609675	Looking north-east	Open Forest - Blackbutt	Not applicable
2A	3E	492778, 6600567	Looking south-west	Swamp Forest - Swamp Mahogany/ Paperbark	W21
2A	3W	496494, 6609010	Looking south	Open Forest - Blackbutt	Not applicable
2A	4E	494575, 6605139	Looking north north-east	Swamp Forest - Swamp Mahogany/ Paperbark	Not applicable
2A	4W	496131, 6608279	Looking north-east	Moist Open Forest – Flooded Gum	W9
2A	5E	494960, 6606206	Looking south south-west	Open Forest - Blackbutt	W17
2A	5W	495668, 6607684	Looking north-east	Moist Open Forest – Flooded Gum	Not applicable
2A	6E	495433, 6607052	Looking north	Open Forest - Blackbutt	Not applicable
2A	6W	494890, 6606346	Looking south south-west	Open Forest - Blackbutt	W7
2A	7E	496240, 6608213	Looking west	Moist Open Forest – Flooded Gum	W16
2A	7W	494355, 6604185	Looking north	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Not applicable
2A	8E	496724, 6609444	Looking south south-west	Moist Open Forest – Flooded Gum	W16
2B	1BE	489545, 6594390	Looking north	Moist Open Forest - Flooded Gum	W37
2B	1BW	490778, 6596540	Looking south	Moist Open Forest - Flooded Gum	W31
2B	2BE	488766, 6593840	Looking south-west	Mixed Floodplain Forest	Not applicable
2B	2BW	489407, 6594440	Looking north-east	Mixed Floodplain Forest	W36
2B	3BE	490153, 6595330	Looking south	Moist Open Forest - Flooded Gum	Not applicable
2B	3BW	489268, 6594420	Looking south	Mixed Floodplain Forest	W39

** number plus side of alignment heading north: E=east, W=west.*

^ UTM eastings, northings; Zone 56J.

Results and Discussion

Rehabilitation Site Monitoring

The results of the rehabilitation site monitoring are provided in **Table 5**. Photos from the four fixed photo points are shown in **Appendix C**. Plantings and/or seeding at these sites are either young or have not been undertaken (in the case of the rehabilitation site at the 15c ancillary compound).

Native seed germination is now evident at the Old Coast Road Temporary Deviation (CH60800) with a number of native species recorded growing from the native seed mix applied on both sides of the highway alignment. Subsequent monitoring events will provide more useful data for assessing the success of these rehabilitation sites.

Table 5 Rehabilitation Site Monitoring

Rehabilitation Site	***Old Coast Rd Temporary Deviation (CH: 60800 West)***	***Old Coast Rd Temporary Deviation (CH: 60800 East)***	***15c Ancillary Compound (CH: 59450 East)***
Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)	Photo Point RS1: 497272, 6610243 Photo Point RS2: 497260, 6610256	Photo Point RS4: 497440, 6610248	Photo Point RS3: 496443, 6609093
Date and time of survey	Winter: 17/07/2018 – 8:00 am – 9:00 am	Winter: 17/07/2018 – 8:00 am – 9:00 am	Winter: 17/07/2018 – 8:00 am – 9:00 am
Weed Abundance and Composition	No weed infestations were observed within the newly landscaped area. No change from Autumn 2018 survey.	No weed infestations were observed within trimmed, topsoiled and hydroseeded batter. No change from Autumn 2018 survey	The northern boundary of this area has <5% intrusion of Whiskey Grass (*Andropogon virginicus*), Broadleaf Paspalum (*Paspalum mandiocanum*), Lantana* (*Lantana camara*), Fireweed (*Senecio madagascariensis*), Cobblers Pegs (*Bidens pilosa*) and Blue Billygoat Weed (*Ageratum houstonianum*).
Evidence of management and control of noxious and environmental weeds	No weeds present. No change from Autumn 2018 survey.	No weeds present. No change from Autumn 2018 survey.	Not applicable as this area is yet to be rehabilitated. No change from Autumn 2018 survey.
Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation	No observed progressive revegetation or successional stages of rehabilitation. No weeds present. No change from Autumn 2018 survey.	No observed progressive revegetation or successional stages of rehabilitation. No weeds present. No change from Autumn 2018 survey.	Not applicable as this area is yet to be rehabilitated.

Rehabilitation Site	Old Coast Rd Temporary Deviation (CH: 60800 West)	Old Coast Rd Temporary Deviation (CH: 60800 East)	15c Ancillary Compound (CH: 59450 East)
Evidence of native establishment of seedlings and plants	Semi established native plant species that have been planted as part of rehabilitation include Water Gum (*Tristaniopsis laurina*) to ~ 1 m height and Tea Tree (*Leptospermum brachyandrum*) to ~ 2 m height. Native regeneration species account for <2% cover with maximum plant height to 35 cm (no change from Autumn 2018 survey). Identifiable species include: ■ Dusky Coral Pea (*Kennedia rubicunda*) ■ Purple Coral Pea (*Hardenbergia violacea*) ■ Pink Kunzea (*Kunzea capitata*) ■ Hickory Wattle (*Acacia falcata*) ■ Green Wattle (*Acacia irrorata*) ■ White Sally Wattle (*Acacia floribunda*) ■ Austral indigo (*Indigofera australis*) ■ *Goodenia sp.* (likely *G. heterophylla*). The hydroseeded grass cover crop has remained died off.	No change from Autumn 2018 survey. Some encroachment (<1% cover) from the edge of the cleared area was recorded with Bracken Fern (*Pteridum esculentum*) and Blady Grass (*Imperata cylindrica*) beginning to recolonise the disturbed area. Very minor (<1%) native regeneration of bushland regeneration hydroseed mix are regenerating to maximum height of 20 cm. Identifiable species include: ■ Dusky Coral Pea ■ Purple Coral Pea ■ Green Wattle. ■ White Sally Wattle. The hydroseeded grass cover crop has remained died off.	Minor natural regrowth <5% was observed of Blackbutt (*Eucalyptus pilularis*), Sally Wattle (*Acacia melanoxylon*), Blady Grass, Water Vine (*Cissus hypoglauca*) and Bracken Fern.
Identification of any of the GHFF food tree species (refer to Appendix B)	No change from Autumn 2018 survey. Applied landscape seed mixes have included species identified within **Appendix B** (Alex Dwyer {Pacifico Environmental Manager} email 8/03/2018). No regeneration of GHFF food tree species has been detected to date.	No change from Autumn 2018 survey. No landscape plantings had been undertaken at the time of monitoring. It appears that no landscape plantings are proposed for this area of the Old Coast Road temporary deviation rehabilitation. Applied landscape seed mixes have included species identified within **Appendix B** (Alex Dwyer {Pacifico Environmental Manager} email 8/03/2018). No regeneration of GHFF food tree species has been detected to date.	Not applicable as this area is yet to be rehabilitated.

* Denotes *Biosecurity Act 2015* listed priority weed species.

Weed Monitoring

Stage 2A

Occurrence of noxious and/or environmental weeds was recorded at 30 sites within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and listed in **Table 6**. Photographs of GHFF habitat areas taken from the fixed photo points are shown in **Appendix C**.

Only very minor changes to weed densities and composition were observed during the subject Winter 2018 monitoring event compared to the previous monitoring event (Autumn 2018). Cool and dry weather conditions were experienced in the month leading up to the survey with the last moderate rainfall event (23 mm) occurring on 3 July 2018 (BOM, 2018). Observed changes include:

- One additional weed site (W16a) was observed during the Winter 2018 survey and comprises a low weed management priority area.
- Additional weed species were recorded at seven sites: W1a, W1b, W3, W20, W21, W22 and W23.
- Weed abundance at site W16 has reduced in several sections due to a reduction in per cent of foliage cover of Lantana.
- An increase in the weed cover of individual species was recorded at site W20. Lantana and Mile-a-minute weed cover class has increased from 1 in Autumn 2018 to 2 in Winter 2018.
- An increase in weed infestation extent was observed at site W4, extending by approximately 50 m to south.
- Evidence of weed management was observed on properties adjacent to site W7.
- Weed dieback from weed management was observed at sites W27 and W28. Current overall weed abundance remained at medium level.

A total of 19 noxious and environmental weed species were recorded. Lantana, Salvinia (*Salvinia molesta*), Fireweed and Blackberry (*Rubus fruticosus*) were recorded on site and are listed as priority weed species for the North Coast of NSW under the *Biosecurity Act 2015*. The primary management duty for these is they '*must not be imported into the state or sold*'.

Lantana, Broadleaf Paspalum and Camphor Laurel (*Cinnamomum camphora*) were recorded within GHFF habitat areas at the highest density, and were also the dominant weed species in those GHFF areas that recorded a 'Medium' weed abundance level (refer to **Table 6**).

One weed site (site W25) was considered to have a high weed management priority, while eight weed sites were considered to have a medium weed management priority (sites W18, W19 {part}, W20, W22, W23, W24, W26 and W27). These areas should be targeted during weed management works.

No obvious changes were recorded between the Autumn 2018 and Winter 2018 fixed photo point monitoring sites (refer to **Appendix C**).

An increase in density of the exotic vine Mile-a-minute (*Ipomoea cairica*) was recorded at site W20 during the Winter 2018 habitat monitoring. No increase in the density of Morning Glory (*Ipomoea indica*) was recorded during the Autumn 2018 habitat monitoring. Both of these species have potential to inhibit native regeneration and smother the canopy of intact GHFF habitat.

Table 6 Abundance and Composition of Noxious and/or Environmental Weeds Sites for Stage 2A

Weed Site Ref.	*Chainage (side of highway)*	*Winter 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Summer 2018 Weed Abundance^^*	*Autumn 2018 Weed Abundance^^*	*Winter 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
Date and time: ■ 16 July 2018 between 7.30 am to 5.00 pm. ■ 17 July 2018 between 7.30 am to 3.30 pm.									
W1a	48400 to 48700 (west)	Lantana* (2), Camphor Laurel (1), Broadleaf Paspalum (1), **Blackberry* (1)**	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	NA	Low	Low	**Additional weeds recorded: Blackberry*.**	No evidence of weed control	Low
W1b	49790 - 50100 (west)	Setaria (*Setaria sphacelata*) (2), Annual Ragweed (*Ambrosia artemisiifolia*) (1), **Broadleaf Paspalum (2), Fireweed* (1), Blue Billygoat Weed (1) Balloon Cotton Bush (*Gomphocarpus physocarpus*) (1)**	Swamp Forest - Swamp Mahogany/ Paperbark	Low	Low	Low	Majority of weed infestation concentrated on batter edge. Blue Water Lily (on swamp fringe) 40% cover in concentrated areas of open water. **Additional weeds recorded: Fireweed*, Broadleaf Paspalum, Blue Billygoat Weed and Balloon Cotton Bush.**	No evidence of weed control	Low

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
W2	51010 - 51165 (west)	Salvinia* (within open water area – approx. chainage 51020) (2)	Swamp Forest - Swamp Mahogany/ Paperbark	Low	Low	Low	Very minor Flax-leaf Fleabane (*Conyza bonariensis*), Broadleaf Paspalum and Annual Ragweed on fauna fence edge.	No evidence of weed control	Low (this species would have minimal impact on GHFF habitat value).
W3	53750 - 53840 (west)	Broadleaf Paspalum (2), Annual Ragweed (1), White Passionflower (*Passiflora subpeltata*) (1), Paddy's Lucerne (*Sida rhombifolia*) (1), Purple-top (*Verbena bonariensis*) (1), **Fireweed* (1), Wild Tobacco Bush (*Solanum mauritianum*) (1).**	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Low	Low	Low	**Additional weeds recorded: Wild Tobacco Bush and Fireweed*.**	No evidence of weed control	Low
W4	54070 - 54150 (west)	Broadleaf Paspalum (2), Lantana* (1) Winter Senna (*Senna septemtrionalis*) (1), Blue Billygoat Weed (1)	Open Forest - Blackbutt	Low	Low	Low	Setaria, Flax-leaf Fleabane and Purple-top present in very low abundance **Area of weed infestation**	No evidence of weed control	Low

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
							extended by approximately 50 m to the south.		
W5	54480 - 54530, (west)	Broadleaf Paspalum (3), Lantana* (1), Wild Tobacco Bush (1), Flaxleaf Fleabane (*Conyza bonariensis*) (1)	Open Forest - Blackbutt	Medium	Medium	Medium	-	No evidence of weed control	**Low**
W6	55220 - 55260 (west)	Setaria (1)	Open Forest - Blackbutt	Low	NA	NA	-	Weed control has not yet commenced	NA
W7	56160 - 56360 (west)	Broadleaf Paspalum (2), Setaria (1), Lantana* (1)	Open Forest - Blackbutt	Low	Low	Low	Lantana* present in low abundance on fringe	Weed control has not yet commenced **Evidence of weed management on adjacent property.**	Low
W8	57370 – 57450 (west)	Lantana* (1), Broadleaf Paspalum (1)	Open Forest - Blackbutt	Low	Low	Low	-	No evidence of weed control	Low
W9	58440 - 58550 (west)	Broadleaf Paspalum (2), Lantana* (1)	Moist Open Forest - Flooded Gum	Low	Low	Low	-	No evidence of weed control	Low
W10	58850 – 58940 (west)	Lantana* (1)	Open Forest - Blackbutt	Low	Low	Low	-	No evidence of weed control	Low

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
W11	59200 - 59250, (west)	Broadleaf Paspalum (1)	Open Forest - Blackbutt	Low	Low	Low	-	No evidence of weed control	Low
W12	59700 - 59740 (west)	Broadleaf Paspalum (2)	Open Forest - Blackbutt	Low	Low	Low	-	No evidence of weed control	Low
W13	59780 - 59810 (west)	Broadleaf Paspalum (2)	Flooded Gum Moist Open Forest	Low	Low	Low	-	Weed control has not yet commenced	Low
W14	60400 - 60540, 60640 – 60665 (west)	Broadleaf Paspalum (2), Morning Glory (1), Rhodes Grass (*Chloris gayana*) (1), Winter Senna (1), Blue Billygoat (1)	Open Forest - Blackbutt	Low	Low	Low	Some sections without GHFF habitat (old hardstand area and stockpile site).	No evidence of weed control	Low
W15	61240 – 61260 (east)	Lantana* (1)	Open Forest - Blackbutt	Low	NA	NA	-	No evidence of weed control	NA
W16	60570 - 60600	Lantana* (2), Broadleaf Paspalum (1)	Flooded Gum Moist Open Forest	Medium	Low	Low	**Weed cover has reduced in several chainage sections due to a reduction in per cent of foliage cover of Lantana*.**	No evidence of weed control	Low
	60300 - 60400	Lantana* (1)		NA	Medium	Low			**Low**
	60040 - 60060	Lantana* (1)		NA	Low	Low			Low
	59780 - 59850	Lantana* (1)		Medium	Low	NA			**NA**
	59550 - 59610	Lantana* (1)		Medium	Low	NA			**NA**

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
	59200 - 59260	Lantana* (1)		Medium	Low	Low			Low
	59000 - 59080	Broadleaf Paspalum (1)		Medium	Low	NA			**NA**
	58470 – 58550	Lantana* (1), Whiskey Grass (1)		Medium	Low	NA			**NA**
	58050 - 58110	Lantana* (1)		Medium	Low	NA			**NA**
	57650 - 57770	None		Medium	Low	NA			**NA**
	57210 - 57250 (east)	Lantana* (1)		Medium	Low	Low			Low
W16a	**56950**	**Lantana* (2), Broadleaf Paspalum (2)**	**Open Forest - Blackbutt**	**Not recorded**	**Not recorded**	**Low**	**New weed site.**	**No evidence of weed control**	**Low**
W17	56100 – 56420 (east)	Broadleaf Paspalum (3), Lantana* (2)	Open Forest - Blackbutt Flooded Gum Moist Open Forest	Low	Low	Low	Mostly intact native canopy but more scattered trees around big house in north. Lower weed cover in south.	No evidence of weed control	Low
W18	56420 – 56580 (east)	Broadleaf Paspalum (4), Lantana* (2)	Open Forest - Blackbutt	Medium	Medium	Medium	Very weedy understorey in north around big house. Very weedy north section.	No evidence of weed control	Medium

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
W19	55960 - 56080	Lantana* (2), Broadleaf Paspalum (2), Setaria (1)	Open Forest - Blackbutt	Low	Medium	Medium	-	No evidence of weed control	Medium
	55630 – 56080 (east)			Low	Low	Low			Low
W20	52980 – 53040 (east)	Lantana* (**2**), Mile a Minute (**2**), Annual Ragweed (1), Setaria (1), **Rhodes Grass (1), Blue Billygoat Weed (1), Winter Senna (1)**	Swamp Forest - Swamp Mahogany/ Paperbark	Medium	Medium	Medium	**Lantana* and Mile-a-minute cover has increased from cover class 1 in Autumn to 2 in Winter 2018. Overall weed abundance has remained medium. Additional weeds recorded: Rhodes Grass, Blue Billygoat Weed and Winter Senna.**	No evidence of weed control	Medium
W21	49830 - 50220 (east)	Setaria (2), **Salvinia* (within open water area along swamp edge – approx. chainage 49830 - 49920) (2), Fireweed* on batter edge (1)**	Swamp Forest - Swamp Mahogany/ Paperbark	Low	Low	Low	Forest is overall in good condition including the understorey except for some sections with Blue Water Lily **and Salvinia*. There are also**	No evidence of weed control	Low (these weeds would have minimal impact on GHFF habitat value).

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
							some minor incursions of exotic grasses and herbs along fence. **Additional weeds recorded: Salvinia* and Fireweed*.**		
W22	49560 – 49670 (east)	Broadleaf Paspalum (4), Lantana* (1), **Balloon Cotton Bush (1)**	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Medium	Medium	Medium	**Additional weeds: Balloon Cotton Bush**	No evidence of weed control	Medium
W23	49030 - 49070 (east)	Broadleaf Paspalum (5), Camphor Laurel (1) **Balloon Cotton Bush (1).**	Flooded Gum Moist Open Forest	High	High	High	Scattered native overstorey of Hard Quandong (*Elaeocarpus obovatus*), Foam Bark Tree (*Jagera pseudorhus*), Broad-leaved Paperbark (*Melaleuca quinquenervia*), with few shrubs and groundcover dominated by Broadleaf Paspalum.	No evidence of weed control	Medium

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
							Additional weeds: Balloon Cotton Bush		
W24	48430 - 48550 (east)	Broadleaf Paspalum (5)	Moist Open Forest - Flooded Gum	High	High	High	Scattered overstorey of Flooded Gum (*Eucalyptus grandis*), Guioa (*Guioa semiglauca*), Broad-leaved Paperbark (*Melaleuca quinquenervia*), but lack of shrub layer and ground cover dominated by Broadleaf Paspalum.	No evidence of weed control	Medium
W25	48260 – 48380 (east)	Lantana* (5), Broadleaf Paspalum (2), Mile a Minute (1), Winter Senna (1).	Moist Open Forest - Flooded Gum	High	High	High	Mostly intact overstorey dominated by Flooded Gum with some River Oak (*Casuarina cunninghamiana*) on edge creek. Understorey dominated by weeds mostly Lantana*.	No evidence of weed control	High

Weed Site Ref.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
W26	47800 – 47832 (east)	Lantana* (2), Wild Tobacco Bush (2), Setaria (1), White Passionflower (1)	Open Forest - Blackbutt	Medium	Medium	Medium	-	No evidence of weed control	Medium
W27	47510 – 47530 (east)	Broadleaf Paspalum (3), Camphor Laurel (2), Purple Top (2), Wild Tobacco Bush (2)	Moist Open Forest – White Mahogany – Grey Gum	Medium	Medium	Medium	-	**Weed dieback evident – evidence of weed control**	**Low**
W28	47450 – 47490 (east)	Camphor Laurel (2), Broadleaf Paspalum (2), Lantana* (2), Blackberry* (1), Narrow-leaved Privet (*Ligustrum sinense*) (1)	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Medium	Medium	Medium	**-**	**Weed dieback evident – evidence of weed control**	Medium

^ *Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%*

^^ Refer to Table 3.

* Denotes *Biosecurity Act 2015* listed priority weed species. Lantana, Fireweed, Blackberry and Salvinia are listed as Weeds of National Significance and as priority weed species for the North Coast of NSW. They must not be imported into the State or sold.

Stage 2B

Occurrence of noxious and/or environmental weeds was recorded at 16 sites within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and listed in **Table 7**. Photographs of GHFF habitat areas taken from the fixed photo points are shown in **Appendix C.**

A total of 12 noxious and environmental weed species were recorded. Fireweed and Lantana were recorded on-site and are listed as priority weed species for the North Coast of NSW under the *Biosecurity Act 2015*. The primary management duty for these is they '*must not be imported into the state or sold*'.

Broadleaf Paspalum, Setaria, and Large-leaved Privet (*Ligustrum lucidum*) were recorded within GHFF habitat areas at the highest density, and were also the dominant weed species in those GHFF areas that recorded a 'Medium' weed abundance level (refer to **Table 7**).

Two weed sites (sites 2BW8 and 2BW16) were considered to have a medium weed management priority. These areas should be targeted during weed management works.

No exotic vines with the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat were observed.

Table 7 Abundance and Composition of Noxious and/or Environmental Weeds Sites for Stage 2B

Weed Site No.	*Chainage (side of highway)*	*Winter 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
2BW1	46180 – 46190 (east)	Broadleaf Paspalum (5), Camphor Laurel (1), Lantana* (1)	Open Forest - Blackbutt	High	-	No evidence of weed control	Medium
2BW2	45440 – 45450 (east)	Broadleaf Paspalum (2), Camphor Laurel (1), Setaria (1)	Moist Open Forest - Flooded Gum	Low	Small creek and riparian zone within survey area.	Evidence of weed control on adjoining property.	Low
2BW3	45170 – 45280 (west)	Broadleaf Paspalum (3), Camphor Laurel (2), Setaria (1)	Moist Open Forest - Flooded Gum	Medium	-	No evidence of weed control	Low
2BW4	44100 – 44200 (east)	Broadleaf Paspalum (3), Fireweed* (1), Setaria (1)	Open Forest - Blackbutt	Medium	-	No evidence of weed control	Low
2BW5	43960 – 44030 (east)	Broadleaf Paspalum (3), Balloon Cotton Bush (1), Crofton Weed (*Ageratina adenophora*) (1), Fireweed* (1)	Moist Open Forest - Flooded Gum	Medium	-	No evidence of weed control	Low
2BW6	43050 – 43090 (east)	Lantana* (2), Broadleaf Paspalum (1)	Moist Open Forest - Flooded Gum	Low	-	No evidence of weed control	Low
2BW7	42980 – 42990 (west)	Lantana* (2), Large-leaved Privet (1), Broadleaf Paspalum (1)	Mixed Floodplain Forest	Low	-	No evidence of weed control	Low
2BW8	42650 – 42880 (west)	Lantana* (3), Large-leaved Privet (3), Camphor Laurel (1), Winter Senna (1), Wild Tobacco Bush (1), Broadleaf Paspalum (1), Setaria (1).	Mixed Floodplain Forest	Medium	-	No evidence of weed control	Medium

Weed Site No.	Chainage (side of highway)	Winter 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
2BW9	42770 – 42800 (east)	Broadleaf Paspalum (2), Lantana* (1)	Moist Open Forest - Flooded Gum	Low	-	No evidence of weed control	Low
2BW10	42620-42630 (east)	Setaria (4), Cobblers Pegs (1), Wild Tobacco Bush (1)	Mixed Floodplain Forest	Medium	-	Evidence of weed control.	Low
2BW11	42500 – 42600 (west)	Broadleaf Paspalum (3), Lantana* (1)	Mixed Floodplain Forest	Medium	-	No evidence of weed control	Low
2BW12	42600 – 42610 (west)	Lantana* (3), Broadleaf Paspalum (2), Wild Tobacco Bush (1), Setaria (1)	Mixed Floodplain Forest	Low	-	No evidence of weed control	Low
2BW13	42500 – 42510 (west)	Large-leaved Privet (2), Lantana* (2), Narrow-leaved Privet (1)	Mixed Floodplain Forest	Low	-	No evidence of weed control	Low
2BW14	42570 – 42600 (east)	Large-leaved Privet (2)	Mixed Floodplain Forest	Low	-	No evidence of weed control	Low
2BW15	42530 – 42600 (east)	Lantana* (2), Large-leaved Privet (2), Narrow-leaved Privet (2), Broadleaf Paspalum (1)	Mixed Floodplain Forest	Low	-	No evidence of weed control	Low
2BW16	42090 – 42220, 42290, 42390	Broadleaf Paspalum (4), Setaria (2), Lantana* (1), Camphor Laurel (1), Fireweed* (1), Wild Tobacco Bush (1).	Mixed Floodplain Forest	High	-	No evidence of weed control	Medium

^ *Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%.*

^^ Refer to Table 3.

* Denotes *Biosecurity Act 2015* listed priority weed species. Lantana and Fireweed are listed as Weeds of National Significance and as priority weed species for the North Coast of NSW. They must not be imported into the State or sold.

Recommendations and Conclusions

Rehabilitation Site Monitoring

Limited regeneration has established to date at the Old Coast Road Temporary Deviation and rehabilitation has not been undertaken to date at the 15c Ancillary Compound. It is recommended that rehabilitation works are undertaken at the 15c Ancillary Compound if construction works at this site are confirmed to be completed. Should upcoming monitoring continue to see limited results from the rehabilitation efforts at Old Coast Rd Temporary Deviation, the rehabilitation efforts are recommended to be reviewed to ensure regeneration is achieved in line with the project landscape plans.

Weed Monitoring

Weed sites W25, W19, W20, W26, 2BW8 and 2BW16 are important target weed management areas to reduce degradation to GHFF habitat. At these sites, there is the potential for Lantana to alter community structure and inhibit regeneration. Large-leaved Privet at site W36 also has the potential to alter vegetation and suppress native regrowth. Management of the weeds at these sites would be consistent with the key objectives of the WC2NH *Weed and Pathogen Management Plan* (GeoLINK 2015) which is to '*ensure the Project avoids, suppresses and controls the spread of all weeds, plant pathogens and invasive species to ensure that impacts to the environment are minimised.*'

Weed sites primarily with dense Broadleaf Paspalum (sites W5, W18, W22, W23, W24 and W27) should be considered somewhat lower priorities for management than sites comprising medium infestations of Lantana and/or Large-leaved Privet for the following reasons:

- There may be a lower likelihood of weed management success (it is difficult to remove this species successfully from degraded communities that have a suitable semi-shaded understorey environment); and
- Being an understorey weed species that occurs in disturbed environments and edges, Broadleaf Paspalum has a low potential to alter either the structure or regeneration potential, and hence the quality of relatively intact GHFF habitat.

Future monitoring should continue to identify any significant increase in the density of the exotic vines (including Morning Glory and Mile-a-minute) which have the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat.

Please contact the undersigned if require any further information.

Yours sincerely
GeoLINK

Grant McLean
Ecologist

References

Benchmark Environmental Management (2014). *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program. Stage 2: Warrell Creek to Nambucca Heads*. Report to Roads and Maritime Services.

Bureau of Meteorology (2018). Daily rainfall. [ONLINE] Available at: http://www.bom.gov.au/jsp/ncc/cdio/wData/wdata?p_nccObsCode=136&p_display_type=dailyDataFile&p_stn_num=059150&p_startYear= . [Accessed 24 July 2018].

GeoLINK (2015). *Weed and Pathogen Management Plan: Warrell Creek to Nambucca Heads Upgrade of the Pacific Highway.* Unpublished report to Acciona and Ferrovial Joint Venture/ Roads and Maritime Services. GeoLINK Consulting, Coffs Harbour.

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Issue Log

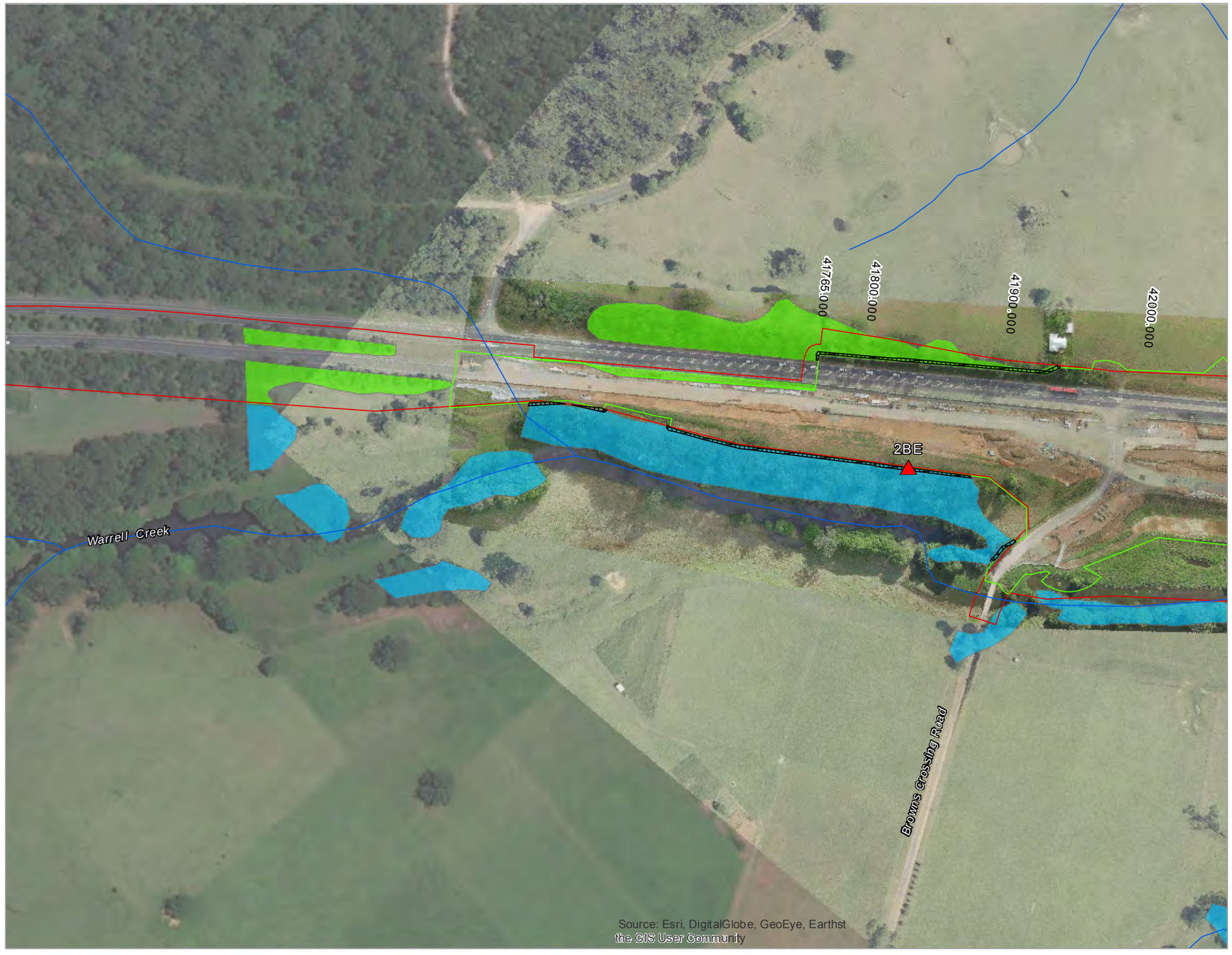
UPR	*Description*	*Date issued*	*Issued By*
2692-1128	First issue (draft)	31/07/2018	David Andrighetto
2692-1131	Second issue	03/08/2018	David Andrighetto

Appendix A

GHFF Weed Survey Areas and Weed Infestation Levels (Winter 2018)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

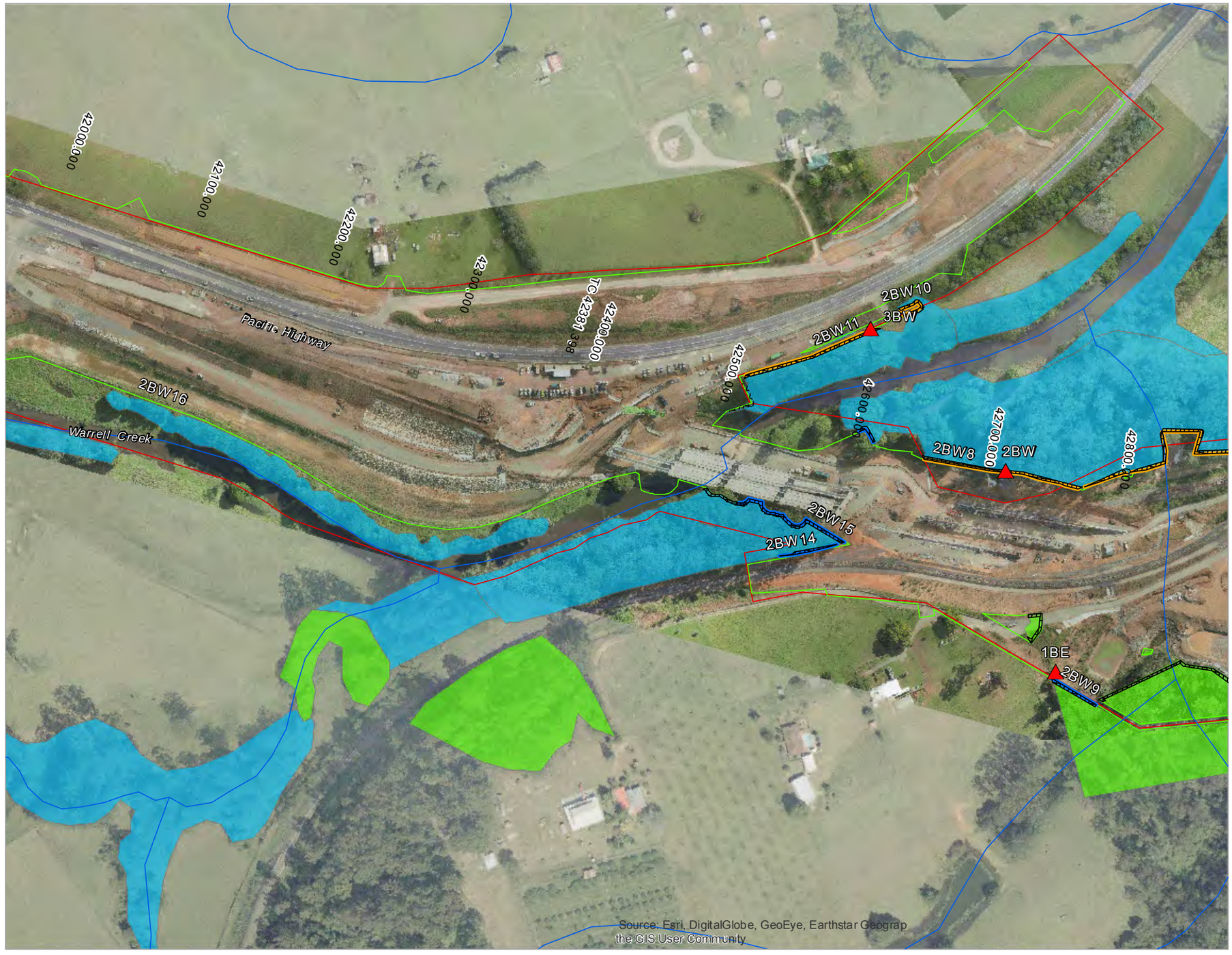
- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- High
- Medium
- Low

Vegetation

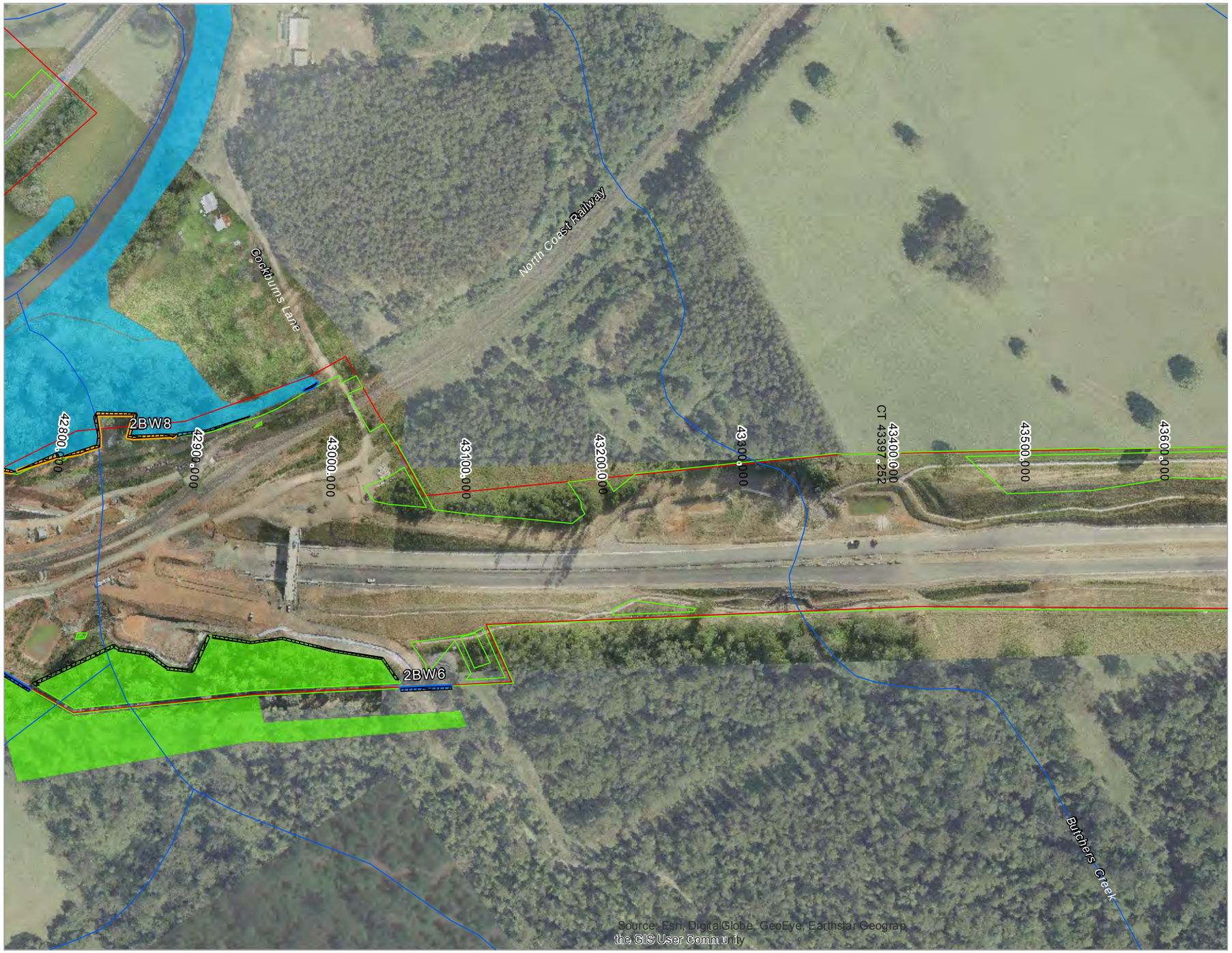
- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Weed Site (Abundance)

- Medium
- Low

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Medium

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Weed Site (Abundance)

- Medium

Vegetation

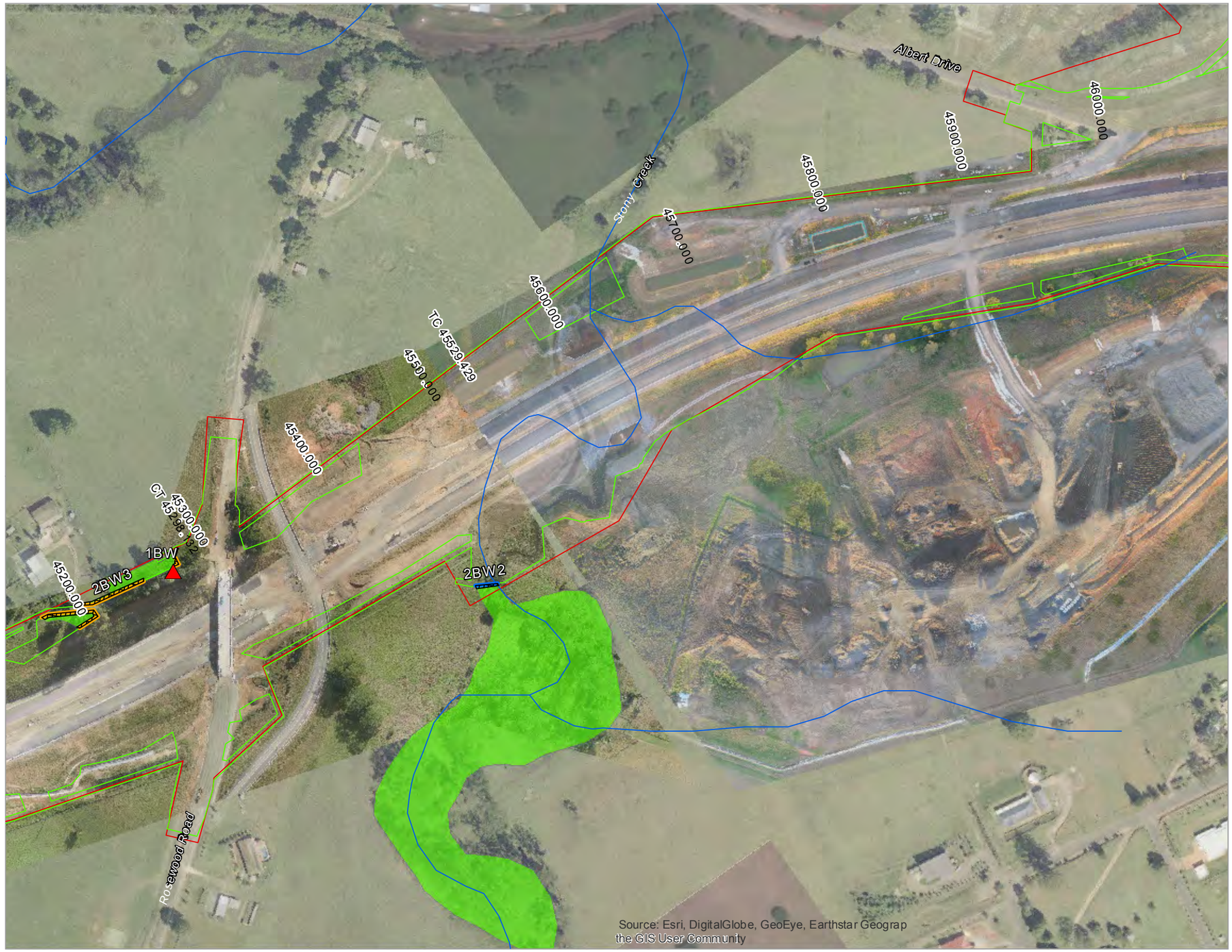
- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Medium
- Low

Vegetation

- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Weed Site (Abundance)

- High

Vegetation

- Blackbutt Open Forest

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Medium

Vegetation

- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Medium

Vegetation

- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

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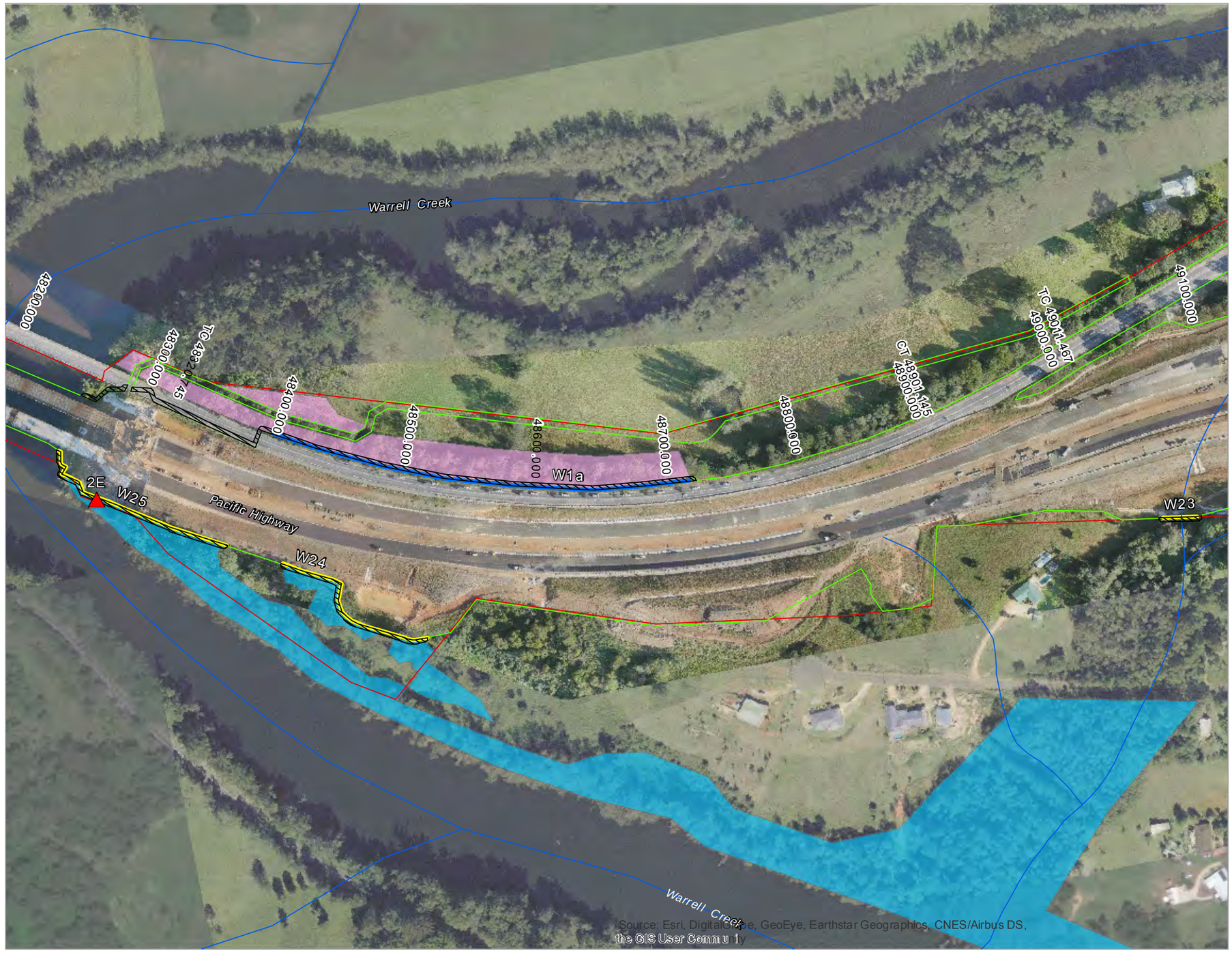

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- High
- Low

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- High
- Medium
- Low

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Weed Site (Abundance)

- Low

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

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Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Weed Site (Abundance)

- Low

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

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Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Mixed Floodplain Forest (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

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Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Weed Site (Abundance)

- Medium

Vegetation

- Moist Open Forest - White Mahogany / Grey Gum / Ironbark
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Low

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

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Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Medium

Vegetation

- Blackbutt Open Forest
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

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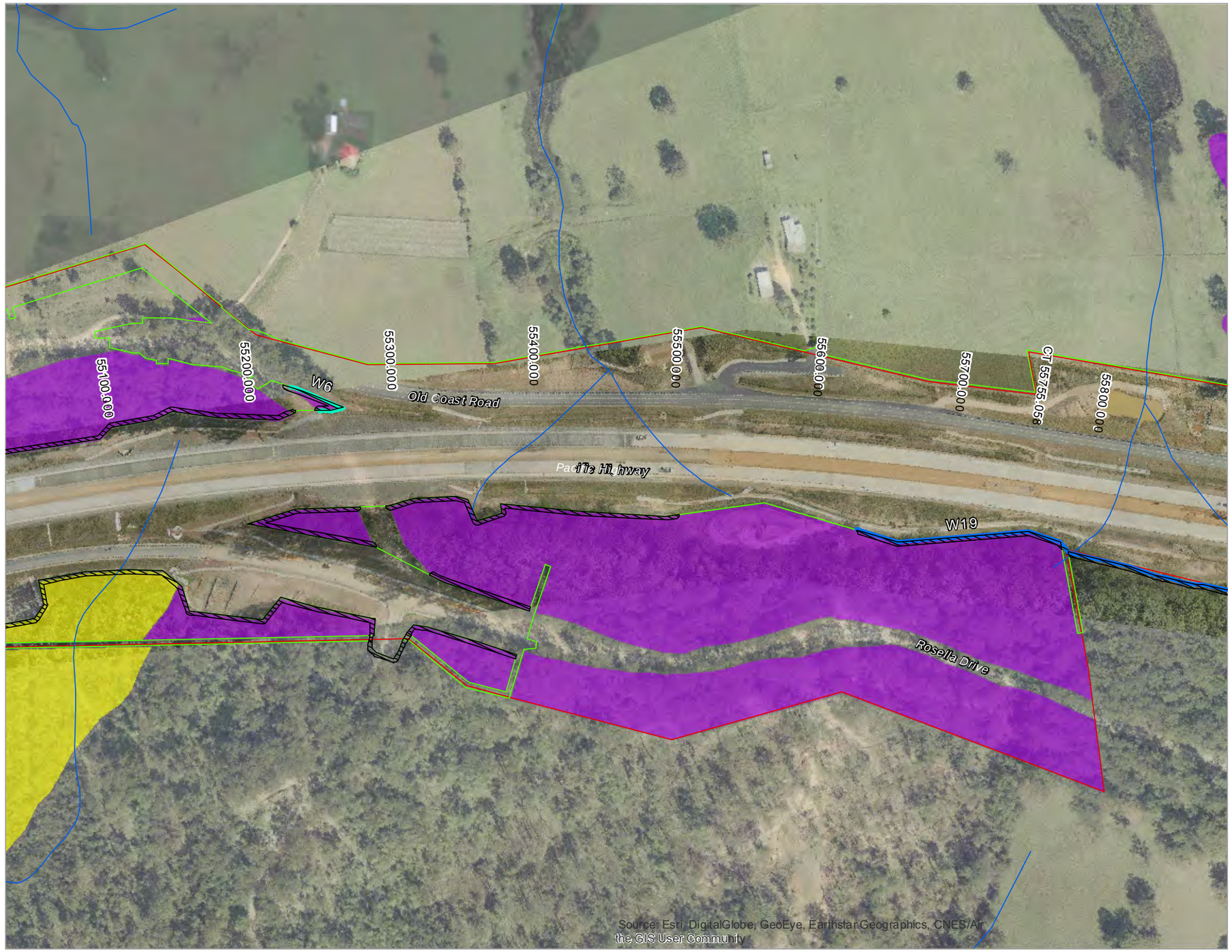

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Weed Site (Abundance)

- Low
- N/A

Vegetation

- Blackbutt Open Forest
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

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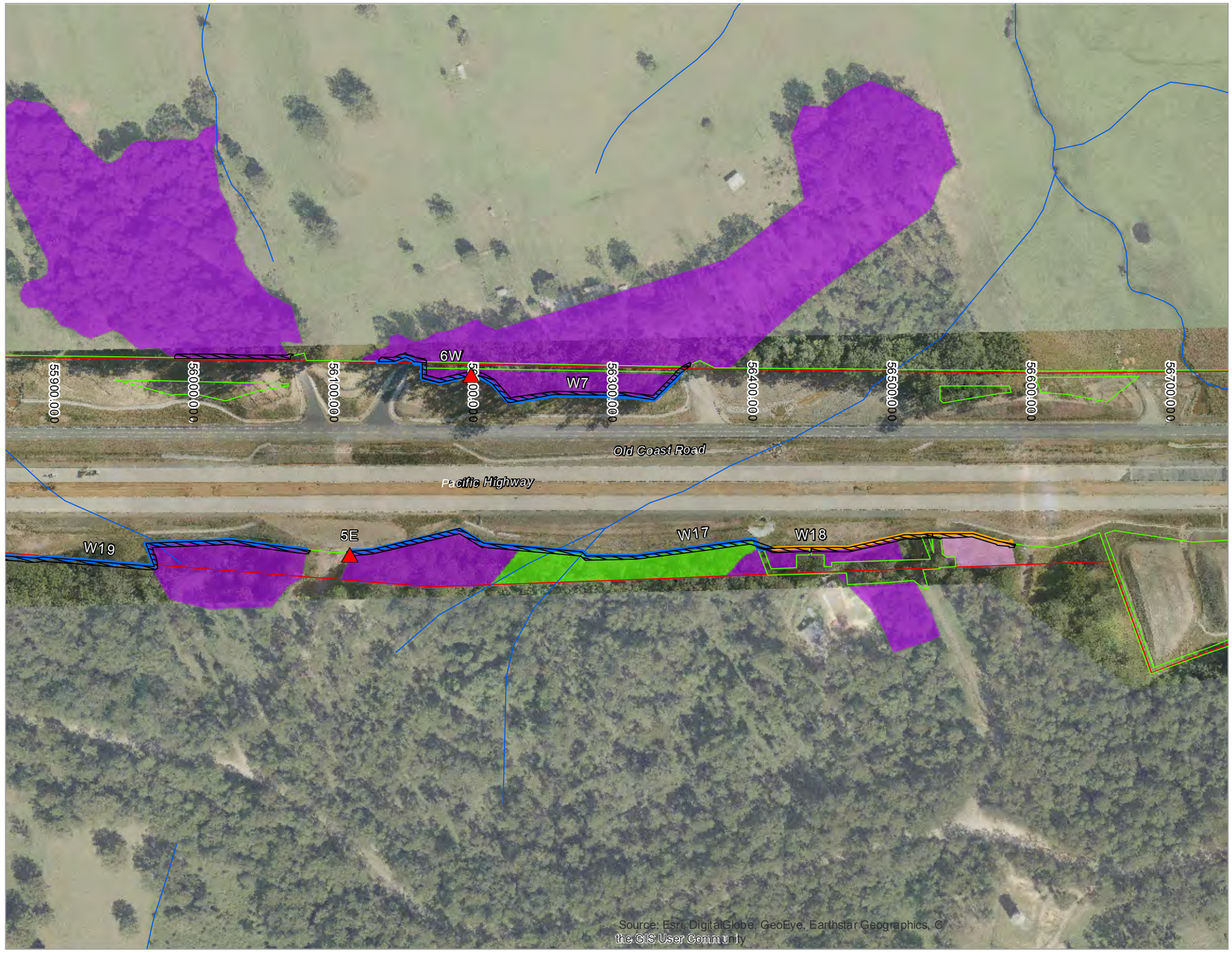

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Medium
- Low

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

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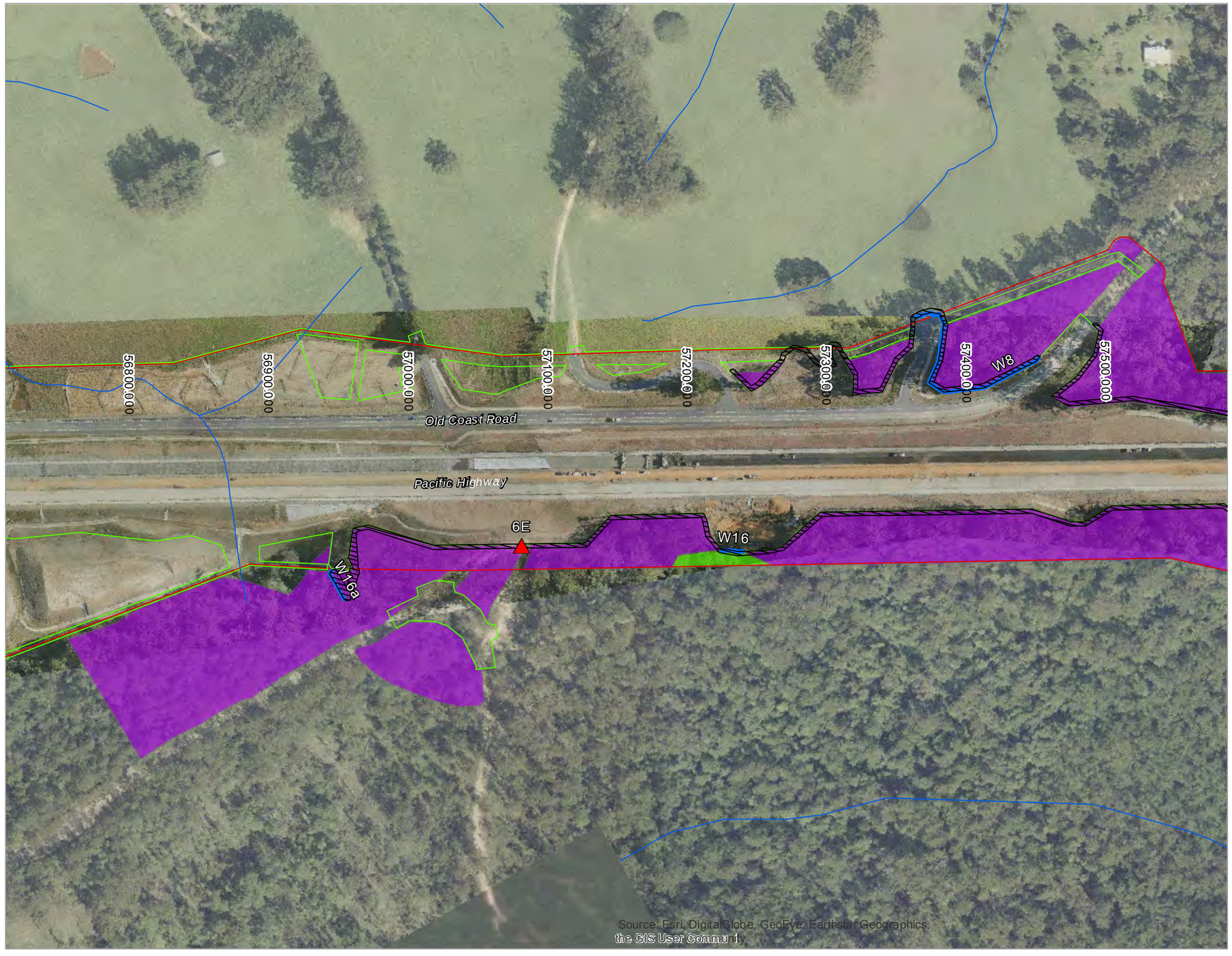
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Low

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- N/A

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Low
- N/A

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
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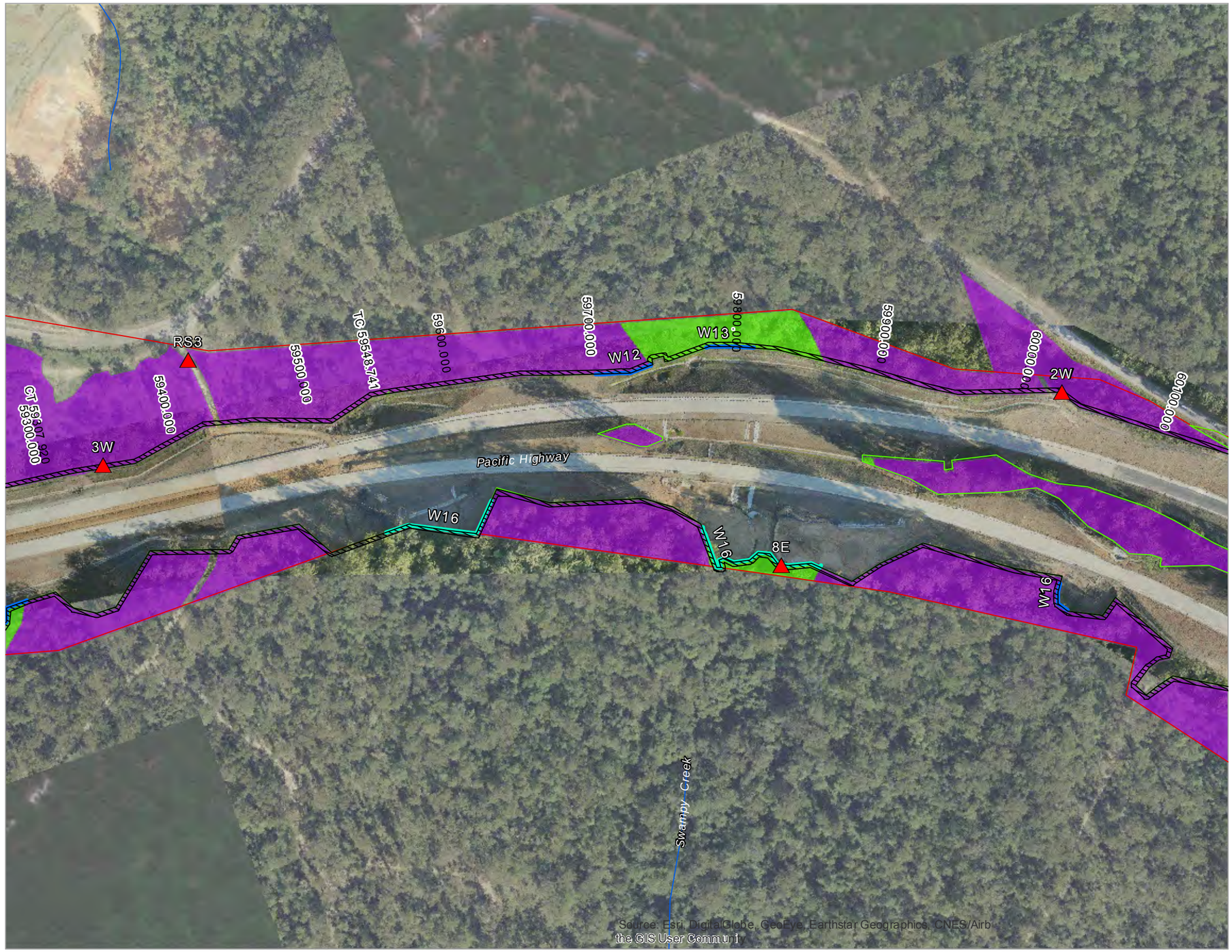

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Low
- N/A

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Weed Site (Abundance)

- Low

Vegetation

- Blackbutt Open Forest

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 31/07/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Weed Site (Abundance)

- N/A

Vegetation

- Blackbutt Open Forest

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Appendix B

GHFF Food Trees Species List

GHFF primary food tree species (blossom diet)			
Banksia integrifolia	Coastal Banksia	*Eucalyptus robusta*	Swamp Mahogany
Corymbia gummifera	Red Bloodwood	*Eucalyptus saligna*	Sydney Blue Gum
Corymbia intermedia	Pink Bloodwood	*Eucalyptus siderophloia*	Northern Grey Ironbark
Corymbia maculata	Spotted Gum	*Eucalyptus tereticornis*	Forest Red Gum
Corymbia variegata	Spotted Gum	*Grevillea robusta*	Silky Oak
Castanospermum australe	Black Bean	*Melaleuca quinquenervia*	Broad-leaved Paperbark
Eucalyptus pilularis	Blackbutt	*Syncarpia glomulifera*	Turpentine
GHFF secondary food tree species (blossom diet)			
Angophora costata	Smooth-barked Apple	*Eucalyptus grandis*	Flooded Gum
Angophora floribunda	Rough-barked Apple	*Eucalyptus propinqua*	Grey Gum
Eucalyptus acmenoides	White Mahogany	*Eucalyptus resinifera*	Red Mahogany
GHFF food tree species (fruit diet)			
Acmena smithii	Lilly Pilly	*Hedycarya angustifolia*	Native Mulberry
Alphitonia excelsa	Red Ash	*Livistona australis*	Cabbage Palm
Archontophoenix cunninghamiana	Bangalow Palm	*Maclura cochinchinensis*	Cockspur Thorn
Avicennia marina	Grey Mangrove	*Melia azedarach*	White Cedar
Cissus hypogaluca	Five-leaf Water Vine	*Melodinus australis*	Southern Melodinus
Dendrocnide excelsa	Giant Stinging Tree	*Morinda jasminoides*	Morinda
Dendrocnide photinophylla	Shining-lved Stinging Tree	*Pennantia cunninghamii*	Brown Beech
Diospyros pentamera	Myrtle Ebony	*Pittosporum undulatum*	Sweet Pittosporum
Diploglottis australis	Native Tamarind	*Planchonella australis*	Black Apple
Eucalyptus reticulatus	Blueberry Ash	*Podocarpus elatus*	Plum Pine
Ehretia acuminata	Koda	*Polyosma cunninghamii*	Featherwood
Elaeocarpus obovatus	Hard Quandong	*Rauwenhoffia leichardtii*	Zig Zag Vine
Ficus coronata	Creek Sandpaper Fig	*Rhodamnia argentea*	Malletwood
Ficus fraseri	Sandpaper Fig	*Syzygium australe*	Brush Cherry
Ficus macrophylla	Moreton Bay Fig	*Syzygium corynanthum*	Sour Cherry
Ficus obliqua	Small-leaved Fig	*Syzygium crebrinerve*	Purple Cherry
Ficus rubiginosa	Rusty Fig	*Syzygium luehmanii*	Riberry
Ficus superba	Deciduous Fig	*Syzygium. oleosum*	Blue Lilly Pilly
Ficus watkinsiana	Strangler Fig	*Schizomeria ovata*	Crabapple

Appendix C

Fixed Photo Point Results

Table C1 Rehabilitation Site Photo Points

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*	*Site Rehabilitation Winter Monitoring Event – July 2018*
CH: 60800 West - Photo Point RS1 – view to the south (W:497272, N:6610243)			
CH: 60800 West - Photo Point RS2 – view to the north-east (E:497260, N:6610256)			
CH: 60800 West - Photo Point RS2 – view to the south-west (E:497260, N:6610256)			

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*	*Site Rehabilitation Winter Monitoring Event – July 2018*
CH: 59450 East - Photo Point RS3 - view to the east (E:496443, N:6609093), no rehabilitation works started at time of monitoring.			
CH: 59450 East - Site reference photo view to the west (E:496443, N:6609093), looking towards Photo Point #3, no rehabilitation works started at time of monitoring.			
CH: 60800 East - Photo Point RS4 (E:497440, N:6610248) - view to the west (no peg installed)			

Table C2 Weed Monitoring Fixed Photo Points (Stage 2A)

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*	*July 2018 photograph*
1E	491906, 6598292			
1W	492671, 6600507			
2E	492372, 6599033			

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph	July 2018 photograph
2W	496675, 6609675			
3E	492778, 6600567			
3W	496494, 6609010			

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph	July 2018 photograph
4E	494575, 6605139			
4W	496131, 6608279			
5E	494960, 6606206			

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*	*July 2018 photograph*
5W	495668, 6607684			
6E	495433, 6607052			
6W	494890, 6606346			

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*	*July 2018 photograph*
7E	496240, 6608213			
7W	494355, 6604185			
8E	496724, 6609444			

* number + side of alignment heading north: E=east, W=west.

Table C3 Weed Monitoring Fixed Photo Points (Stage 2B)

*Photo Point ID**	*Photo Point GPS Coordinates^*	*July 2018 photograph*
1BE	489545, 6594390	
1BW	490778, 6596540	
2BE	488766, 6593840	

*Photo Point ID**	*Photo Point GPS Coordinates^*	*July 2018 photograph*
2BW	489407, 6594440	
3BE	490153, 6595330	
3BW	489268, 6594420	

Appendix 4: Spring 2018 Stage 2A and Stage 2B monitoring report.

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16 November 2018
Ref No: 2692-1156

Roads and Maritime Service
124 Albert Drive
DONNELLYVILLE NSW 2447

Attention: Mr Kris Hincks

Dear Kris

WC2NH Stage 2A and 2B GHFF Habitat Monitoring – Spring 2018 (Issue 2)

Introduction

This report presents the habitat monitoring results of Grey-Headed Flying-fox (GHFF) habitat adjacent to the Warrell Creek to Nambucca Heads Highway Upgrade (WC2NH) project for:

- Stage 2A: the fourth and final quarterly monitoring event (spring 2018); and
- Stage 2B: the second quarterly monitoring event (spring 2018).

Quarterly GHFF habitat monitoring is required for Stage 2A (chainage 47700 to 61300) and Stage 2B (chainage 41700 to 47700) (refer to **Appendix A**) for up to one year after the opening of these sections of WC2NH to traffic. Quarterly GHFF habitat monitoring is undertaken in accordance with the *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program – Stage 2: Warrell Creek to Nambucca Heads* (Benchmark Environmental Management, 2014).

The *Warrell Creek to Nambucca Heads Flying-fox Management Plan* (Sinclair Knight Merz, 2017) recognised that the quality of vegetation adjacent to the Project area could be detrimentally affected by invasion of noxious and environmental weeds. A main goal identified for management during operation of the Project is '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'* (Sinclair Knight Merz, 2017).

Methodology

The monitoring of Grey-headed Flying-fox habitat includes the following components:

1. Monitoring of identified revegetation/ rehabilitation areas to ensure the establishment/ restoration of seedlings and plants.
2. Monitoring both revegetation/ rehabilitation areas and other habitat areas adjacent to the Project to manage invasion of noxious and environmental weeds.

For brevity, component 1 is henceforth referred to as 'rehabilitation site monitoring', and component 2 is referred to as 'weed monitoring'.

Field surveys were undertaken by GeoLINK ecologists Grant McLean and Frank Makin on:

- 30 October 2018 between 7.00 am to 4.00 pm; and
- 31 October 2018 between 7.30 am to 2.30 pm.

Rehabilitation Site Monitoring

The locations of the GHFF habitat areas requiring revegetation/ rehabilitation are listed in **Table 1** and correspond with Stage 2A of the Project. Monitoring of these areas aims to assess the effectiveness of rehabilitation of GHFF habitat areas cleared during the construction of the Project.

Table 1 Location of GHFF Habitat Rehabilitation Sites

Habitat Type	*Location*	*Site*
Open Forest - Blackbutt	CH: 59450 East	15c ancillary compound
Open Forest - Blackbutt	CH: 60800 East	Old Coast Rd Temporary Deviation

The following data was recorded for each location:

- Date and time of monitoring.
- Weed abundance and composition.
- Evidence of management and control of noxious and environmental weeds.
- Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation.
- Evidence of native plant establishment of seedlings.
- Identification of any of the GHFF food tree plants referred to in **Appendix B**.

Photos were also taken at the four fixed photo points associated with the rehabilitation sites (refer to **Table 2**).

Table 2 Locations of Fixed Photo Points for Rehabilitation Sites

Photo Point ID	*Photo Point GPS Coordinates**	*Corresponding Rehabilitation Site*
RS1	497272, 6610243	Old Coast Road temporary deviation (west)
RS2	497260, 6610256	Old Coast Road temporary deviation (west)
RS3	496443, 6609093	15c ancillary compound
RS4	497440, 6610248	Old Coast Road temporary deviation (east)

** UTM eastings, northings; Zone 56J*

Weed Monitoring

The Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval defined GHFF habitat as habitat consisting of:

- Swamp Forest - Swamp Mahogany/ Paperbark.
- Moist Open Forest - Flooded Gum.
- Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark.
- Mixed Floodplain Forest.
- Open Forest - Blackbutt.

All instances of the above plant communities occurring along the outside of the Project clearing corridor were targeted during the field surveys. Within two metres of the cleared edge of these habitat areas the following data was recorded in relation to weeds:

- Date and time of monitoring.
- Weed abundance and composition.
- Evidence of management and control of noxious and environmental weeds.

Weed abundance for individual species was measured using modified Braun-Blanquet cover classes between 1 and 5: 1 (<5%), 2 (6-25%), 3 (26-50%), 4 (51-75%), and 5 (76-100%). Abundance scores for identified weed sites were classified based on the categories in **Table 3**. Priority weed sites for management were identified based on species present and the percentage cover, prioritising *Biosecurity Act 2015* listed species and weeds with potential to degrade flying-fox foraging habitat values.

Table 3 Weed Abundance Classification for Weed Sites

Noxious/ Environmental Weed Cover (%)	*Weed Abundance Classification*
0-10	NA
11-39	Low
40-69	Medium
70-100	High

Photos were taken at the fixed photo points established during the Summer 2018 weed monitoring for Stage 2A and at fixed photo points established during the Winter 2018 weed monitoring for Stage 2B. Locations of the fixed photo points are listed in **Table 4**.

Table 4 Locations of Fixed Photo Points

Stage	*Photo Point ID**	*Photo Point GPS Coordinates^*	*Notes on Photo Direction*	*Vegetation Type*	*Corresponding Weed Infestation*
2A	1E	491906, 6598292	Looking north	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	W28
2A	1W	492671, 6600507	Looking north north-east	Swamp Forest - Swamp Mahogany/ Paperbark	W1b
2A	2E	492372, 6599033	Looking north-east	Moist Open Forest - Flooded Gum	W25

Stage	Photo Point ID*	Photo Point GPS Coordinates^	Notes on Photo Direction	Vegetation Type	Corresponding Weed Infestation
2A	2W	496675, 6609675	Looking north-east	Open Forest - Blackbutt	Not applicable
2A	3E	492778, 6600567	Looking south-west	Swamp Forest - Swamp Mahogany/ Paperbark	W21
2A	3W	496494, 6609010	Looking south	Open Forest - Blackbutt	Not applicable
2A	4E	494575, 6605139	Looking north north-east	Swamp Forest - Swamp Mahogany/ Paperbark	Not applicable
2A	4W	496131, 6608279	Looking north-east	Moist Open Forest – Flooded Gum	W9
2A	5E	494960, 6606206	Looking south south-west	Open Forest - Blackbutt	W17
2A	5W	495668, 6607684	Looking north-east	Moist Open Forest – Flooded Gum	Not applicable
2A	6E	495433, 6607052	Looking north	Open Forest - Blackbutt	Not applicable
2A	6W	494890, 6606346	Looking south south-west	Open Forest - Blackbutt	W7
2A	7E	496240, 6608213	Looking west	Moist Open Forest – Flooded Gum	W16
2A	7W	494355, 6604185	Looking north	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Not applicable
2A	8E	496724, 6609444	Looking south south-west	Moist Open Forest – Flooded Gum	W16
2B	1BE	489545, 6594390	Looking north	Moist Open Forest - Flooded Gum	2BW9
2B	1BW	490778, 6596540	Looking south	Moist Open Forest - Flooded Gum	2BW3
2B	2BE	488766, 6593840	Looking south-west	Mixed Floodplain Forest	2BW18
2B	2BW	489407, 6594440	Looking north-east	Mixed Floodplain Forest	2BW8
2B	3BE	490153, 6595330	Looking south	Moist Open Forest - Flooded Gum	Not applicable
2B	3BW	489268, 6594420	Looking south	Mixed Floodplain Forest	2BW11

** number plus side of alignment heading north: E=east, W=west.*

^ UTM eastings, northings; Zone 56J.

Results and Discussion

Rehabilitation Site Monitoring

The results of the rehabilitation site monitoring are provided in **Table 5**. Photos from the four fixed photo points are shown in **Appendix C**. Plantings and/ or seeding at these sites are either young or have not been undertaken (in the case of the rehabilitation site at the 15c ancillary compound).

Native seed germination is evident at the Old Coast Road Temporary Deviation (CH60800) with a number of native species recorded growing from the native seed mix applied on both sides of the highway alignment. However native species growth has remained stagnant and cover is minimal.

Table 5 Rehabilitation Site Monitoring

Rehabilitation Site	***Old Coast Rd Temporary Deviation (CH: 60800 West)***	***Old Coast Rd Temporary Deviation (CH: 60800 East)***	***15c Ancillary Compound (CH: 59450 East)***
Photo Point GPS Coordinates (UTM eastings, northings; Zone 56J)	Photo Point RS1: 497272, 6610243 Photo Point RS2: 497260, 6610256	Photo Point RS4: 497440, 6610248	Photo Point RS3: 496443, 6609093
Date and time of survey	Spring: 30/10/2018 – 11:57 am	Spring: 30/10/2018 – 11:40 am	Spring: 31/10/2018 – 1:22 pm
Weed Abundance and Composition	No weed infestations were observed within the newly landscaped area. No change from winter 2018 survey.	No weed infestations were observed within trimmed, top-soiled and hydroseeded batter. No change from winter 2018 survey	The northern boundary of this area has <5% intrusion of Whiskey Grass (*Andropogon virginicus*), Broadleaf Paspalum (*Paspalum mandiocanum*), Lantana* *(Lantana camara*) and Blue Billygoat Weed (*Ageratum houstonianum*). A minor reduction in Fireweed (*Senecio madagascariensis*) and Cobblers Pegs (*Bidens pilosa*) was evident when compared to the winter 2018 survey.
Evidence of management and control of noxious and environmental weeds	No weeds present. No change from winter 2018 survey.	No weeds present. No change from winter 2018 survey.	No evidence of weed management observed.
Evidence of any progressive revegetation/ rehabilitation during the construction phase using collected topsoil and seed at specific sites and to develop different successional stages of rehabilitation	No observed progressive revegetation or successional stages of rehabilitation. No weeds present. No change from winter 2018 survey.	No observed progressive revegetation or successional stages of rehabilitation. No weeds present. No change from winter 2018 survey.	A mulch layer has been applied to the site that was not previously evident during the winter 2018 survey.
Evidence of native establishment of seedlings and plants	Establishment of Hickory Wattle (*Acacia falcata*) and Large-leaf Hop-bush (*Dodonaea triquetra*) to 30 cm	No change from Winter 2018 survey. Some encroachment (<1% cover) from the edge of the cleared area was	Areas with recently applied mulch (since the winter 2018 monitoring) continue to show no evidence of native establishment of seedlings and plants.

Rehabilitation Site	Old Coast Rd Temporary Deviation (CH: 60800 West)	Old Coast Rd Temporary Deviation (CH: 60800 East)	15c Ancillary Compound (CH: 59450 East)
	on the southern drain embankment. No other changes from Winter 2018 survey. Semi established native plant species that have been planted as part of rehabilitation include Water Gum (*Tristaniopsis laurina*) to ~ 1 m height and Tea Tree (*Leptospermum brachyandrum*) to ~ 2 m height. Native regeneration species account for <2% cover with maximum plant height to 35 cm. Identifiable species include: ■ Dusky Coral Pea (*Kennedia rubicunda*) ■ Purple Coral Pea (*Hardenbergia violacea*) ■ Pink Kunzea (*Kunzea capitata*) ■ Green Wattle (*Acacia irrorata*) ■ White Sally Wattle (*Acacia floribunda*) ■ Austral indigo (*Indigofera australis*) ■ *Goodenia sp.* (likely *G. heterophylla*). The hydroseeded grass cover crop has remained died off.	recorded with Bracken Fern (*Pteridum esculentum*) and Blady Grass (*Imperata cylindrica*) beginning to recolonise the disturbed area. Very minor (<1%) native regeneration of bushland regeneration hydroseed mix are regenerating to maximum height of 20 cm. Identifiable species include: ■ Dusky Coral Pea ■ Purple Coral Pea ■ Green Wattle. ■ White Sally Wattle. The hydroseeded grass cover crop has remained died off.	Minor natural regrowth <5% was observed of Blackbutt (*Eucalyptus pilularis*), Sally Wattle (*Acacia melanoxylon*), Blady Grass, Water Vine (*Cissus hypoglauca*), Bracken Fern and Kangaroo Grass (*Themeda triandra*) on the northern edge of the site where no mulch has been applied.
Identification of any of the GHFF food tree species (refer to Appendix B)	No change from winter 2018 survey. Applied landscape seed mixes have	No change from winter 2018 survey. No landscape plantings had been	No evidence of GHFF food tree recruitment from landscaping at the time of monitoring. Minor natural regeneration on

Rehabilitation Site	*Old Coast Rd Temporary Deviation (CH: 60800 West)*	*Old Coast Rd Temporary Deviation (CH: 60800 East)*	*15c Ancillary Compound (CH: 59450 East)*
	included species identified within **Appendix B** (Alex Dwyer {Pacifico Environmental Manager} email 8/03/2018). No regeneration of GHFF food tree species has been detected to date.	undertaken at the time of monitoring. It appears that no landscape plantings are proposed for this area of the Old Coast Road temporary deviation rehabilitation. Applied landscape seed mixes have included species identified within **Appendix B** (Alex Dwyer {Pacifico Environmental Manager} email 8/03/2018). No regeneration of GHFF food tree species has been detected to date.	the northern end includes Blackbutt, a GHFF food tree species.

* Denotes *Biosecurity Act 2015* listed priority weed species.

Weed Monitoring

Stage 2A

Occurrence of noxious and/ or environmental weeds was recorded at 27 sites (identified as low, medium or high) within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and listed in **Table 6**. Photographs of GHFF habitat areas taken from the fixed photo points are shown in **Appendix C**.

Only very minor changes to weed densities and composition were observed during the subject spring 2018 monitoring event compared to the previous monitoring event (winter 2018). Cool and wet weather conditions (178 mm total rainfall for October) were experienced in the month leading up to the survey (BOM, 2018). Observed changes include:

- Five additional weed sites (W2a, W19a, W19b, W19c and W19d) were observed during the spring 2018 survey and comprise low weed management priority areas.
- Additional weed species were recorded at eleven sites: W1a, W1b, W2, W5, W6, W12, W20, W22, W23, W24 and W25.
- Weed abundance at site W19 and W26 has reduced to Low. Weed abundance at sites W8, W11, W12 and W16 (in several sections) and W19 has reduced to NA.
- An increase in the weed cover of individual species was recorded at sites W20 (Setaria) and W21 (Salvinia - *Salvinia molesta*).
- A decrease in weed infestation extent was observed at site W19, reducing the northern extent by approximately 170 m to south.

A total of 27 noxious and environmental weed species were recorded. Lantana, Salvinia, Fireweed and Blackberry (*Rubus fruticosus*) were recorded on-site and are listed as priority weed species for the North Coast of NSW under the *Biosecurity Act 2015*. The primary management duty for these is they '*must not be imported into the state or sold*'.

Broadleaf Paspalum and Lantana were recorded within GHFF habitat areas at the highest density, and were also the dominant weed species in those GHFF areas that recorded a 'high' weed abundance level (refer to **Table 6**).

One weed site (site W25) was considered to have a high weed management priority, while seven weed sites were considered to have a medium weed management priority (sites W18, W19 {part}, W20, W22, W23, W24 and W28). These areas should be targeted during weed management works.

A reduction in weeds and general vegetative cover was observed at fixed photo point monitoring site 1E attributed to disturbance associated with fencing installation. No other obvious changes were recorded between the winter 2018 and spring 2018 fixed photo point monitoring sites (refer to **Appendix C**).

No increase in the densities of the exotic vines Mile-a-minute (*Ipomoea cairica*) or Morning Glory (*Ipomoea indica*) were recorded during the spring 2018 habitat monitoring. Both of these species have potential to inhibit native regeneration and smother the canopy of intact GHFF habitat.

Table 6 Abundance and Composition of Noxious and/ or Environmental Weeds Sites for Stage 2A

Weed Site Ref.	*Chainage (side of highway)*	*Spring 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Summer 2018 Weed Abundance^^*	*Autumn 2018 Weed Abundance^^*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
Date and time: ■ 30 October 2018 between 7.00 am to 4.00 pm. ■ 31 October 2018 between 7.30 am to 2.30 pm.										
W1a	48400 to 48700 (west)	Lantana* (2), Camphor Laurel (1), Broadleaf Paspalum (2), Blackberry* (1), Blue Billygoat Weed	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	NA	Low	Low	Low	**Additional weeds recorded: Blue Billygoat Weed**	No evidence of weed control	Low
W1b	49790 - 50100 (west)	Setaria (*Setaria sphacelata*) **(1),** Annual Ragweed (*Ambrosia artemisiifolia*) (1), Broadleaf Paspalum (2), Fireweed* (1), Blue Billygoat Weed (1) Balloon Cotton Bush (*Gomphocarpus physocarpus*) (1), **Paddy's Lucerne (1), Purple Top (1).**	Swamp Forest - Swamp Mahogany/ Paperbark	Low	Low	Low	Low	Majority of weed infestation concentrated on batter edge. Blue Water Lily (on swamp fringe) 40% cover in concentrated areas of open water. **Minor reduction in Setaria cover recorded from 2 in Winter 2018 to 1 in Spring 2018. Additional weeds recorded:**	No evidence of weed control	Low

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
								Paddy's Lucerne (1), Purple Top (1).		
W2	51010 - 51165 (west)	Salvinia* (within open water area – approx. chainage 51020) (2), **Paddy's Lucerne (1), Purple top (1).**	Swamp Forest - Swamp Mahogany/ Paperbark	Low	Low	Low	Low	Very minor Flax-leaf Fleabane (*Conyza bonariensis*), Broadleaf Paspalum and Annual Ragweed on fauna fence edge. **Additional weeds recorded: Paddy's Lucerne (1), Purple Top (1).**	No evidence of weed control	Low (this species would have minimal impact on GHFF habitat value).
W2a	**53580 - 53700**	**Lantana (1), Mickey Mouse Plant (*Ochna serrulata*) (1)**	**Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark**	**Not recorded**	**Not recorded**	**Not recorded**	**NA**	**Minor new weed infestation with Lantana and Mickey Mouse Plant growth detected in Spring 2018 survey.**	**No evidence of weed control**	**Low**
W3	53750 - 53840 (west)	Broadleaf Paspalum (2), Annual Ragweed (1), White Passionflower (*Passiflora*	Moist Open Forest - White Mahogany/ Grey Gum/	Low	Low	Low	Low	Additional weeds recorded: Wild Tobacco Bush and Fireweed*.	No evidence of weed control	Low

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
		subpeltata) (1), Paddy's Lucerne (*Sida rhombifolia*) (1), Purple-top (*Verbena bonariensis*) (1), Fireweed* (1), Wild Tobacco Bush (*Solanum mauritianum*) (1).	Ironbark							
W4	54120 - 54150 (west)	Broadleaf Paspalum (2), Lantana* (1) Winter Senna (*Senna septemtrionalis*) (1), Blue Billygoat Weed (1)	Open Forest - Blackbutt	Low	Low	Low	Low	Setaria, Flax-leaf Fleabane and Purple-top present in very low abundance.	No evidence of weed control	Low
W5	54480 - 54530, (west)	Broadleaf Paspalum (3), Lantana* (1), Wild Tobacco Bush (1), Flaxleaf Fleabane (*Conyza bonariensis*) (1), **Setaria (1)**	Open Forest - Blackbutt	Medium	Medium	Medium	Medium	**Additional weeds recorded: Setaria (1)**	No evidence of weed control	**Low**
W6	55220 - 55260 (west)	Setaria (1), **Broadleaf Paspalum (1)**	Open Forest - Blackbutt	Low	NA	NA	NA	**Additional weeds recorded: Broadleaf Paspalum (1)**	Weed control has not yet commenced	Low
W7	56160 -	Broadleaf Paspalum	Open Forest -	Low	Low	Low	Low	Lantana* present	Weed control	Low

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
	56360 (west)	(2), Setaria (1), Lantana* (1)	Blackbutt					in low abundance on fringe	has not yet commenced **Evidence of weed management on adjacent property.**	
W8	57370 – 57450 (west)	Lantana* (1), Broadleaf Paspalum (1)	Open Forest - Blackbutt	Low	Low	Low	**NA**	**Weed abundance has reduced from Low to NA.**	No evidence of weed control	Low
W9	58440 - 58550 (west)	Broadleaf Paspalum (2), Lantana* (1)	Moist Open Forest - Flooded Gum	Low	Low	Low	Low	-	No evidence of weed control	Low
W10	58850 – 58940 (west)	Lantana* (1)	Open Forest - Blackbutt	Low	Low	Low	Low	-	No evidence of weed control	Low
W11	59200 - 59250, (west)	Broadleaf Paspalum (1)	Open Forest - Blackbutt	Low	Low	Low	**NA**	**Weed abundance has reduced from Low to NA.**	No evidence of weed control	Low
W12	59700 - 59740 (west)	**Broadleaf Paspalum (1), Lantana (1)**	Open Forest - Blackbutt	Low	Low	Low	**NA**	**Weed abundance has reduced from Low to NA.** **Additional weeds recorded:**	No evidence of weed control	Low

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
								Lantana (1)		
W13	59780 - 59810 (west)	Broadleaf Paspalum (2)	Flooded Gum Moist Open Forest	Low	Low	Low	Low	-	Weed control has not yet commenced	Low
W14	60400 - 60540, 60640 – 60665 (west)	Broadleaf Paspalum (2), Morning Glory (1), Rhodes Grass (*Chloris gayana*) (1), Winter Senna (1), Blue Billygoat Weed (1), **Crofton (1)**	Open Forest - Blackbutt	Low	Low	Low	Low	Some sections without GHFF habitat (old hardstand area and stockpile site).	No evidence of weed control	Low
W15	61240 – 61260 (east)	Lantana* (1)	Open Forest - Blackbutt	Low	NA	NA	NA	-	No evidence of weed control	Low
W16	60570 - 60600	**Lantana* (1),** Broadleaf Paspalum (1)	Flooded Gum Moist Open Forest	Medium	Low	Low	**NA**	**Weed cover has reduced in several chainage sections due to a reduction in per cent of foliage cover of Lantana*.**	No evidence of weed control	Low
	60300 - 60400	Lantana* (1)		NA	Medium	Low	**NA**			Low
	60040 - 60060	Lantana* (1)		NA	Low	Low	**NA**			Low
	59780 - 59850	Lantana* (1)		Medium	Low	NA	NA			Low
	59550 - 59610	Lantana* (1)		Medium	Low	NA	NA			Low
	59200 - 59260	Lantana* (1)		Medium	Low	Low	NA			Low

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
	59000 - 59080	Broadleaf Paspalum (1)		Medium	Low	NA	NA			Low
	58470 – 58550	Lantana* (1), Whiskey Grass (1)		Medium	Low	NA	NA			Low
	58050 - 58110	Lantana* (1)		Medium	Low	NA	NA			Low
	57650 - 57770	None		Medium	Low	NA	NA			Low
	57210 - 57250 (east)	Lantana* (1)		Medium	Low	Low	Low			Low
W16a	56950	Lantana* (2), Broadleaf Paspalum (2)	Open Forest - Blackbutt	Not recorded	Not recorded	Low	Low	-	No evidence of weed control	Low
W17	56100 – 56420 (east)	Broadleaf Paspalum (3), **Lantana* (1)**	Open Forest - Blackbutt Flooded Gum Moist Open Forest	Low	Low	Low	Low	Mostly intact native canopy but more scattered trees around big house in north. Lower weed cover in south. **Reduction in Lantana weed composition cover.**	No evidence of weed control	Low
W18	56420 – 56580 (east)	Broadleaf Paspalum (4), **Lantana* (1)**	Open Forest - Blackbutt	Medium	Medium	Medium	Medium	Very weedy understorey in north around big house. Very	No evidence of weed control	Medium

Weed Site Ref.	*Chainage (side of highway)*	*Spring 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Summer 2018 Weed Abundance^^*	*Autumn 2018 Weed Abundance^^*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
								weedy north section. **Reduction in Lantana weed composition cover.**		
W19	**55800 - 56080**	Lantana* (2), Broadleaf Paspalum (2), Setaria (1)	Open Forest - Blackbutt	Low	Medium	Medium	**Low**	**Reduction in site length of approximately 170 m.**	**Slashing along fence line evident.**	Medium
	55620 - 55800 (east)			Low	Low	Low	**NA**			Low
W19a	**55350**	**Broadleaf Paspalum (1)**	**Open Forest - Blackbutt**	**Not recorded**	**Not recorded**	**Not recorded**	**NA**	**New weed site.**	**No evidence of weed control**	**Low**
W19b	**55350**	**Broadleaf Paspalum (1), Lantana (1), Setaria (1)**	**Open Forest - Blackbutt**	**Not recorded**	**Not recorded**	**Not recorded**	**NA**	**New weed site.**	**No evidence of weed control**	**Low**
W19c	**55200**	**Setaria (1), Whisky Grass (1)**	**Open Forest - Blackbutt**	**Not recorded**	**Not recorded**	**Not recorded**	**NA**	**New weed site.**	**No evidence of weed control**	**Low**
W19d	**53550-53590**	**Setaria (2), Broadleaf Paspalum (2)**	Swamp Forest - Swamp Mahogany/ Paperbark	**Not recorded**	**Not recorded**	**Not recorded**	**Low**	**New weed site.**	**No evidence of weed control**	**Low**
W20	52980 – 53040 (east)	Lantana* (**2**), Mile a Minute (**2**), Annual Ragweed (1), **Setaria (3),** Rhodes	Swamp Forest - Swamp Mahogany/	Medium	Medium	Medium	Medium	**Setaria cover has increased from cover class 1 in winter**	No evidence of weed control	Medium

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
		Grass (1), Blue Billygoat Weed (1), Winter Senna (1), **Tobacco Bush (*Solanum mauritianum*)**	Paperbark					**2018 to 3 in spring 2018. Overall weed abundance has remained medium. Additional weeds recorded: Tobacco Bush**		
W21	49830 - 50220 (east)	Setaria (on batter edge) (2), **Salvinia* (within open water area along swamp edge) (3), Blue Water Lily (1), and Fireweed* on batter edge (1)**	Swamp Forest - Swamp Mahogany/ Paperbark	Low	Low	Low	Low	Forest is overall in good condition including the understorey except for some sections with Blue Water Lily **and Salvinia*. There are also some minor incursions of exotic grasses and herbs along fence.** **Salvinia cover has increased from cover class 2 in winter 2018 to 3 in spring 2018.**	No evidence of weed control	Low (these weeds would have minimal impact on GHFF habitat value).

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
								Overall weed abundance has remained medium.		
W22	49560 – 49670 (east)	Broadleaf Paspalum (4), Lantana* (1), Balloon Cotton Bush (1), **Camphor Laurel (1), Mickey Mouse Plant (1), Tobacco Bush (1), Fireweed (1) and Paddy's Lucerne**	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Medium	Medium	Medium	Medium	**Additional weeds: Camphor Laurel (1), Mickey Mouse Plant (1), Tobacco Bush (1), Fireweed (1) and Paddy's Lucerne**	No evidence of weed control	Medium
W23	49030 - 49070 (east)	Broadleaf Paspalum (5), Camphor Laurel (1) Balloon Cotton Bush (1), **Blue Billygoat Weed (1).**	Flooded Gum Moist Open Forest	High	High	High	High	Scattered native overstorey of Hard Quandong (*Elaeocarpus obovatus*), Foam Bark Tree (*Jagera pseudorhus*), Broad-leaved Paperbark (*Melaleuca quinquenervia*), with few shrubs and groundcover dominated by Broadleaf Paspalum. **Additional**	No evidence of weed control	Medium

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
								weeds: Blue Billygoat Weed		
W24	48430 - 48550 (east)	Broadleaf Paspalum (5), **Lantana (1)**	Moist Open Forest - Flooded Gum	High	High	High	High	Scattered overstorey of Flooded Gum (*Eucalyptus grandis*), Guioa (*Guioa semiglauca*), Broad-leaved Paperbark (*Melaleuca quinquenervia*), but lack of shrub layer and ground cover dominated by Broadleaf Paspalum. **Additional weeds: Lantana**	No evidence of weed control	Medium
W25	48260 – 48380 (east)	Lantana* (5), Broadleaf Paspalum (2), **Setaria (2),** Mile a Minute (1), Winter Senna (1).	Moist Open Forest - Flooded Gum	High	High	High	High	Mostly intact overstorey dominated by Flooded Gum with some River Oak (*Casuarina cunninghamiana*) on edge creek. Understorey dominated by weeds mostly	No evidence of weed control	High

Weed Site Ref.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Summer 2018 Weed Abundance^^	Autumn 2018 Weed Abundance^^	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
								Lantana*. **Additional weeds: Setaria**		
W26	47800 – 47832 (east)	Lantana* (2), Wild Tobacco Bush (2), Setaria (1), White Passionflower (1), **Winter Senna (1).**	Open Forest - Blackbutt	Medium	Medium	Medium	**Low**	-	No evidence of weed control	**Low**
W27	47510 – 47530 (east)	Broadleaf Paspalum (3), Camphor Laurel (2), Purple Top (2), Wild Tobacco Bush (2)	Moist Open Forest – White Mahogany – Grey Gum	Medium	Medium	Medium	Medium	-	**Recently cleared for fence installation.**	**Low**
W28	47450 – 47490 (east)	Camphor Laurel (2), Broadleaf Paspalum (2), Lantana* (2), Blackberry* (1), Narrow-leaved Privet (*Ligustrum sinense*) (1)	Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark	Medium	Medium	Medium	Medium	**-**	**Recently cleared for fence installation.**	Medium

^ *Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%*

^^ Refer to Table 3.

* Denotes *Biosecurity Act 2015* listed priority weed species. Lantana, Fireweed, Blackberry and Salvinia are listed as Weeds of National Significance and as priority weed species for the North Coast of NSW. They must not be imported into the State or sold.

Bold text denotes change from winter 2018 monitoring event.

Stage 2B

Occurrence of noxious and/ or environmental weeds was recorded at 20 sites (identified as low, medium or high) within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and listed in **Table 7**. Photographs of GHFF habitat areas taken from the fixed photo points are shown in **Appendix C.**

A total of 21 noxious and environmental weed species were recorded. Blackberry, Fireweed and Lantana were recorded on-site and are listed as priority weed species for the North Coast of NSW under the *Biosecurity Act 2015*. The primary management duty for these is they '*must not be imported into the state or sold*'.

Broadleaf Paspalum, Setaria, and Large-leaved Privet (*Ligustrum lucidum*) were recorded within GHFF habitat areas at the highest density, and were also the dominant weed species in those GHFF areas that recorded a 'Medium' or 'High' weed abundance level (refer to **Table** 6**7**).

One weed site (2BW8a) has a high weed management priority. Two weed sites (sites 2BW1 and 2BW16) were considered to have a medium weed management priority. These areas should be targeted during weed management works.

No exotic vines with the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat were observed.

Table 7 Abundance and Composition of Noxious and/or Environmental Weeds Sites for Stage 2B

Weed Site No.	*Chainage (side of highway)*	*Spring 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
2BW1	46180 – 46190 (east)	**Setaria (4),** Camphor Laurel (1)	Open Forest - Blackbutt	High	**Medium**	**Spring 2018 weed composition has changed from the Winter 2018 survey. Setaria is present in Spring as opposed to Broadleaf Paspalum in winter. Broadleaf Paspalum cover in Winter 2018 is considered a typographical error and has been rectified. Overall weed abundance has been reduced to medium.**	No evidence of weed control	Medium
2BW2	45440 – 45450 (east)	Broadleaf Paspalum (2), Camphor Laurel (1), Setaria (1)	Moist Open Forest - Flooded Gum	Low	Low	Small creek and riparian zone within survey area.	**No evidence of weed control.**	Low
2BW3	45170 – 45280 (west)	Broadleaf Paspalum (3), Camphor Laurel (2),	Moist Open Forest - Flooded	Medium	Medium	**Additional weeds**	No evidence of weed control	Low

Weed Site No.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
		Setaria (1), **Blackberry (1), Small-leaved Privet (1), Lantana (1).**	Gum			**recorded: Blackberry, Small-leaved Privet, Lantana**.		
2BW4	44100 – 44200 (east)	Broadleaf Paspalum (3), **Purple Top (1), Rhodes Grass (1), Camphor Laurel (1), Whisky Grass (1).**	Open Forest - Blackbutt	Medium	**Low**	**Spring 2018 weed composition has increased from the Winter 2018 survey however overall weed abundance has been reduced to low.**	No evidence of weed control	Low
2BW5	43960 – 44030 (east)	Broadleaf Paspalum (3), Balloon Cotton Bush (1), Crofton Weed (*Ageratina adenophora*) (1), Fireweed* (1)	Moist Open Forest - Flooded Gum	Medium	Medium	-	No evidence of weed control	Low
2BW6	43050 – 43090 (east)	**Lantana* (1),** Broadleaf Paspalum (1)	Moist Open Forest - Flooded Gum	Low	Low	**Slight reduction in Lantana cover form 2 in Winter 2018 to 1 Spring 2018 within weed composition.**	No evidence of weed control	Low
2BW7	42980 – 42990 (west)	Lantana* (2), Large-leaved Privet (1), Broadleaf Paspalum (1)	Mixed Floodplain Forest	Low	Low	-	No evidence of weed control	Low

Weed Site No.	*Chainage (side of highway)*	*Spring 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
2BW7a	**42800 - 42900**	**Lantana (1)**	**Moist Open Forest - Flooded Gum**	**Not recorded**	**NA**	**Lantana growth detected in Spring 2018 survey.**	**No evidence of weed control**	**Low**
2BW8	**42700** – 42880 (west)	Lantana* (3), Large-leaved Privet (3), Camphor Laurel (1), Winter Senna (1), Wild Tobacco Bush (1), Broadleaf Paspalum (1), Setaria (1).	Mixed Floodplain Forest	Medium	Medium	**2BW8 has been split into 2 sections (see 2BW8a below) to identify area of high weed activity.**	No evidence of weed control	Medium
2BW8a	**42650 - 42700**	**Large-leaved Privet (4), Lantana (3), Tobacco Bush (2).**	**Mixed Floodplain Forest**	**Medium**	**High**	**2BW8 has been split into 2 sections to identify area of high weed activity.** **Weed abundance has increased from Winter 2018 survey.**	**No evidence of weed control**	**High**
2BW9	42770 – 42800 (east)	Broadleaf Paspalum (2), Lantana* (1), **Blue Billygoat Weed (1)**	Moist Open Forest - Flooded Gum	Low	Low	**Additional weeds: Blue Billygoat Weed**	No evidence of weed control	Low
2BW10	42620-42630 (east)	**Setaria (3),** Cobblers Pegs (1), Wild Tobacco Bush (1)	Mixed Floodplain Forest	Medium	Medium	**Slight reduction in Setaria cover from 4 in Winter 2018 to 3 Spring 2018 within weed**	Evidence of weed control.	Low

Weed Site No.	Chainage (side of highway)	Spring 2018 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
						composition.		
2BW11	42500 – 42600 (west)	Broadleaf Paspalum (3), Lantana* (1), **Tobacco Bush (1)**	Mixed Floodplain Forest	Medium	Medium	**Additional weeds: Tobacco Bush**	No evidence of weed control	Low
2BW12	42600 – 42610 (west)	Lantana* (3), Broadleaf Paspalum (2), Wild Tobacco Bush (1), Setaria (1)	Mixed Floodplain Forest	Low	Low	-	No evidence of weed control	Low
2BW13	42500 – 42510 (west)	Large-leaved Privet (2), Lantana* (2), Narrow-leaved Privet (1)	Mixed Floodplain Forest	Low	Low	-	No evidence of weed control	Low
2BW14	42570 – 42600 (east)	Large-leaved Privet (2), **Broadleaf Paspalum (1)**	Mixed Floodplain Forest	Low	Low	**Additional weeds: Broadleaf Paspalum**	No evidence of weed control	Low
2BW15	42530 – 42600 (east)	Lantana* (2), Large-leaved Privet (2), Narrow-leaved Privet (2), Broadleaf Paspalum (1), **Camphor Laurel (saplings) (1)**	Mixed Floodplain Forest	Low	Low	**Additional weeds: Camphor Laurel**	No evidence of weed control	Low
2BW16	42090 – 42220, 42290, 42390 (east)	Broadleaf Paspalum (4), Setaria (2), Lantana* (1), Camphor Laurel (1), Fireweed* (1), Wild Tobacco Bush (1).	Mixed Floodplain Forest	High	High	-	No evidence of weed control	Medium
2BW17	**41900 – 41920 (east)**	**Small-leaved Privet (2), Setaria (2), Lantana (1), Paddy's Lucerne (1), Tobacco Plant (1)**	**Mixed Floodplain Forest**	**Not recorded**	**Low**	**New site**	**No evidence of weed control**	**Low**

Weed Site No.	*Chainage (side of highway)*	*Spring 2018 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
2BW18	**41830 – 41880 (east)**	**Lantana (2), Camphor Laurel (2), Paddy's Lucerne (1), White Passionflower (1)**	**Mixed Floodplain Forest**	**Not recorded**	**Low**	**New site**	**No evidence of weed control**	**Low**
2BW19	**41560 – 41620 (east)**	**Blackberry (2), Lantana (2), Broadleaf Paspalum (2), Paddy's Lucerne (2), Annual Ragweed (1), Tobacco Bush (1)**	**Mixed Floodplain Forest**	**Not recorded**	**Low**	**New site**	**No evidence of weed control**	**Low**

^ *Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%.*

^^ Refer to Table 3.

* Denotes *Biosecurity Act 2015* listed priority weed species. Lantana and Fireweed are listed as Weeds of National Significance and as priority weed species for the North Coast of NSW. They must not be imported into the State or sold.

Bold text denotes change from winter 2018 monitoring event.

Stage 2A Annual Monitoring Findings

Discussion

Comparison with previous results

In general, the weed monitoring results have remained fairly consistent, with only minor changes in abundance (refer to **Table 8**). The total number of weed species has steadily increased over the monitoring period generally attributed to small scale weed growth comprising <5% weed abundance. One weed occurrence area (site 25) was classified as high weed abundance and high management priority over the duration of the four quarterly monitoring events. Nine areas were considered to have a medium weed management priority (sites 5, 16, 18, 22, 23, 24, 26, 27 and 28) the first quarterly (Summer 2018) monitoring event as opposed to seven sites (sites W18, W19 {part}, W20, W22, W23, W24 and W28) in final Spring 2018. Site differences are attributed to seasonal and species variations. No significant differences in sites identified as high or medium weed management priority were observed over the monitoring period.

Eighteen weed occurrence areas were identified as a low weed management priority during the first quarterly (Summer 2018) monitoring event. This increased to 26 low management priority areas in Spring 2018. Additional low weed management priority sites are mainly attributed to new environmental weed growth such as Broadleaf Paspalum and Setaria as well as small scale Lantana occurrences comprising <10% weed abundance.

Lantana, Broad-leaved Paspalum (*Paspalum mandiocanum*) and Camphor Laurel (*Cinnamomum camphora*) were recorded within GHFF habitat areas at the highest density and were also the dominant weed species in those GHFF areas that recorded a Medium weed infestation level across all survey periods.

Table 8 Comparison of Weed Abundance and Composition

Weed Abundance (km2)	***Summer 2018***	***Autumn 2018***	***Winter 2018***	***Spring 2018***
High	0.61	0.61	0.61	0.61
Medium	2.51	1.79	1.26	1.20
Low	5.65	6.89	6.59	5.32
Total	8.78	9.30	8.46	7.13
Total number of weed species	19	21	23	27

Recommendations and Conclusions

Rehabilitation Site Monitoring

Limited regeneration has established to date at all rehabilitation sites. This has been observed throughout the monitoring program. The monitoring results indicate that rehabilitation goals in line with the Project landscape plans have not been achieved and a review of the regeneration efforts is required.

Weed Monitoring

Weed sites W25, W19, W20, W23, W24, W28 are important target weed management areas to reduce degradation to GHFF habitat. At these sites, there is the potential for Lantana to alter community structure and inhibit regeneration.

Management of the weeds at these sites would be consistent with the key objectives of the WC2NH *Weed and Pathogen Management Plan* (GeoLINK 2015) which is to '*ensure the Project avoids, suppresses and controls the spread of all weeds, plant pathogens and invasive species to ensure that impacts to the environment are minimised.*'

Weed sites primarily with dense Broadleaf Paspalum (sites W5, W17, W18, W22, W23, W24 and W27) should be considered somewhat lower priorities for management than sites comprising medium infestations of Lantana for the following reasons:

- There may be a lower likelihood of weed management success (it is difficult to remove this species successfully from degraded communities that have a suitable semi-shaded understorey environment); and
- Being an understorey weed species that occurs in disturbed environments and edges, Broadleaf Paspalum has a low potential to alter either the forest structure or regeneration potential, and hence the quality of relatively intact GHFF habitat.

No significant increase in the density of the exotic vines (including Morning Glory and Mile-a-minute) which have the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat was observed over the monitoring period.

Conclusion: Project Success

In relation to weed monitoring, the *Warrell Creek to Nambucca Heads Flying-fox Management Plan* (Sinclair Knight Merz, 2017) identifies the main goal for management during the duration of the Project as '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'*. The performance threshold by which this is measured is '*Deterioration in the quality of adjacent habitat vegetation as a result of the Project (as determined by qualified ecologist*)' (Sinclair Knight Merz, 2017). Potential indicators of success as listed in the *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program – Stage 2: Warrell Creek to Nambucca Heads* (Benchmark Environmental Management, 2014) include '*No deterioration in the quality of adjacent habitat vegetation as a result of the Project'*.

The following limitations must be considered when interpreting the data:

- Limited dataset (short survey period of four survey events contained within one year) making it challenging to observe weed impacts over time.
- Natural seasonal variations in species growth / dieback.

Notwithstanding, based on the results to date '*deterioration in the quality of adjacent habitat vegetation as a result of the Project'* has not been detected and the main goal of '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'* has been observed.

In relation to rehabilitation efforts, the monitoring results indicate that rehabilitation goals in line with the Project landscape plans have not been achieved and a review of the regeneration efforts is required.

Stage 2B Monitoring Report

Recommendations and Conclusions

Weed sites 2BW8 and 2BW8a are important target weed management areas to reduce degradation to GHFF habitat. At these sites, there is the potential for Lantana and Large-leaved Privet to alter community structure and inhibit regeneration. Management of the weeds at these sites would be consistent with the key objectives of the WC2NH *Weed and Pathogen Management Plan* (GeoLINK 2015) which is to '*ensure the Project avoids, suppresses and controls the spread of all weeds, plant pathogens and invasive species to ensure that impacts to the environment are minimised.*'

Weed sites primarily with dense Setaria and Broadleaf Paspalum (sites 2BW1, 2BW3, 2BW5, 2BW10, 2BW11 and 2BW16) should be considered somewhat lower priorities for management than sites comprising medium infestations of Lantana and/ or Large-leaved Privet for the following reasons:

- There may be a lower likelihood of weed management success (it is difficult to remove this species successfully from degraded communities that have a suitable semi-shaded understorey environment); and
- Being an understorey weed species that occurs in disturbed environments and edges, Broadleaf Paspalum and Setaria have a low potential to alter either the forest structure or regeneration potential, and hence the quality of relatively intact GHFF habitat.

Future monitoring should identify any incursions of exotic vines (including Morning Glory and Mile-a-minute) which have the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat. None have been observed to date during Stage 2B monitoring.

Please contact the undersigned if require any further information.

Yours sincerely
GeoLINK

Grant McLean
Ecologist

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Issue Log

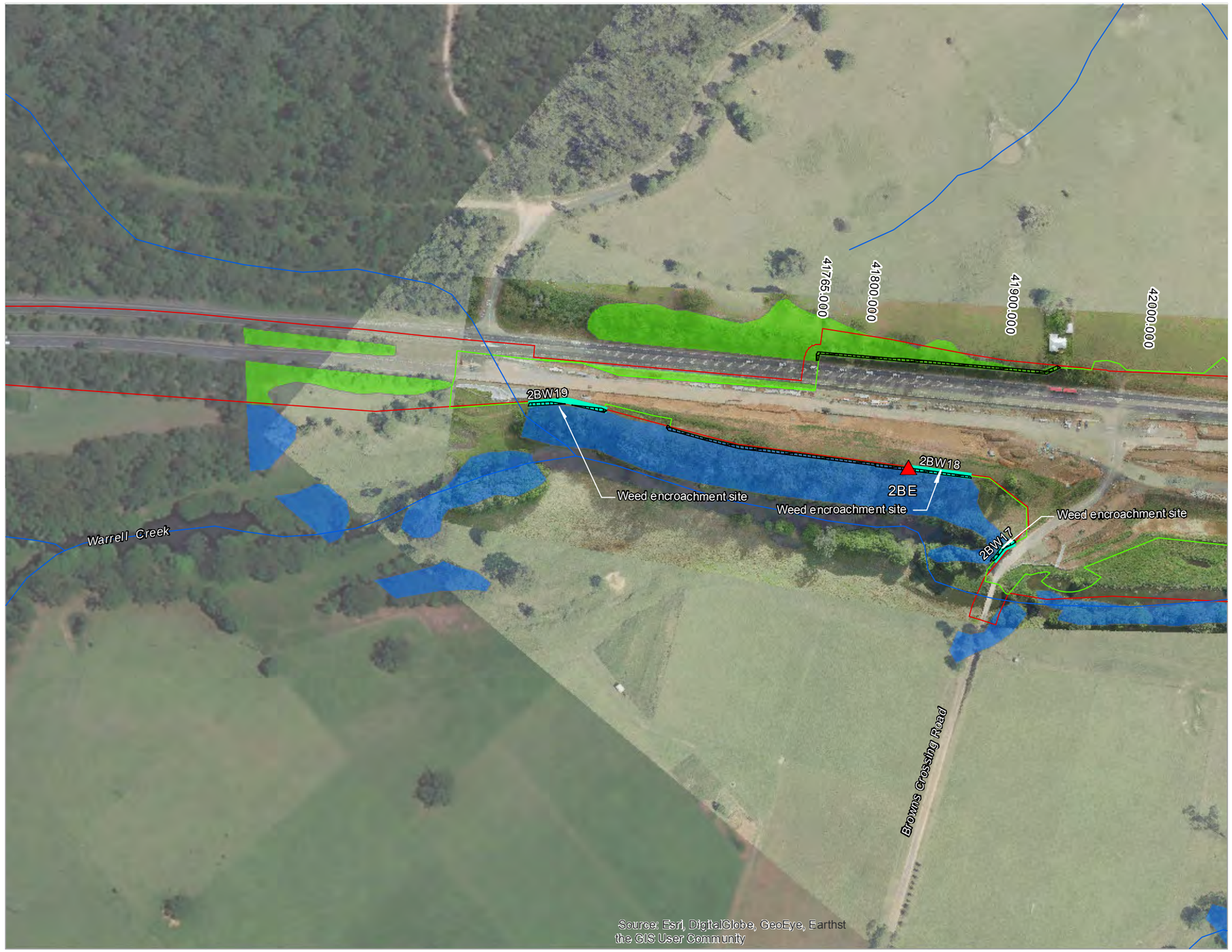
UPR	*Description*	*Date issued*	*Issued By*
2692-1153	First issue (draft)	14/11/2018	Grant McLean
2692-1156	Second issue (final)	16/11/2018	Grant McLean

Appendix A

GHFF Weed Survey Areas and Weed Infestation Levels (Spring 2018)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

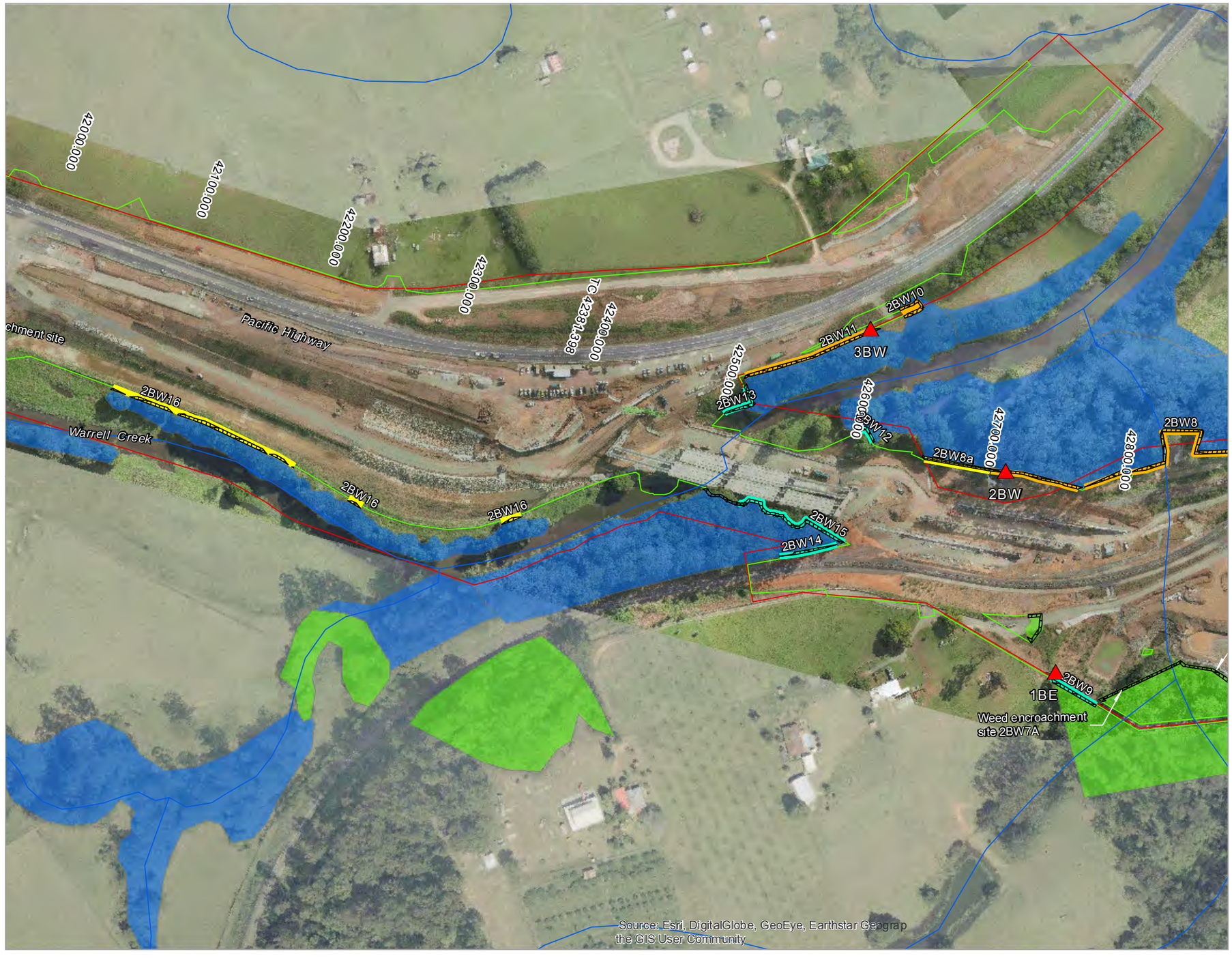
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

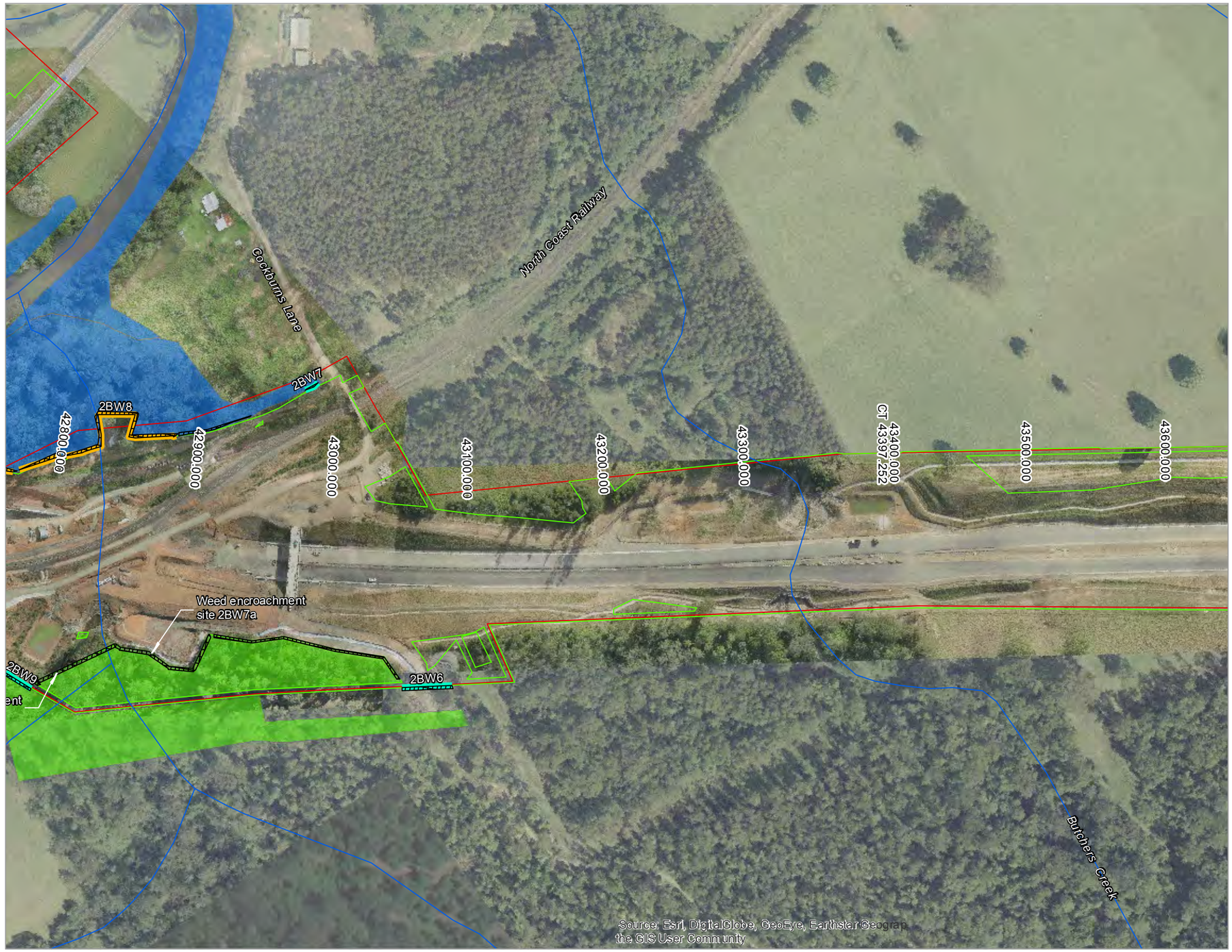
- High
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

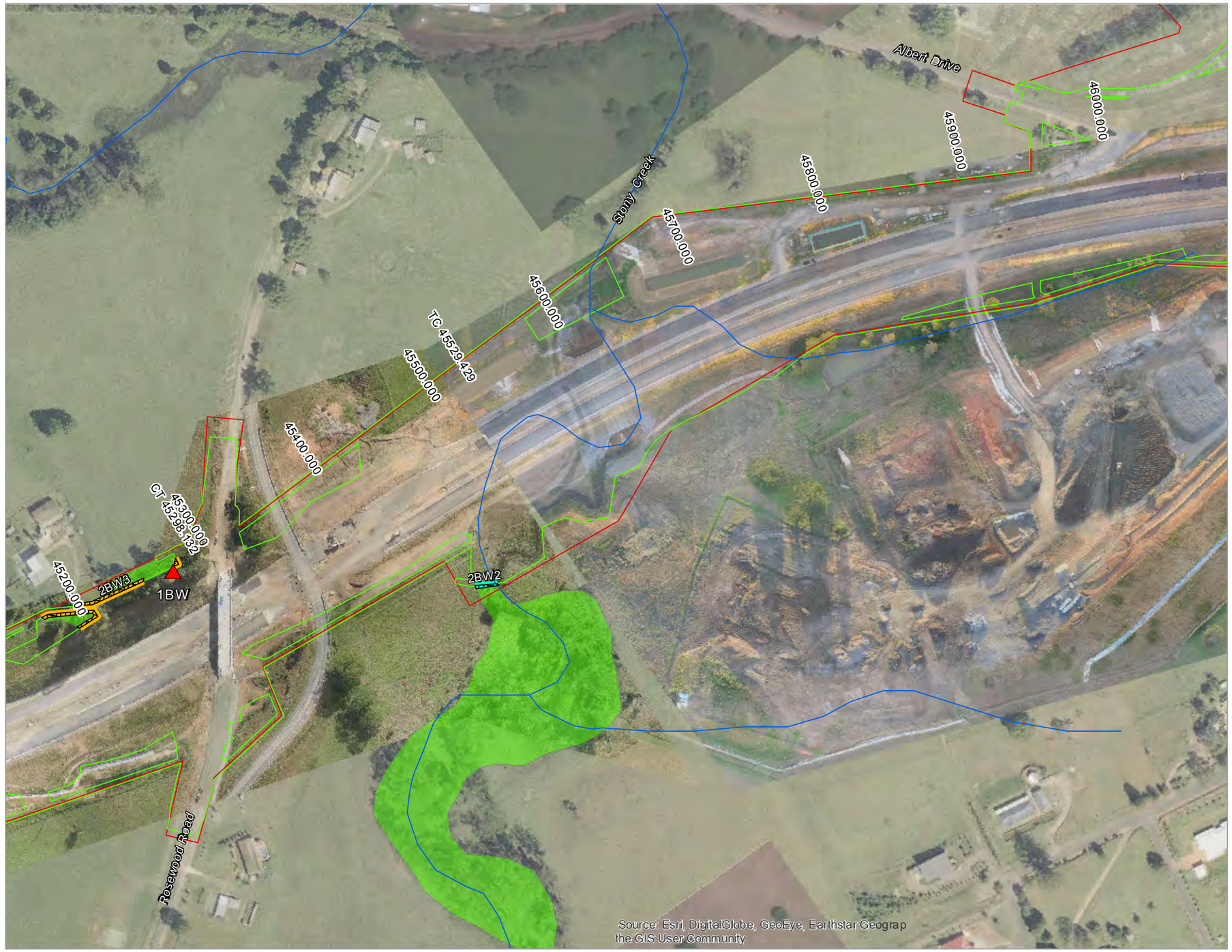
- Medium

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Vegetation

- Blackbutt Open Forest

Weed Site (Abundance)

- Medium

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

Weed Site (Abundance)

- Medium

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

Weed Site (Abundance)

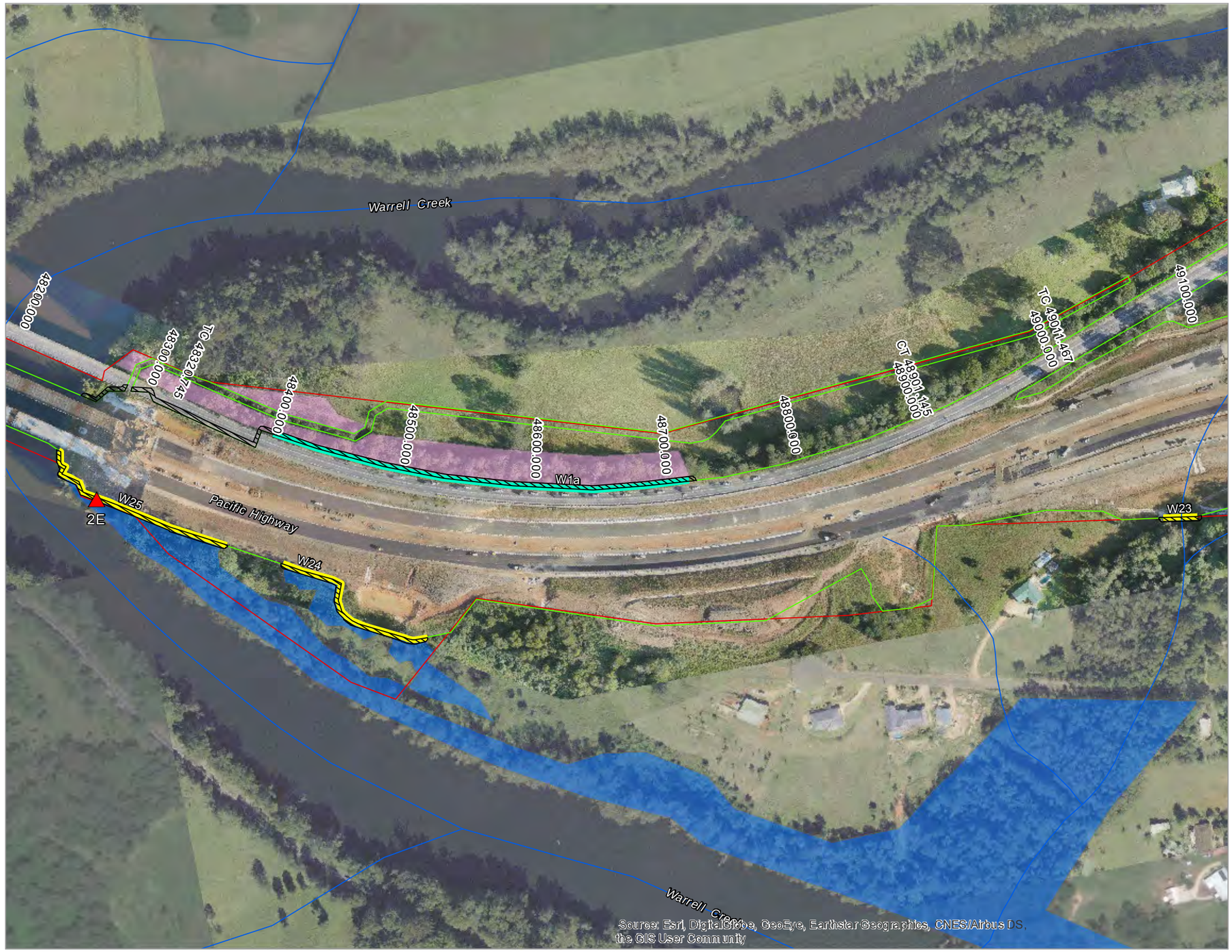
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

Weed Site (Abundance)

- High
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

- High
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Mixed Floodplain Forest (EEC)

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Moist Open Forest - White Mahogany / Grey Gum / Ironbark
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

- Medium

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

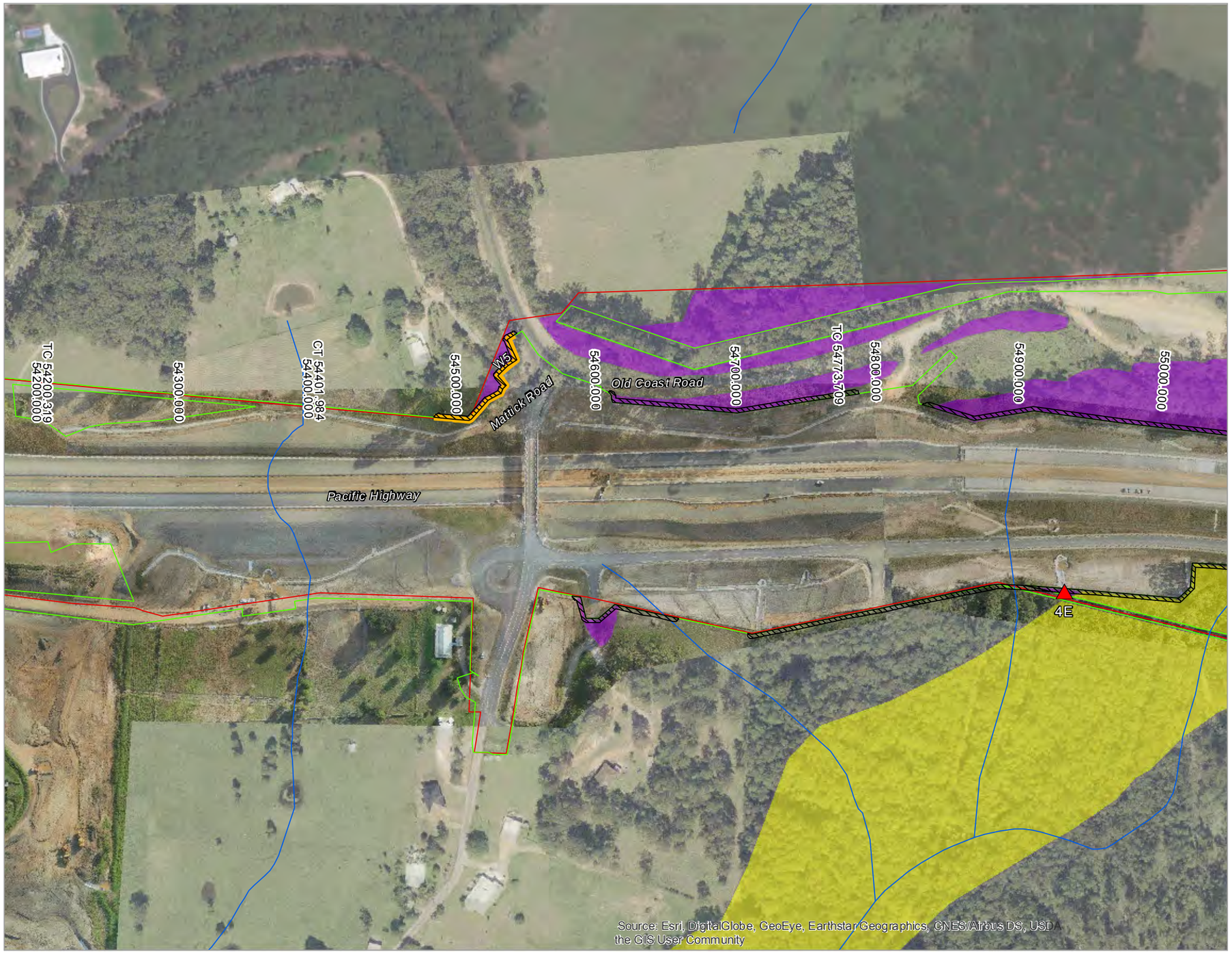
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

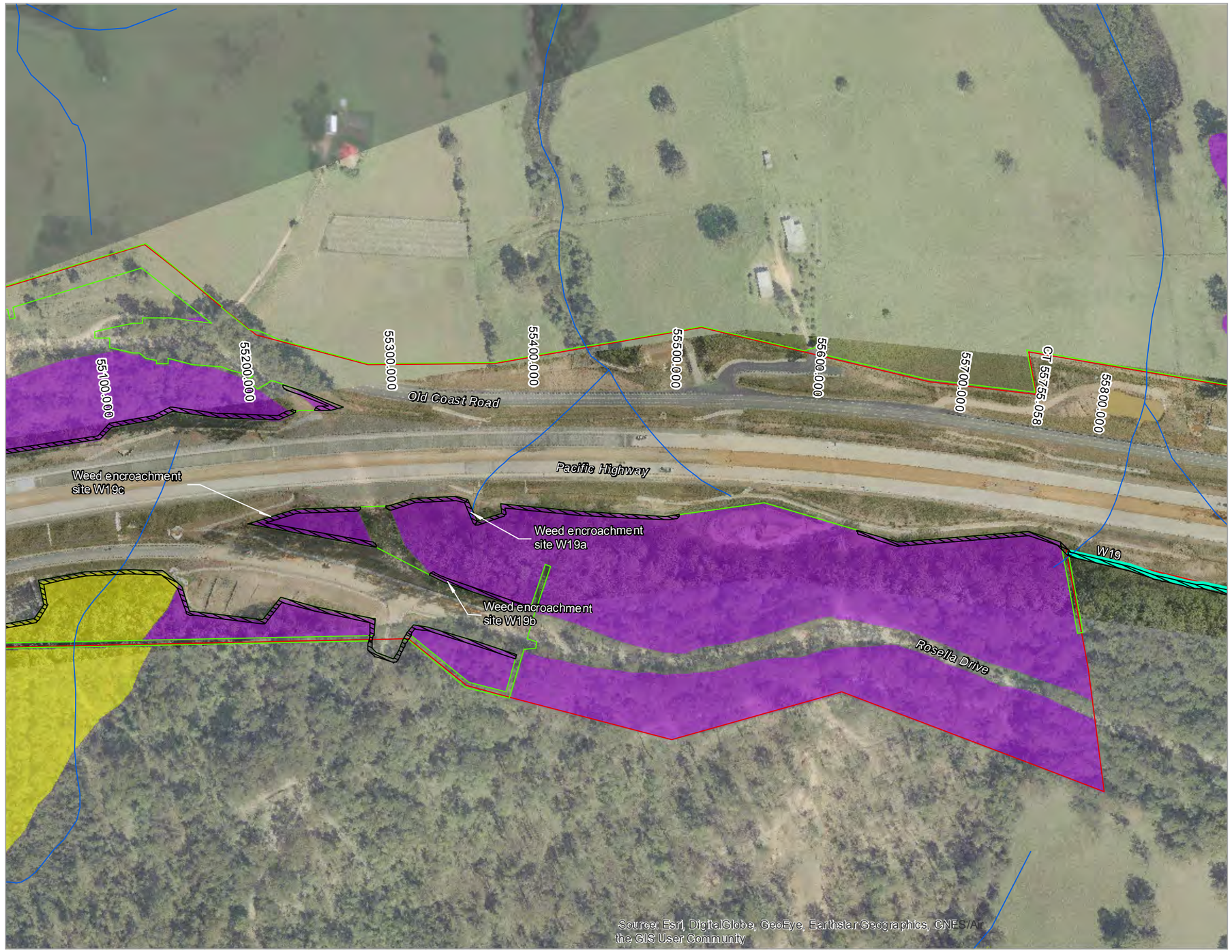
- Medium

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Blackbutt Open Forest
- Swamp Forest - Swamp Mahogany/ Paperbark (EEC)

Weed Site (Abundance)

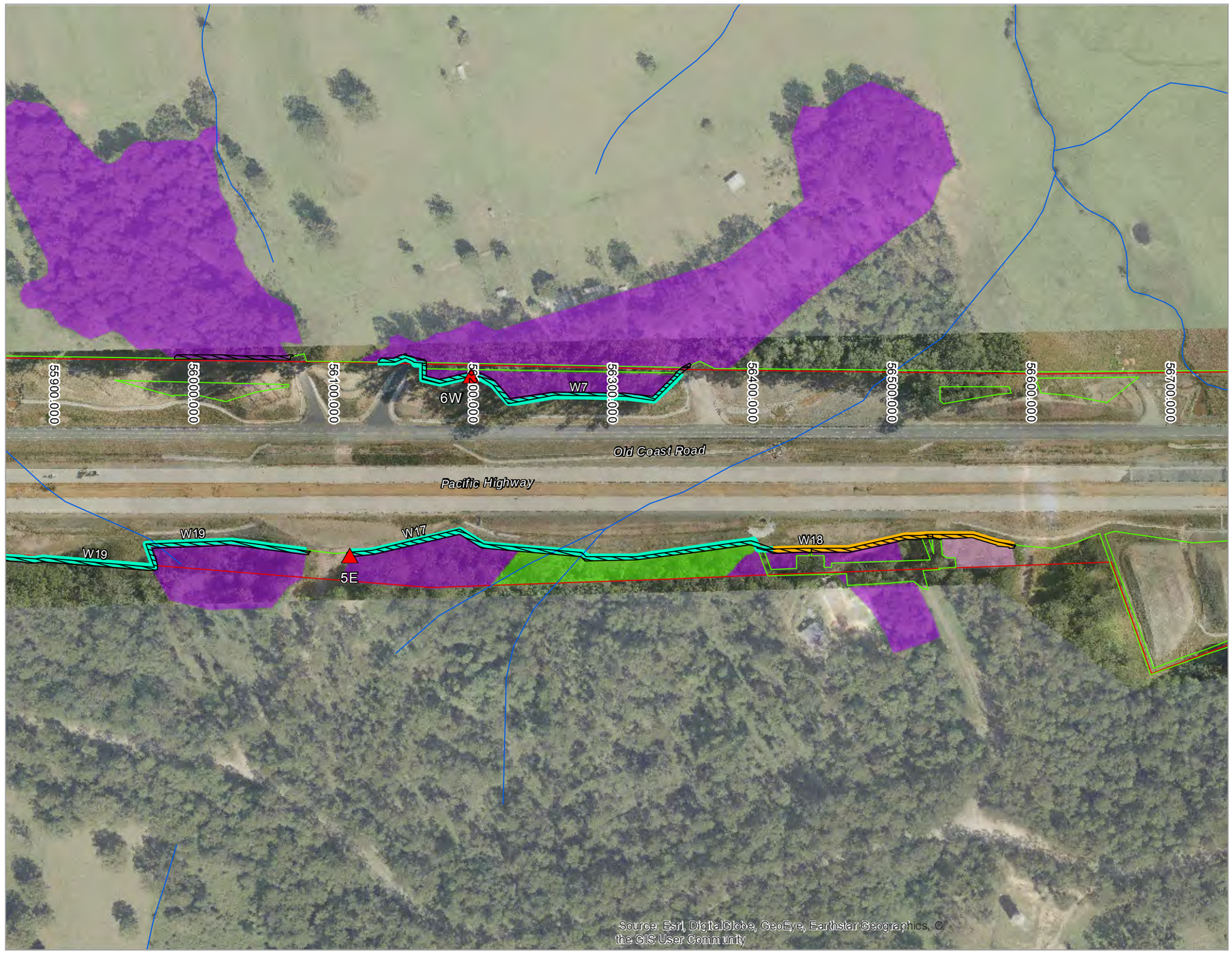
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum
- Moist Open Forest - White Mahogany / Grey Gum / Ironbark

Weed Site (Abundance)

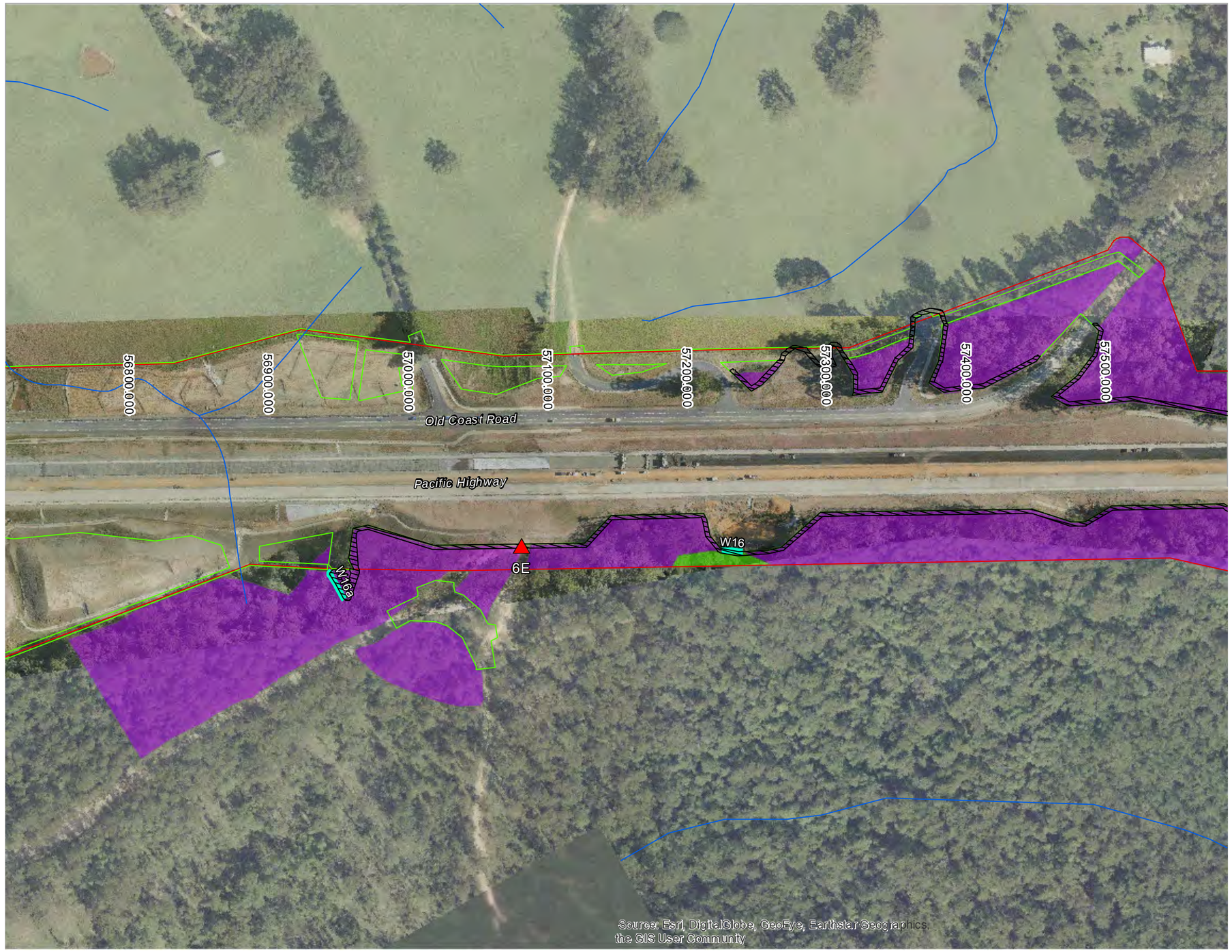
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

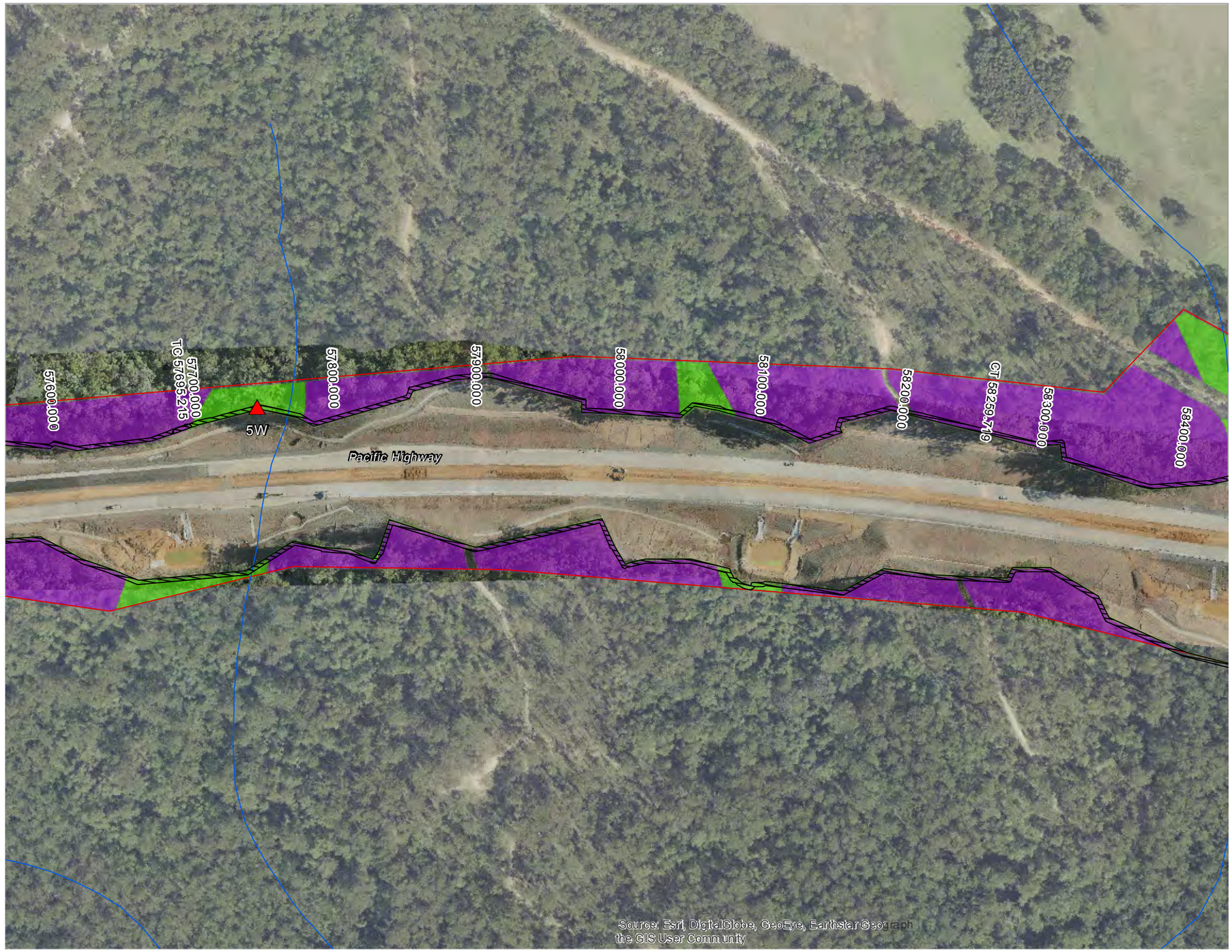
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

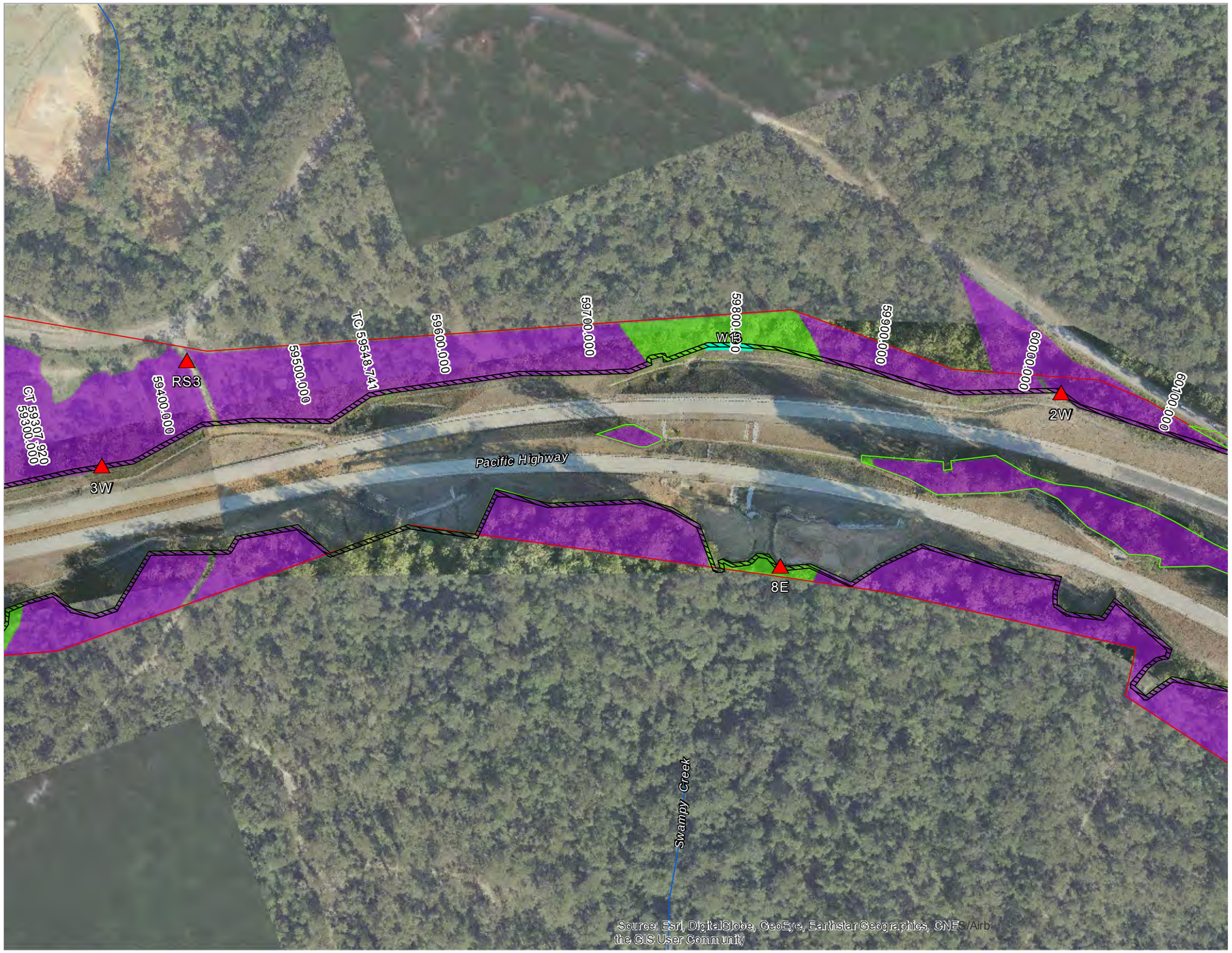
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: GJM Date: 14/11/2018
Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest

Weed Site (Abundance)

- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

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Source of base data: ESRI and AFJV

LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2A GBFF weed survey area

Vegetation

- Blackbutt Open Forest

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stages 2A and 2B)

Appendix B

GHFF Food Trees Species List

GHFF primary food tree species (blossom diet)			
Banksia integrifolia	Coastal Banksia	*Eucalyptus robusta*	Swamp Mahogany
Corymbia gummifera	Red Bloodwood	*Eucalyptus saligna*	Sydney Blue Gum
Corymbia intermedia	Pink Bloodwood	*Eucalyptus siderophloia*	Northern Grey Ironbark
Corymbia maculata	Spotted Gum	*Eucalyptus tereticornis*	Forest Red Gum
Corymbia variegata	Spotted Gum	*Grevillea robusta*	Silky Oak
Castanospermum australe	Black Bean	*Melaleuca quinquenervia*	Broad-leaved Paperbark
Eucalyptus pilularis	Blackbutt	*Syncarpia glomulifera*	Turpentine
GHFF secondary food tree species (blossom diet)			
Angophora costata	Smooth-barked Apple	*Eucalyptus grandis*	Flooded Gum
Angophora floribunda	Rough-barked Apple	*Eucalyptus propinqua*	Grey Gum
Eucalyptus acmenoides	White Mahogany	*Eucalyptus resinifera*	Red Mahogany
GHFF food tree species (fruit diet)			
Acmena smithii	Lilly Pilly	*Hedycarya angustifolia*	Native Mulberry
Alphitonia excelsa	Red Ash	*Livistona australis*	Cabbage Palm
Archontophoenix cunninghamiana	Bangalow Palm	*Maclura cochinchinensis*	Cockspur Thorn
Avicennia marina	Grey Mangrove	*Melia azedarach*	White Cedar
Cissus hypogaluca	Five-leaf Water Vine	*Melodinus australis*	Southern Melodinus
Dendrocnide excelsa	Giant Stinging Tree	*Morinda jasminoides*	Morinda
Dendrocnide photinophylla	Shining-lved Stinging Tree	*Pennantia cunninghamii*	Brown Beech
Diospyros pentamera	Myrtle Ebony	*Pittosporum undulatum*	Sweet Pittosporum
Diploglottis australis	Native Tamarind	*Planchonella australis*	Black Apple
Eucalyptus reticulatus	Blueberry Ash	*Podocarpus elatus*	Plum Pine
Ehretia acuminata	Koda	*Polyosma cunninghamii*	Featherwood
Elaeocarpus obovatus	Hard Quandong	*Rauwenhoffia leichardtii*	Zig Zag Vine
Ficus coronata	Creek Sandpaper Fig	*Rhodamnia argentea*	Malletwood
Ficus fraseri	Sandpaper Fig	*Syzygium australe*	Brush Cherry
Ficus macrophylla	Moreton Bay Fig	*Syzygium corynanthum*	Sour Cherry
Ficus obliqua	Small-leaved Fig	*Syzygium crebrinerve*	Purple Cherry
Ficus rubiginosa	Rusty Fig	*Syzygium luehmanii*	Riberry
Ficus superba	Deciduous Fig	*Syzygium. oleosum*	Blue Lilly Pilly
Ficus watkinsiana	Strangler Fig	*Schizomeria ovata*	Crabapple

Appendix C

Fixed Photo Point Results

Table C1 Rehabilitation Site Photo Points

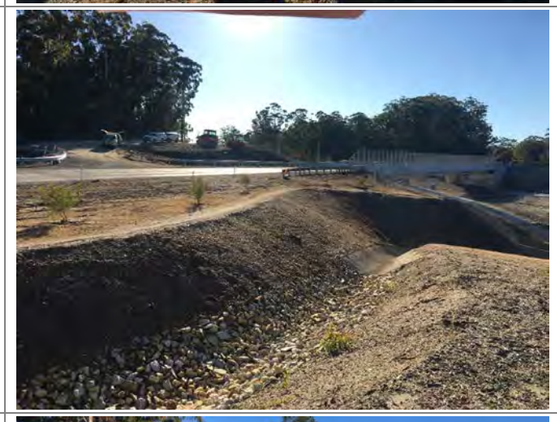
Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*	*Site Rehabilitation Winter Monitoring Event – July 2018*	*Site Rehabilitation Winter Monitoring Event – October 2018*
CH: 60800 West - Photo Point RS1 – view to the south (W:497272, N:6610243)				
CH: 60800 West - Photo Point RS2 – view to the north-east (E:497260, N:6610256)				
CH: 60800 West - Photo Point RS2 – view to the south-west (E:497260, N:6610256)				

Photo Monitoring Point Location	*Site Rehabilitation Summer Monitoring Event – February 2018*	*Site Rehabilitation Autumn Monitoring Event – May 2018*	*Site Rehabilitation Winter Monitoring Event – July 2018*	*Site Rehabilitation Winter Monitoring Event – October 2018*
CH: 59450 East - Photo Point RS3 - view to the east (E:496443, N:6609093), no rehabilitation works started at time of monitoring.				
CH: 59450 East - Site reference photo view to the west (E:496443, N:6609093), looking towards Photo Point #3, no rehabilitation works started at time of monitoring.				
CH: 60800 East - Photo Point RS4 (E:497440, N:6610248) - view to the west (no peg installed)				

Table C2 Weed Monitoring Fixed Photo Points (Stage 2A)

*Photo Point ID **	*Photo Point GPS Coordinates^*	*February 2018 photograph*	*May 2018 photograph*	*July 2018 photograph*	*October 2018 photograph*
1E	491906, 6598292				
1W	492671, 6600507				
2E	492372, 6599033				

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph	July 2018 photograph	October 2018 photograph
2W	496675, 6609675				
3E	492778, 6600567				
3W	496494, 6609010				

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph	July 2018 photograph	October 2018 photograph
4E	494575, 6605139				
4W	496131, 6608279				
5E	494960, 6606206				

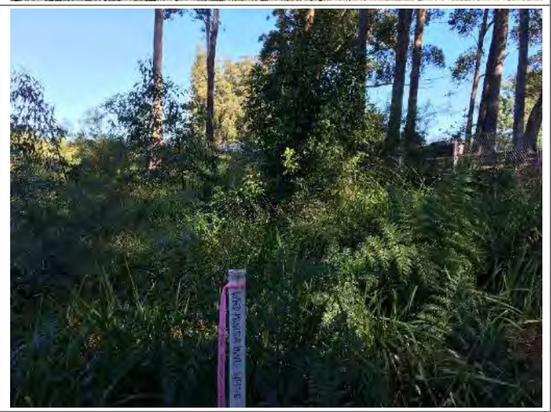
Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph	July 2018 photograph	October 2018 photograph
5W	495668, 6607684				
6E	495433, 6607052				
6W	494890, 6606346				

Photo Point ID *	Photo Point GPS Coordinates^	February 2018 photograph	May 2018 photograph	July 2018 photograph	October 2018 photograph
7E	496240, 6608213				
7W	494355, 6604185				
8E	496724, 6609444				

* number + side of alignment heading north: E=east, W=west.

Table C3 Weed Monitoring Fixed Photo Points (Stage 2B)

*Photo Point ID**	*Photo Point GPS Coordinates^*	*July 2018 photograph*	*October 2018 photograph*
1BE	489545, 6594390		
1BW	490778, 6596540		
2BE	488766, 6593840		

*Photo Point ID ****	*Photo Point GPS Coordinates^*	*July 2018 photograph*	*October 2018 photograph*
2BW	489407, 6594440		
3BE	490153, 6595330		
3BW	489268, 6594420		

Appendix 5: Summer 2019 Stage 2B monitoring report.

GeoLINK environmental management and design

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1 February 2019
Ref No: 2692-1161

Roads and Maritime Service
Sent via Email to: Kris.HINCKS@rms.nsw.gov.au

Attention: Mr Kris Hincks

Dear Kris

WC2NH Stage 2B GHFF Habitat Monitoring – Summer 2019

Introduction

This report presents the results of the third quarterly (summer 2019) Grey-Headed Flying-fox (GHFF) habitat monitoring event for Stage 2B (chainage 41700 to 47700 - refer to **Appendix A**) of Warrell Creek to Nambucca Heads Highway Upgrade (WC2NH or the Project). Quarterly GHFF habitat monitoring is required for one year after the opening of each section of WC2NH to traffic in accordance with the *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program – Stage 2: Warrell Creek to Nambucca Heads* (Benchmark Environmental Management, 2014).

The *Warrell Creek to Nambucca Heads Flying-fox Management Plan* (Sinclair Knight Merz, 2017) recognised that the quality of vegetation adjacent to the Project area could be detrimentally affected by invasion of noxious and environmental weeds. A main goal identified for management during operation of the Project is '*no reduction of the quality of flying-fox habitats adjacent to the Project corridor due to the operation of the Project and to minimise the impact of edge effects'* (Sinclair Knight Merz, 2017).

Methodology

The WC2NH GHFF habitat monitoring includes the following components:

1. Monitoring of identified revegetation/ rehabilitation areas to ensure the establishment/ restoration of seedlings and plants.
2. Monitoring both revegetation/ rehabilitation areas and other habitat areas adjacent to the Project to manage invasion of noxious and environmental weeds.

There are no GHFF revegetation/ rehabilitation areas associated with Stage 2B, therefore the subject monitoring event exclusively related to the second component of the monitoring program (henceforth referred to as 'weed monitoring').

Weed Monitoring

The Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval defined GHFF habitat as habitat consisting of:

- Swamp Forest - Swamp Mahogany/ Paperbark.
- Moist Open Forest - Flooded Gum.
- Moist Open Forest - White Mahogany/ Grey Gum/ Ironbark.
- Mixed Floodplain Forest.
- Open Forest - Blackbutt.

All instances of the above plant communities occurring along the outside of the Stage 2B Project clearing corridor were targeted during the field surveys. Within two metres of the cleared edge of these habitat areas the following data was recorded in relation to weeds:

- Date and time of monitoring.
- Weed abundance and composition.
- Evidence of management and control of noxious and environmental weeds.

Weed abundance for individual species was measured using modified Braun-Blanquet cover classes between 1 and 5: 1 (<5%), 2 (6-25%), 3 (26-50%), 4 (51-75%), and 5 (76-100%). Abundance scores for identified weed sites were classified based on the categories in **Table 1**. Priority weed sites for management were identified based on species present and the percentage cover, prioritising *Biosecurity Act 2015* listed species and weeds with potential to degrade flying-fox foraging habitat values. The field surveys were undertaken by GeoLINK ecologists Jessica O'Leary and Frank Makin on 22 January 2019 between 8:00 am to 12:00 pm (eight person hours in total).

Table 1 Weed Abundance Classification for Weed Sites

Noxious/ Environmental Weed Cover (%)	*Weed Abundance Classification*
0-10	NA
11-39	Low
40-69	Medium
70-100	High

Photos were taken at the fixed photo points established during the winter 2018 weed monitoring for Stage 2B. Locations of the fixed photo points are listed in **Table2**.

Table 2 Locations of Fixed Photo Points

*Photo Point ID**	*Photo Point GPS Coordinates^*	*Notes on Photo Direction*	*Vegetation Type*	*Corresponding Weed Infestation*
1BE	489545, 6594390	Looking north	Moist Open Forest - Flooded Gum	2BW9
1BW	490778, 6596540	Looking south	Moist Open Forest - Flooded Gum	2BW3
2BE	488766, 6593840	Looking south-west	Mixed Floodplain Forest	2BW18
2BW	489407, 6594440	Looking north-east	Mixed Floodplain Forest	2BW8
3BE	490153, 6595330	Looking south	Moist Open Forest - Flooded Gum	Not applicable
3BW	489268, 6594420	Looking south	Mixed Floodplain Forest	2BW11

** number plus side of alignment heading north: E=east, W=west.*

^ UTM eastings, northings; Zone 56J

Results and Discussion

Occurrence of noxious and/or environmental weeds was recorded at 23 sites (identified as low, medium or high) within the edge of GHFF habitat adjacent to the Project area. These weed occurrences are shown in **Appendix A** and listed in **Table 3**. Photographs of GHFF habitat areas taken from the fixed photo points are shown in **Appendix B.**

A total of 21 noxious and environmental weed species were recorded. Blackberry (*Rubus fruticosus*), Fireweed (*Senecio madagascariensis*) and Lantana (*Lantana camara*) were recorded on-site and are listed as priority weed species for the North Coast of NSW under the *Biosecurity Act 2015*. The primary management duty for these is they '*must not be imported into the state or sold*'.

Overall the summer 2019 monitoring event has recorded an increase in weed species presence and abundance within the exiting weed survey areas. This is consistent with the expected summer growth period for the mid-north coast region. Two new weed infestation areas were recorded (2BW4a and 2BW20) which contain low weed abundance infestations.

Broad-leaved Paspalum (*Paspalum mandiocanum*), Setaria (*Seteria sphacelata*), Lantana and Large-leaved Privet (*Ligustrum lucidum*) were recorded within GHFF habitat areas at the highest density. They were also the dominant weed species in at infestations with 'Medium' or 'High' weed abundance levels (refer to Error! Reference source not found.**3**).

One weed survey area was nominated as a 'High' priority weed management area and four sites were nominated as 'Medium' weed management priority areas. Weed management priority areas are listed below and shown in **Appendix C**:

- 2BW8a - High weed management priority
- 2BW1 - Medium weed management priority
- 2BW8 - Medium weed management priority
- 2BW13 - Medium weed management priority
- 2BW16 - Medium weed management priority.

The summer 2019 monitoring event has recorded a slight increase from three medium management priority sites, recorded during the spring 2018 monitoring event, to four within the current monitoring event. These areas should be targeted during weed management works. To date, no management of weed infestation areas has be recorded during field surveys.

No significant change to the structure or composition of GHFF habitat has been recorded during fixed photo point monitoring. No exotic vines with the potential to inhibit native regeneration and smother the canopy of intact GHFF habitat were observed.

Table 3 Abundance and Composition of Noxious and/or Environmental Weeds Infestations at Stage 2B

Weed Site No.	*Chainage (side of highway)*	*Summer 2019 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Summer 2019 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
2BW1	46180 – 46190 (east)	**Setaria (2),** Camphor Laurel (1), **Lantana (1), Tobacco Bush (1), Broad-leaved Paspalum (2)**	Open Forest - Blackbutt	High	Medium	Medium	**Additional weed species present to those recorded during the previous monitoring event (spring 2018).**	No evidence of weed control	Medium
2BW2	45440 – 45450 (east)	Broad-leaved Paspalum (2), Camphor Laurel (1), **Setaria (3)**	Moist Open Forest - Flooded Gum	Low	Low	Low	Small creek and riparian zone within survey area. **Increase in abundance of Setaria since the previous monitoring event (spring 2018).**	No evidence of weed control.	Low
2BW3	45170 – 45280 (west)	**Broad-leaved Paspalum (2),** Camphor Laurel (2), **Setaria (2),** Blackberry (1), Small-leaved Privet (1), Lantana (1), **Fleabane**	Moist Open Forest - Flooded Gum	Medium	Medium	Medium	**Changes from the previous monitoring event (spring 2018) include:** ▪ **A decrease in Broad-leaved Paspalum cover.** ▪ **An increase in Setaria cover.** ▪ **Additional weed species recorded.**	No evidence of weed control	Low

Weed Site No.	Chainage (side of highway)	Summer 2019 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Summer 2019 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
		(1), Balloon Cotton Bush (1)							
2BW4a	**44230 – 44280 (west)**	**Camphor Laurel (1), Lantana (1), Setaria (1)**	**Open Forest - Blackbutt**	**Not recorded**	**Not recorded**	**Low**	**New weed infestation area with low abundance of weeds**	**N/A**	**Low**
2BW4**b**	44100 – 44200 (east)	Broad-leaved Paspalum (3), Purple Top (1), Rhodes Grass (1), Camphor Laurel (1), Whisky Grass (1), **Setaria (1)**	Open Forest - Blackbutt	Medium	Low	Low	**Seteria now recorded during summer 2019 (not previously recorded for this site)**	No evidence of weed control	Low
2BW5	43960 – 44030 (east)	Broad-leaved Paspalum (3), Balloon Cotton Bush (1), Crofton Weed (1), Fireweed* (1), **Setaria (1)**	Moist Open Forest - Flooded Gum	Medium	Medium	Medium	No GHFF habitat vegetation exists immediately adjacent to the weed survey area. The weeds recorded within 2BW5 pose low risk of encroachment into the retained Moist Open Flooded Gum Forest which is 15 m from the weed infestation area.	No evidence of weed control	Low
2BW6	43050 – 43090	Lantana* (1), Broad-	Moist Open Forest -	Low	Low	Low	No change since the previous monitoring	No evidence of weed	Low

Weed Site No.	Chainage (side of highway)	Summer 2019 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Summer 2019 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
	(east)	leaved Paspalum (1)	Flooded Gum				event (spring 2018)	control	
2BW7	42980 – 42990 (west)	Lantana* (2), Large-leaved Privet (1), Broad-leaved Paspalum (1)	Mixed Floodplain Forest	Low	Low	Low	No change since the previous monitoring event (spring 2018)	No evidence of weed control	Low
2BW7a	42800 - 42900	Lantana (1)	Moist Open Forest - Flooded Gum	Not recorded	Low	Low	No change since the previous monitoring event (spring 2018)	No evidence of weed control	Low
2BW8	42700 – 42880 (west)	Lantana* (3), Large-leaved Privet (3), Camphor Laurel (1), Winter Senna (1), Wild Tobacco Bush (1), Broad-leaved Paspalum (1), Setaria (1), **Rhodes Grass (1), Annual Ragweed**	Mixed Floodplain Forest	Medium	Medium	Medium	During spring 2BW8 was split into two sections (see 2BW8a below) to identify area of high weed activity. **Additional weed species recorded during summer 2019.**	No evidence of weed control	Medium

Weed Site No.	Chainage (side of highway)	Summer 2019 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Summer 2019 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
		(1), Fleabane (1), Setaria (1), Spear Thistle (1), Paddy's Lucerne (1)							
2BW8a	42650 - 42700	Large-leaved Privet (4), Lantana (3), Tobacco Bush (2), **Broad-leaved Paspalum (2), Setaria (1)**	Mixed Floodplain Forest	Medium	High	High	**Additional weed species recorded during summer 2019.**	No evidence of weed control	High
2BW9	42770 – 42800 (east)	Broad-leaved Paspalum (2), Lantana* (1), Blue Billygoat Weed (1)	Moist Open Forest - Flooded Gum	Low	Low	Low	No change since the previous monitoring event (spring 2018)	No evidence of weed control	Low
2BW10	42620-42630 (east)	Setaria (3), Cobblers Pegs (1), Wild Tobacco Bush (1), **Lantana (2),**	Mixed Floodplain Forest	Medium	Medium	Medium	**Additional weed species recorded during summer 2019.**	Evidence of weed control.	Low

Weed Site No.	*Chainage (side of highway)*	*Summer 2019 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Summer 2019 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
		Annual Ragweed (1)							
2BW11	42500 – 42600 (west)	Broad-leaved Paspalum (3), Lantana* (1), Tobacco Bush (1), **Annual Ragweed (1), Setaria (1), Paddy's Lucerne (1)**	Mixed Floodplain Forest	Medium	Medium	Medium	**Additional weed species recorded during summer 2019.**	No evidence of weed control	Low
2BW12	42600 – 42610 (west)	Lantana* (3), Broad-leaved Paspalum (2), Wild Tobacco Bush (1), **Setaria (2) Purple Top**	Mixed Floodplain Forest	Low	Low	Low	**Additional weed species recorded during summer 2019.**	No evidence of weed control	Low
2BW13	42500 – 42510 (west)	Large-leaved Privet (2), **Lantana* (3), Small-leaved Privet (2)**	Mixed Floodplain Forest	Low	Low	**Medium**	**Changes from the previous monitoring event (spring 2018) include:** ▪ **Increase in abundance of Lantana and Small-leaved Privet.** ▪ **Overall weed**	No evidence of weed control	**Medium**

Weed Site No.	Chainage (side of highway)	Summer 2019 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Summer 2019 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
							abundance has increased from low to medium.		
2BW14	42570 – 42600 (east)	Large-leaved Privet (2), Broad-leaved Paspalum (1)	Mixed Floodplain Forest	Low	Low	Low	No change since the previous monitoring event (spring 2018)	No evidence of weed control	Low
2BW15	42530 – 42600 (east)	Lantana* (2), Large-leaved Privet (2), Small-leaved Privet (2), Broad-leaved Paspalum (1), Camphor Laurel (saplings) (1)	Mixed Floodplain Forest	Low	Low	Low	No change since the previous monitoring event (spring 2018)	No evidence of weed control	Low
2BW16	42090 – 42220, 42290, 42390 (east)	Broad-leaved Paspalum (4), Setaria **(3)**, Lantana* (1), Camphor Laurel (1), Wild Tobacco	Mixed Floodplain Forest	High	High	High	**Changes from the previous monitoring event (spring 2018) include:** ▪ **Fireweed was not recorded during summer 2019** ▪ **Seteria has increase in abundance.**	No evidence of weed control	Medium

Weed Site No.	Chainage (side of highway)	Summer 2019 Weed Composition (Cover Class^)	GHFF Habitat Type (Plant Community)	Winter 2018 Weed Abundance^^	Spring 2018 Weed Abundance^^	Summer 2019 Weed Abundance^^	Comments	Evidence of Management and Control	Weed Management Priority
		Bush (1), **Blue Billy Goat (1), Purple Top (1), Croftons Weed (1), Fleabane (1), Cobblers Pegs (1)**					▪ **Additional weed species recorded.**		
2BW17	41900 – 41920 (east)	Small-leaved Privet (2), Setaria (2), Lantana (1), Paddy's Lucerne (1), Tobacco Plant (1)	Mixed Floodplain Forest	Not recorded	Low	Low	No change since the previous monitoring event (spring 2018)	No evidence of weed control	Low
2BW18	41830 – 41880 (east)	Lantana (2), Camphor Laurel (2), Paddy's Lucerne (1), White Passionflower (1)	Mixed Floodplain Forest	Not recorded	Low	Low	Weeds recorded at this survey area pose minimal risk of encroachment into the adjacent Mixed Floodplain Forest which is >5 m from the weed infestation area.	No evidence of weed control	Low
2BW19	41560 – 41620 (east)	Blackberry (2), Lantana (2), Broad-leaved Paspalum	Mixed Floodplain Forest	Not recorded	Low	Low	Grass species currently being grazed.	No evidence of weed control	Low

Weed Site No.	*Chainage (side of highway)*	*Summer 2019 Weed Composition (Cover Class^)*	*GHFF Habitat Type (Plant Community)*	*Winter 2018 Weed Abundance^^*	*Spring 2018 Weed Abundance^^*	*Summer 2019 Weed Abundance^^*	*Comments*	*Evidence of Management and Control*	*Weed Management Priority*
		(2), Paddy's Lucerne (2), Annual Ragweed (1), Tobacco Bush (1)							
2BW20	**41765-41960 (west)**	**Setaria (1), Lantana (1), Tobacco Bush (1)**	**Moist Open Forest - Flooded Gum**	**Not recorded**	**Not recorded**	**Low**	**New weed infestation area with low abundance of weeds**	**N/A**	**Low**

^ *Modified Braun-Blanquet cover classes of 1=<5%, 2=6-25%, 3=26-50%, 4=51-75%, and 5=76-100%.*

^^ Refer to Table 2.

* Denotes *Biosecurity Act 2015* listed priority weed species. Lantana, Blackberry and Fireweed are listed as Weeds of National Significance and as priority weed species for the North Coast of NSW. They must not be imported into the State or sold.

Bold text denotes change from spring 2018 monitoring event.

Recommendations and Conclusions

Weed sites 2BW1, 2BW8, 2BW8a, 2BW13 and 2BW16 are key target weed management areas to reduce degradation to GHFF habitat. At these sites, there is the potential for Lantana, Large-leaved Privet and Small-leaved Privet to alter community structure and inhibit regeneration. Management of the weeds at these sites would be consistent with the key objectives of the WC2NH *Weed and Pathogen Management Plan* (GeoLINK 2015) which is to '*ensure the Project avoids, suppresses and controls the spread of all weeds, plant pathogens and invasive species to ensure that impacts to the environment are minimised.*'

Weed sites primarily with dense Setaria and Broad-leaved Paspalum or lower profile herbaceous species (at sites 2BW3, 2BW5, 2BW10 and 2BW11) should be considered somewhat lower priorities for management than sites comprising medium or high infestations of Lantana and/ or Large-leaved or Small-leaved Privet for the following reasons:

- There may be a lower likelihood of weed management success (it is difficult to remove these species (particularly the grasses) successfully from degraded communities that have a suitable semi-shaded understorey environment); and
- Being understorey weed species that occur in disturbed environments, edge grass and herbaceous weed species have a low potential to alter either the forest structure or regeneration potential, and hence the quality of relatively intact GHFF habitat.

Please contact the undersigned if require any further information.

Yours sincerely
GeoLINK

Jessica O'Leary
Ecologist

References

Benchmark Environmental Management (2014). *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program. Stage 2: Warrell Creek to Nambucca Heads*. Report to Roads and Maritime Services.

GeoLINK (2015). *Weed and Pathogen Management Plan: Warrell Creek to Nambucca Heads Upgrade of the Pacific Highway.* Unpublished report to Acciona and Ferrovial Joint Venture/ Roads and Maritime Services. GeoLINK Consulting, Coffs Harbour.

Sinclair Knight Merz (2017). *Warrell Creek to Nambucca Heads Upgrade of the Pacific Highway; Flying-fox Management Plan.* Report to Roads and Maritime Services.

Issue Log

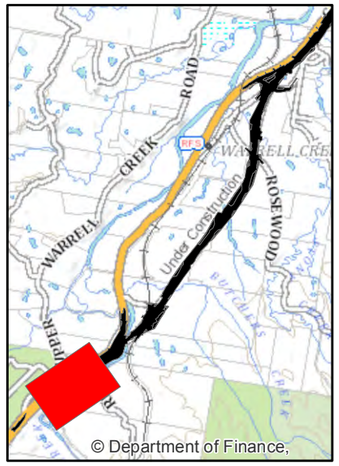
UPR	*Description*	*Date issued*	*Issued By*
2692-1161	First issue	01/02/2019	Jessica O'Leary

Appendix A

GHFF Weed Survey Areas and Weed Infestation Levels (Summer 2019)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

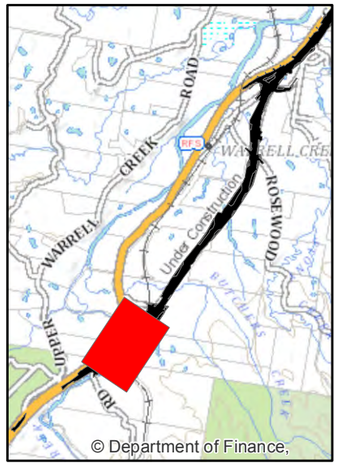
- High
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

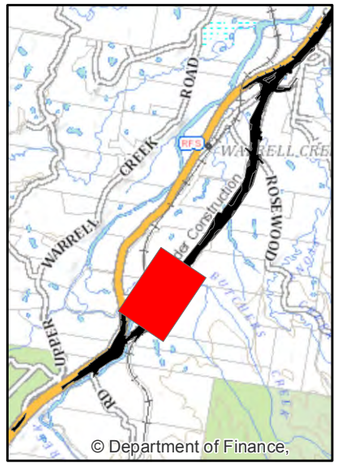
- High
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

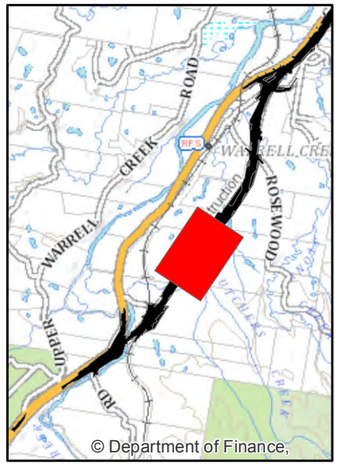
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

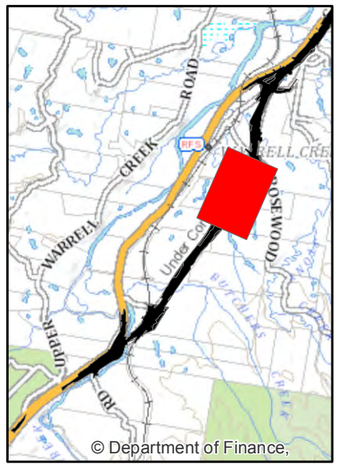
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Vegetation

- Blackbutt Open Forest
- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

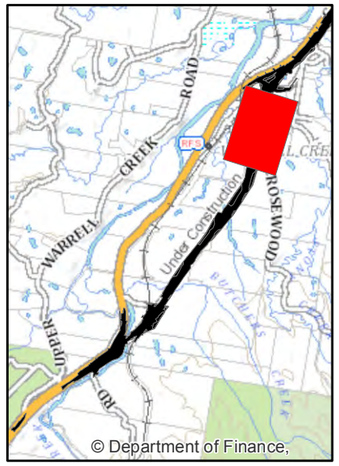
- Medium
- Low

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Moist Open Forest - Flooded Gum

Weed Site (Abundance)

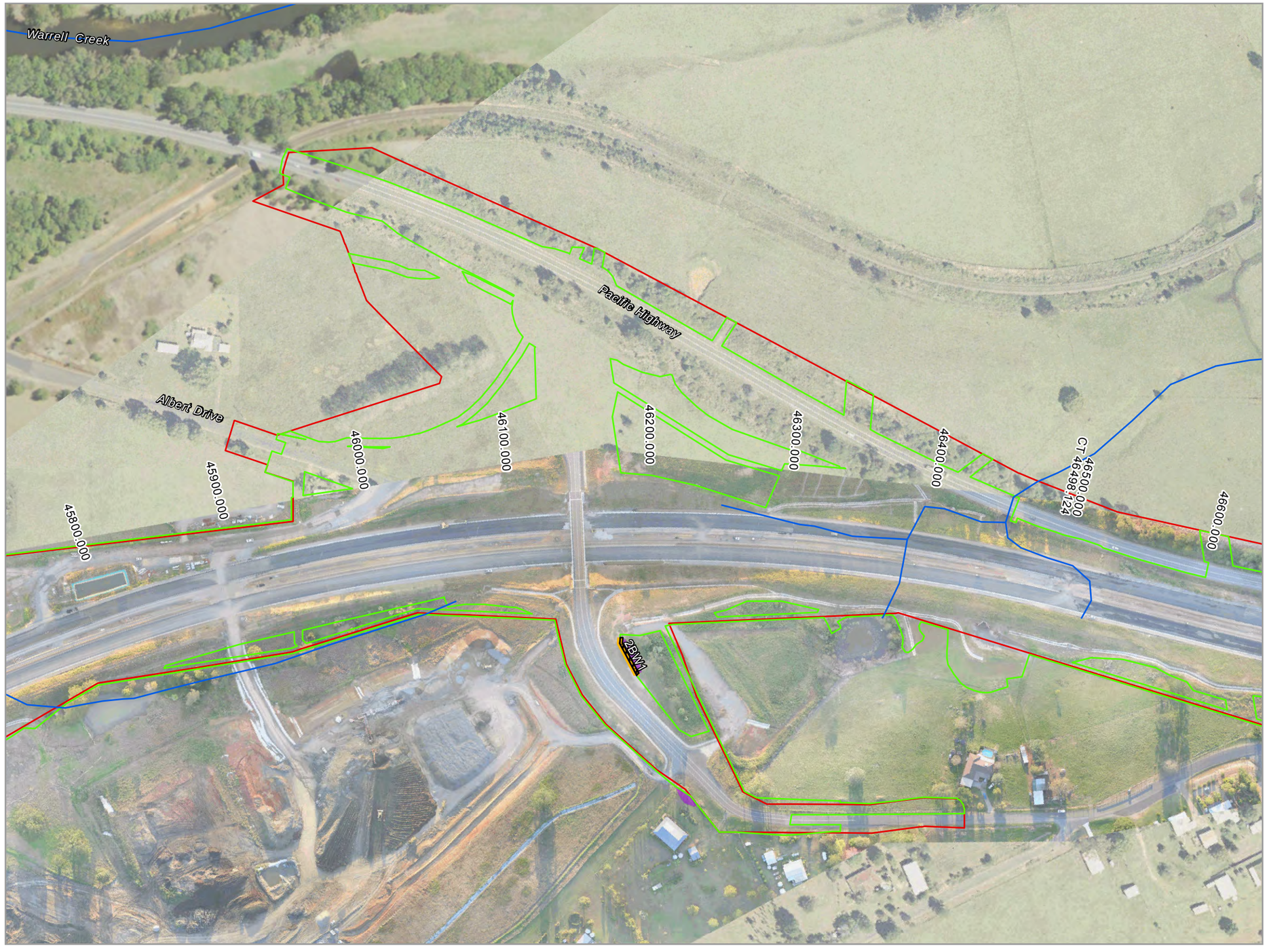
- Medium
- Low

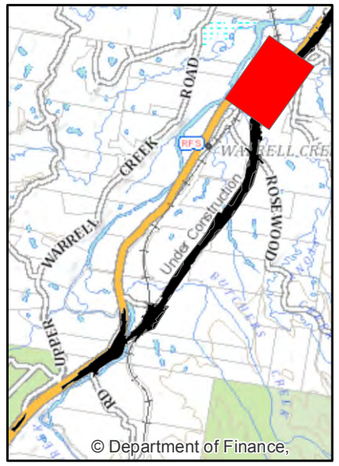
0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV





LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Vegetation

- Blackbutt Open Forest

Weed Site (Abundance)

- Medium

0 60

GHFF Weed Survey Areas and Weed Infestation Levels (Stage 2B)

Appendix B

Fixed Photo Point Results

Table B1 Weed Monitoring Fixed Photo Points (Stage 2B)

*Photo Point ID **	*Photo Point GPS Coordinates^*	*July 2018 photograph*	*October 2018 photograph*	*January 2019 photograph*
1BE	489545, 6594390			
1BW	490778, 6596540			
2BE	488766, 6593840			

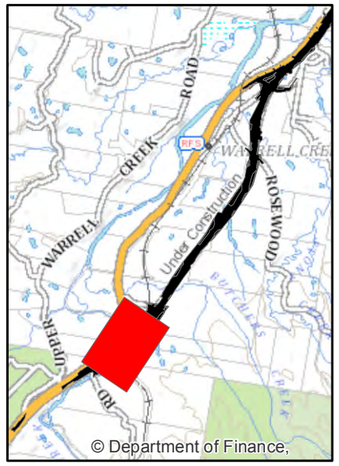
Photo Point ID *	Photo Point GPS Coordinates^	July 2018 photograph	October 2018 photograph	January 2019 photograph
2BW	489407, 6594440			
3BE	490153, 6595330			
3BW	489268, 6594420			

Appendix C

Weed Management Priority Areas

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV



LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Management Priority

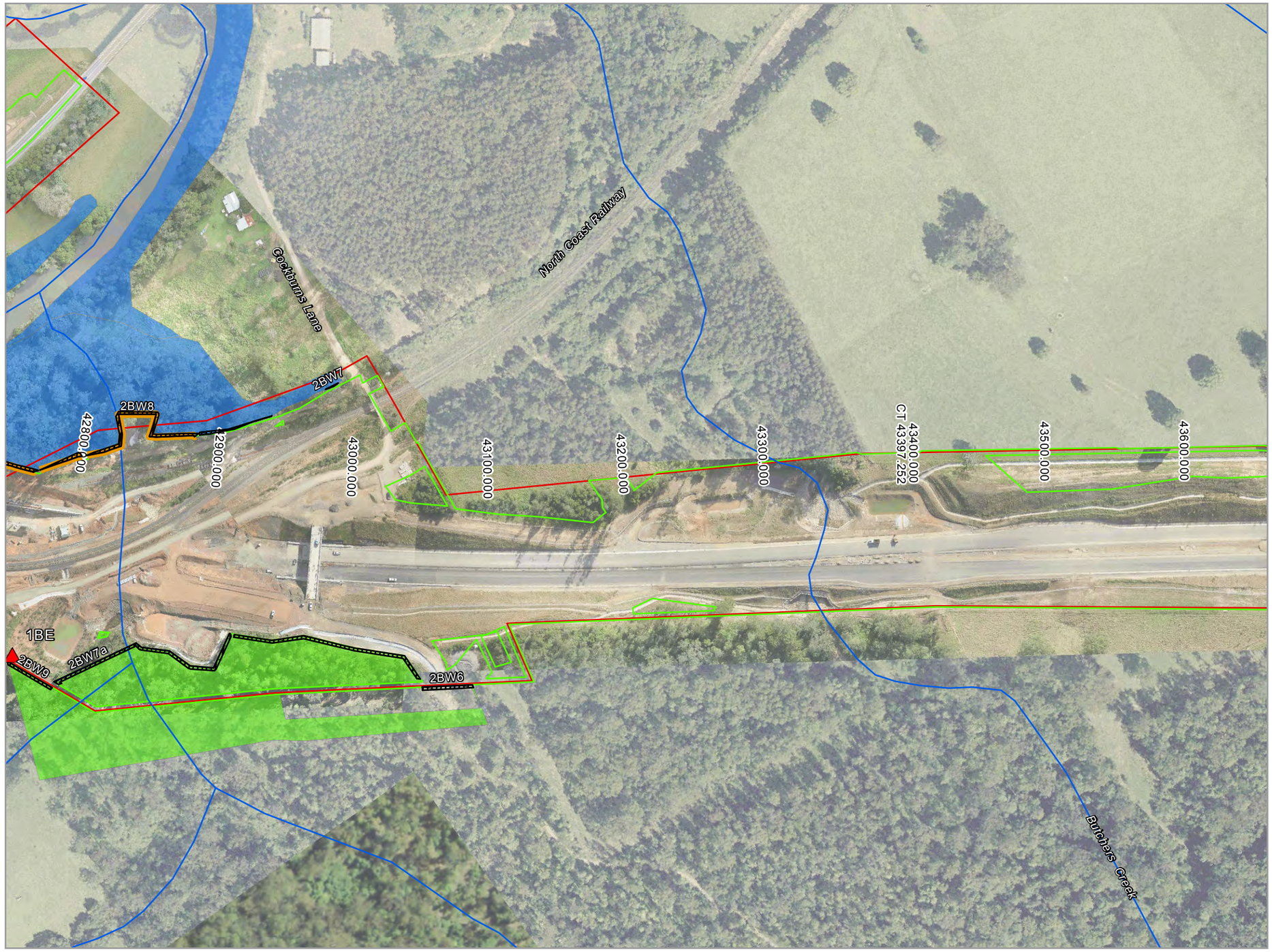
- High
- Medium

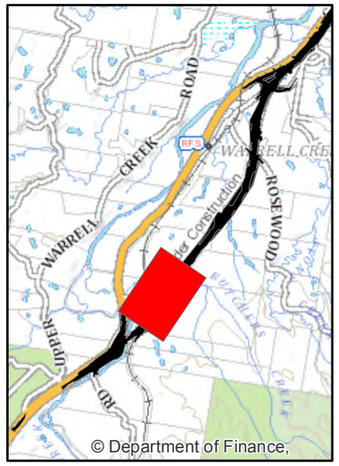
0 60

Weed Management Priority Areas (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV





LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area
- Fixed photo point

Vegetation

- Mixed Floodplain Forest (EEC)
- Moist Open Forest - Flooded Gum

Weed Management Priority

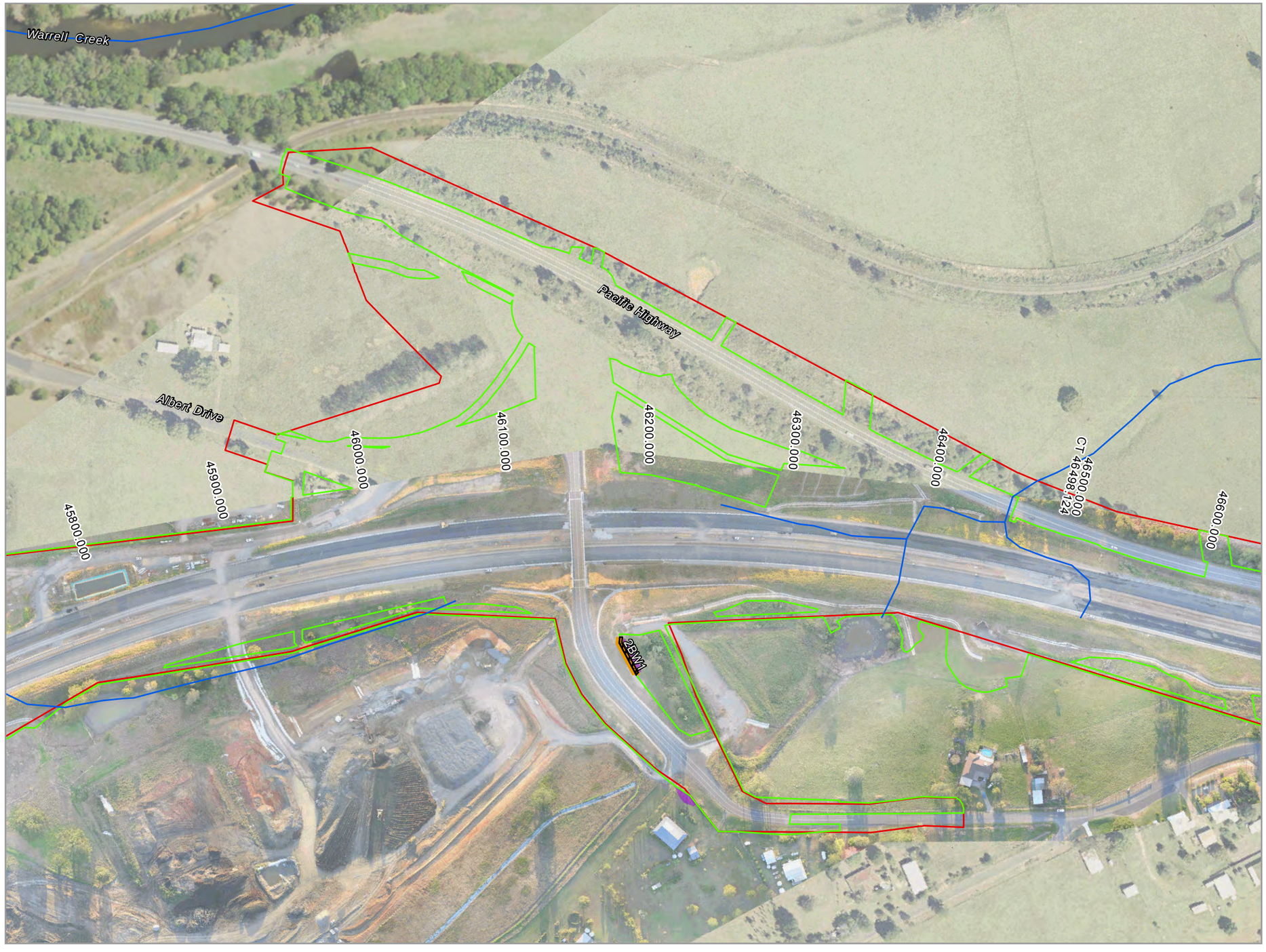
- Medium

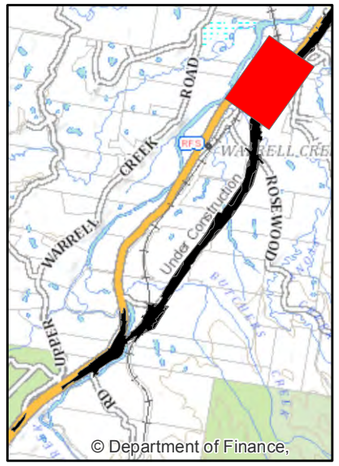
0 60

Weed Management Priority Areas (Stage 2B)

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 25/01/2019
Source of base data: ESRI and AFJV





LEGEND

- Project boundary
- Clearing limit
- Watercourse
- Stage 2B GHFF weed survey area

Vegetation

- Blackbutt Open Forest

Weed Management Priority

- Medium

0 60

Weed Management Priority Areas (Stage 2B)