APPENDIX G

TEC Vegetation Monitoring Program

APPENDIX G TEC VEGETATION MONITORING PROGRAM

The purpose of this monitoring program is to inform, through the management targets detailed herein, whether the objectives of the *Bunbury Outer Ring Road Northern and Central Section Additional Information Request for Preliminary Documentation EPBC Ref: 2019/8471* (BORR IPT, 2020a) are being achieved or whether management actions need to be reviewed and revised.

The monitoring program comprises:

- Threatened Ecological Community (TEC) vegetation monitoring plan
- Drainage monitoring plan for TEC vegetation
- Triggers, thresholds and contingency actions for management of TEC vegetation

1 TEC VEGETATION MONITORING PLAN

This monitoring program has been designed to enable the detection of a decline in vegetation condition, using species composition and vegetation health attributes as measurement parameters.

The TEC vegetation targeted in this monitoring plan comprises occurrences of three TECs listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. These are:

- 'Banksia Woodlands of the Swan Coastal Plain' TEC (Banksia Woodland TEC)
- 'Clay Pans of the Swan Coastal Plain TEC (Clay Pans TEC)
- '*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the SCP' (Corymbia Woodland) TEC.

Potential impact (Monitoring) sites as listed in sections 2.4.1, 2.4.2 and 2.4.3 of BORR IPT (2020a) and shown on Figure 1 will be monitored in comparison to Reference Sites.

Reference Sites on Crown land or road reserve known to support the relevant TEC vegetation that are located in close proximity to the Monitoring Sites have been identified. The purpose of Reference Sites is to enable comparison of Monitoring Site data with data from sites located away from the Proposal Area to assist in determining whether any impacts have resulted from Proposal implementation. Permission to establish monitoring transects in these sites has been secured. To facilitate comprehensive data analysis, and to minimise risk of loss of reference sites through fire or other unanticipated events, two Reference Sites have been identified for Claypan and Corymbia Woodland TEC types, and three for Banksia Woodland TEC.

Monitoring Sites and Reference Sites are listed in Table 1 and Table 2 respectively, and are shown on Figure 1.

Table 1 Monitoring Site details

SITE / OCCURRENCE CODE AND TENURE	TEC TYPE	LOCATION AND LOT NUMBER
BW-N-I-1 **Private property**	Banksia Woodland TEC	Forrest Highway interchange, Australind Lot 131 on Plan 27972 and Lot 104 on Plan 31579, on the eastern side of the Highway
BW-N-I-2 **Road reserve**	Banksia Woodland TEC	Forrest Highway west, Australind, within the western road reserve of Forrest Highway northbound.
BW-N-I-3 **Private property**	Banksia Woodland TEC	Moore Road east the BORR interchange Lot 504 on Plan 71846
BW-N-I-4 **Private property**	Banksia Woodland TEC	Wallrodt Road, Davenport, near Willinge Drive Lot 111 on Plan 403618
BW-N-I-5 **Private property**	Banksia Woodland TEC	South Western Highway at the BORR interchange Lot 80 on Plan 404278
BW-N-I-6 **Private property**	Banksia Woodland TEC	Wallrodt Road, Davenport Lot 2 on Plan 401654
CP-N-I-1 **Road reserve**	Claypan TEC	Bell Road, Dardanup. Within the road reserve west of the Proposal Area. 500 m from the Proposal Area.

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TEC monitoring and reference sites

Project No. **61-37041**
Revision No. **0**
Date **8/04/2020**

FIGURE 1

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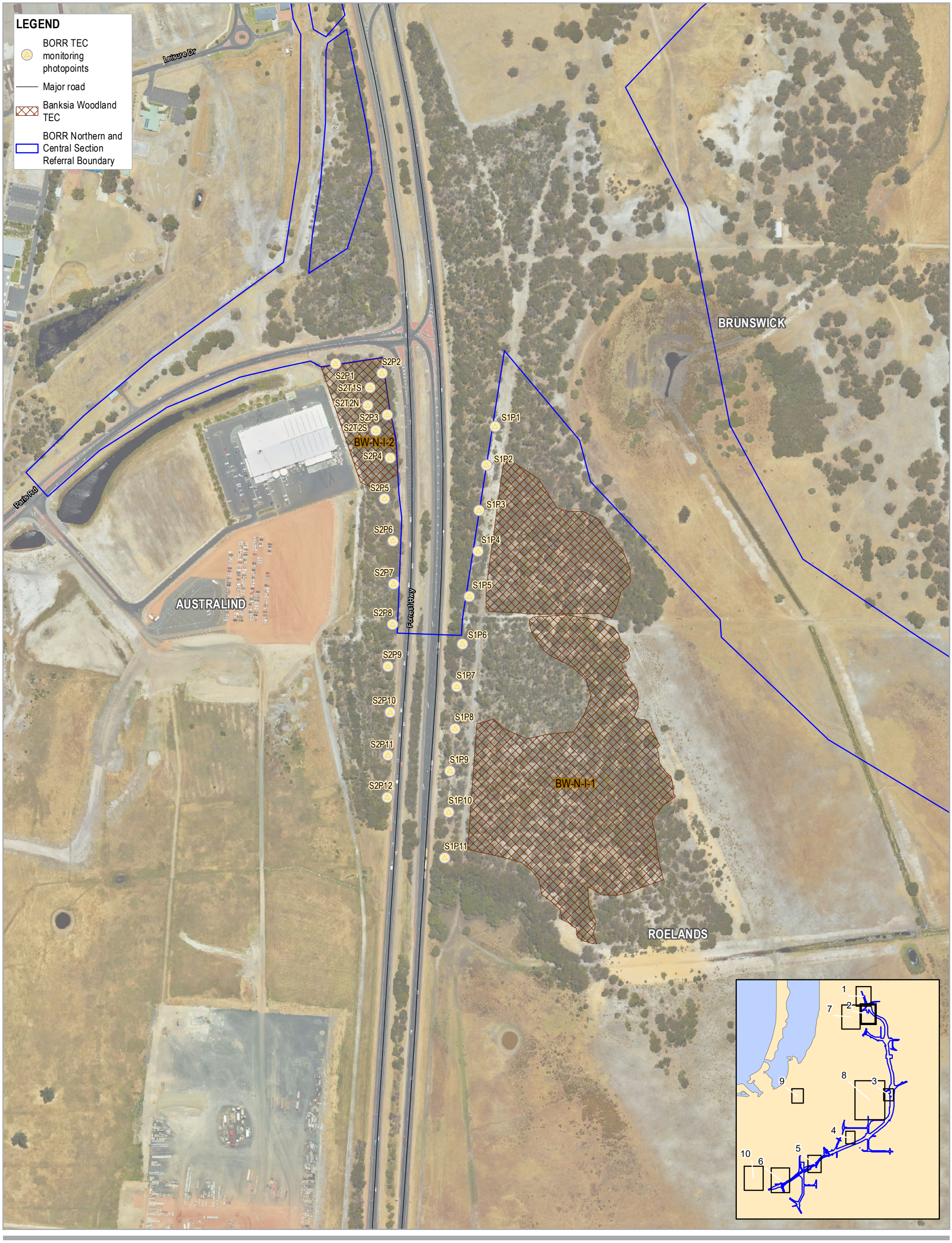

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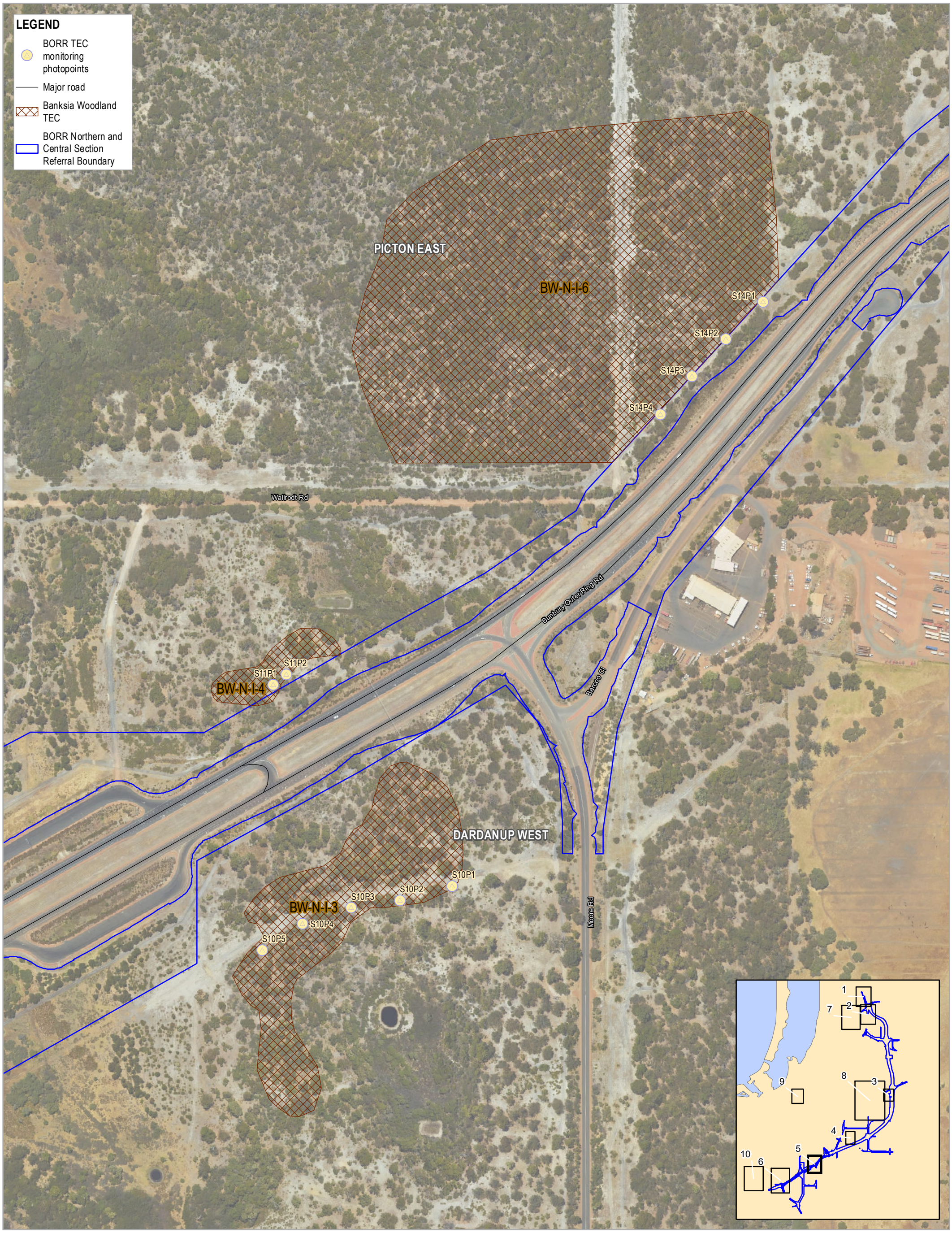

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Response to EPA Notice of Decision to Assess: Additional Information Request

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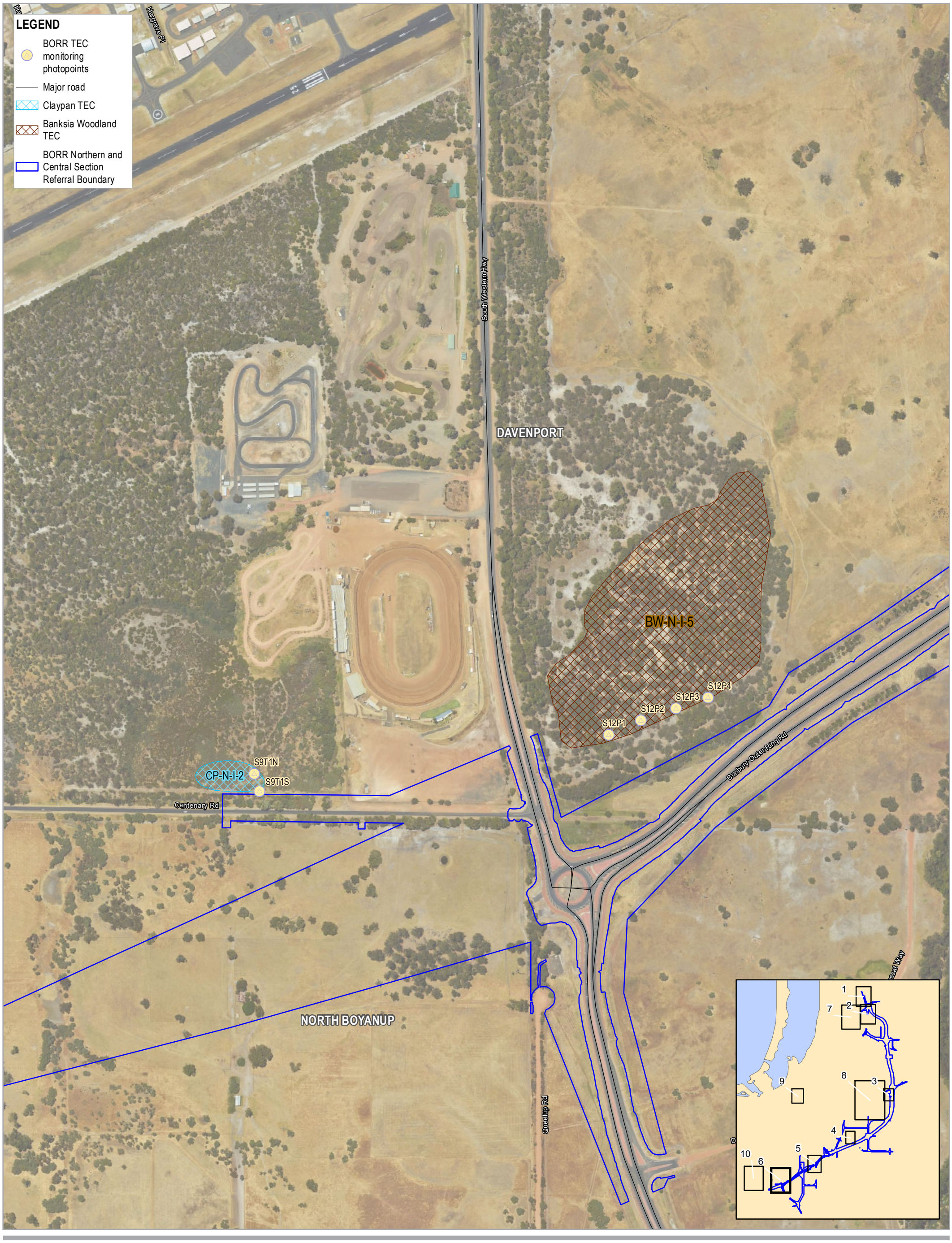

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Response to EPA Notice of Decision to Assess:
Additional Information Request

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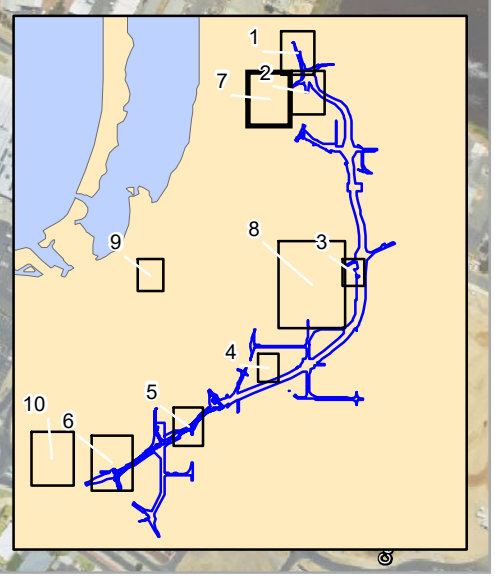
LEGEND

BORR TEC monitoring photopoints

Norfolk Lane
Kingston Dr
Peter Anderson Dr
Leisure Dr
Cockatoo Cle
Kowari Way
Euro Br
Walingale Dr
Paris Rd
R2T1N
R2T1S
BW-N-R-1
BW-N-R-2
R1T1N
R1T1S
AUSTRALIND
Topaz Ct
Tsavorite Prom
The Boulevard
Sapphire Br
Grand Ent
Hewdon Rd
Figgott Dr
Sweeny Dr
Jadeite St
McQuade Cir
Bundidup Cl
Shenfield Ct
Hanton Tce
Sheron Cr
Jardup Vsta
Glentana App
Homestead Gra
Aquila Dr
Apollo Way
Andromeda Rd
Tanzanite Rd
Tourmaline Ridge
Diamond Link
Ruby Fawy
Emerald Way
Turquoise Lane
Opal Dr
The Promenade
Peridot Br
Azurite Dr
Onyx Br
Malachite Dr
Constellation Dr
Mercury Pass



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Additional Information Request

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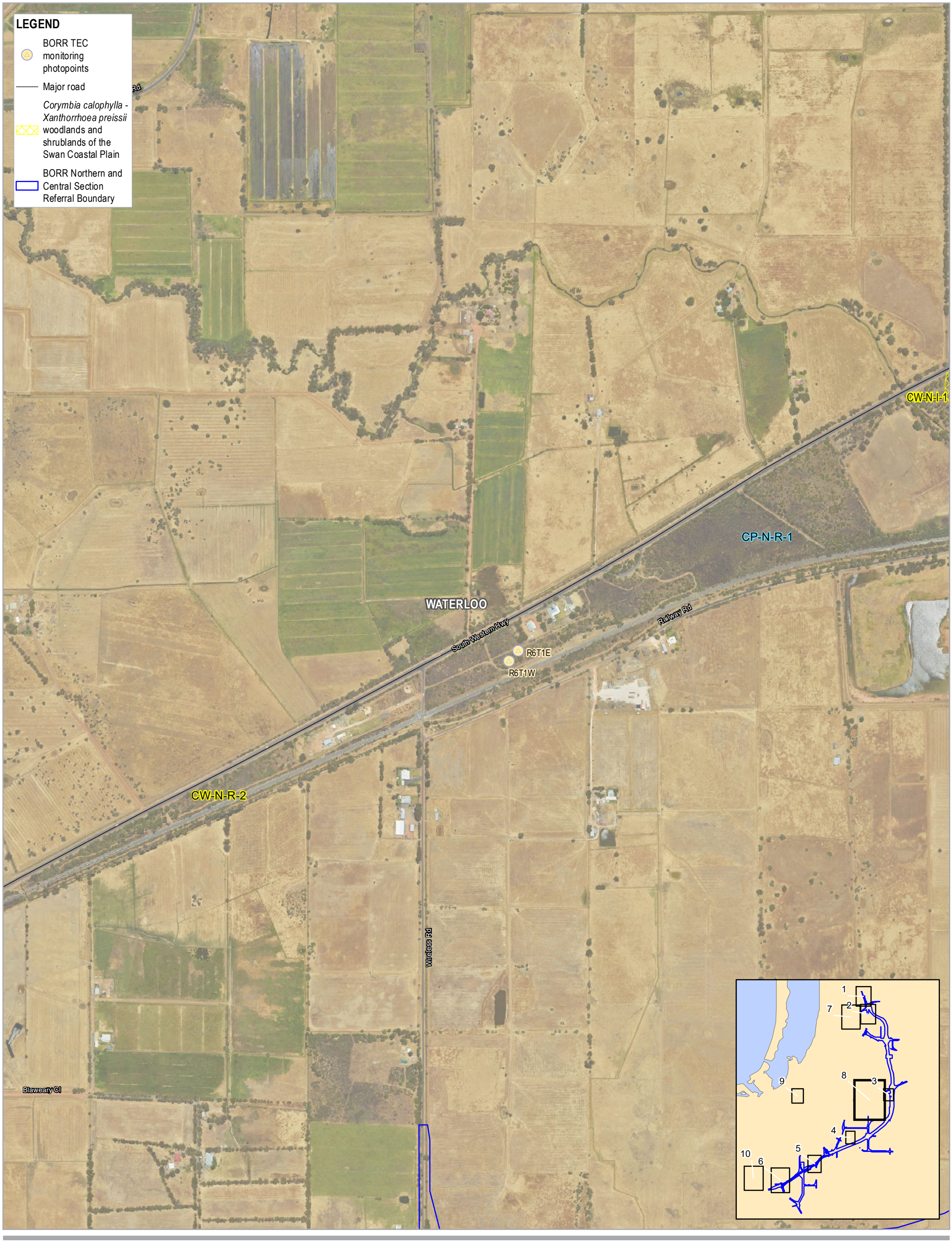

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Response to EPA Notice of Decision to Assess: Additional Information Request

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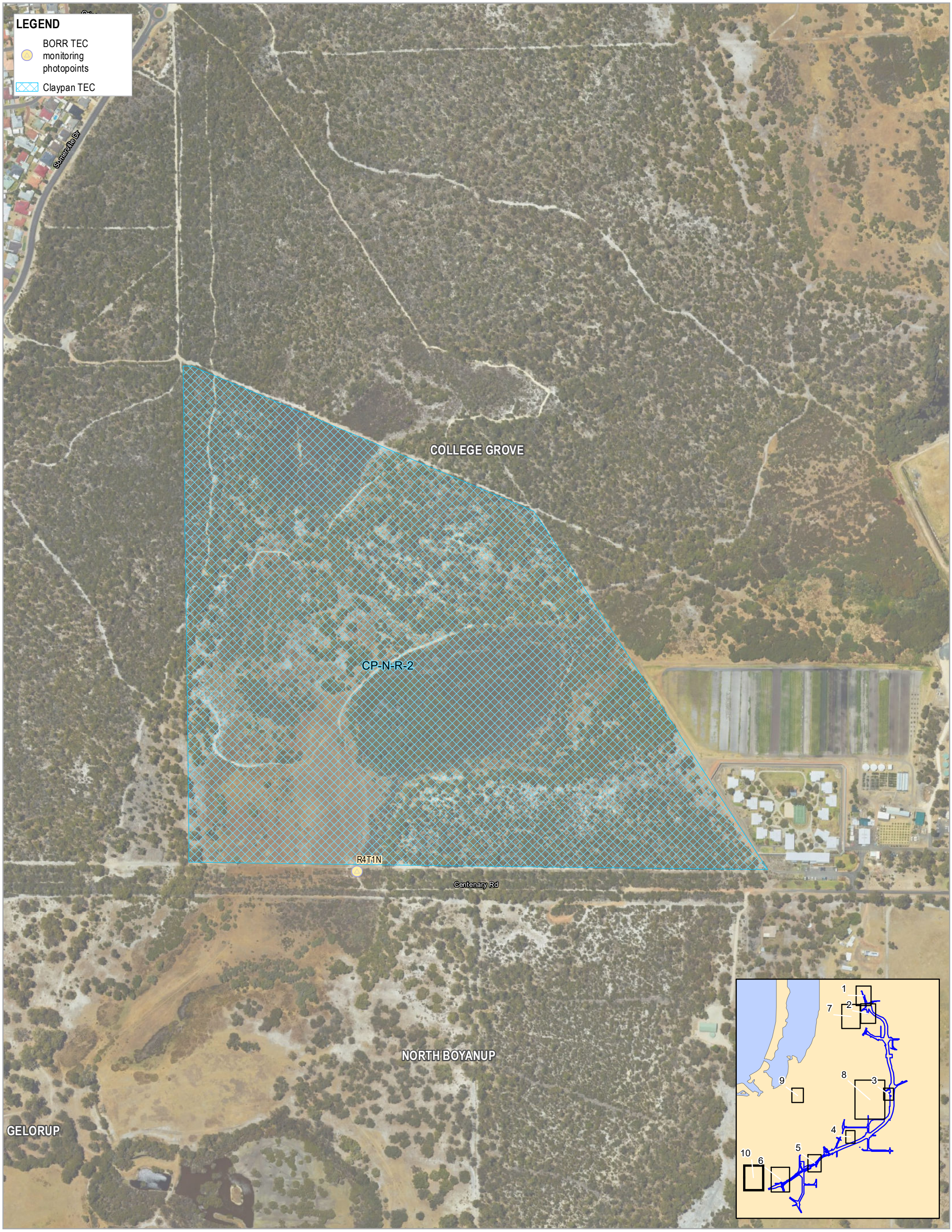

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Bunbury Outer Ring Road Northern and Central Section
Response to EPA Notice of Decision to Assess: Additional Information Request

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SITE / OCCURRENCE CODE AND TENURE	TEC TYPE	LOCATION AND LOT NUMBER
CP-N-I-2 Reserve	Claypan TEC	Manea Park
CW-N-I-1 Road reserve	Corymbia Woodland TEC	South Western Highway road reserve, Waterloo
CW-N-I-2 Road reserve	Corymbia Woodland TEC	Railway Road reserve northern side, west of the Proposal Area boundary east of Waterloo-Dardanup Road

Table 1 Reference site details

REFERENCE SITE NAME	TEC TYPE	LOCATION
BW-N-R-1	Banksia Woodland TEC	Wardandi Nature Reserve (R26070), Paris Road Australind
BW-N-R-2	Banksia Woodland TEC	Reserve 35061, Paris Road Australind
BW-N-R-3	Banksia Woodland TEC	Forrest Highway Road reserve at Old Coast Road junction
CP-N-R-1	Claypan TEC (FCT08)	Waterloo Nature reserve (R46108)
CP-N-R-2	Claypan TEC (FCT08)	Manea Park (R16044)
CW-N-R-1	FCT03c '*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the SCP' TEC	Waterloo Nature Reserve (R46108)
CW-N-R-2	FCT03c '*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the SCP' TEC	Railway Road reserve west

The monitoring program has been developed with reference to the following documents:

- Environmental Factor Guideline: Flora and Vegetation. Government of Western Australia (EPA 2016a)
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b)
- Banksia Woodland TEC Conservation Advice (TSSC 2016)
- Claypan TEC Conservation Advice (TSSC 2012)
- *'Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the SCP' Conservation Advice (TSSC 2017).

1.1 Personnel

Surveys will be conducted by an experienced botanist with appropriate experience and qualifications, including demonstrated experience as a field botanist in the Swan Coastal Plain.

1.2 Optimal timing

To maximise the proportion of native species recorded during the field surveys, monitoring of Banksia Woodland and Corymbia Woodland TEC vegetation will be carried out in spring.

Claypan TEC vegetation monitoring will be carried out in winter through to early summer, dependent on rainfall and in consultation with DBCA as required.

1.3 Frequency

The transect vegetation monitoring program will be undertaken annually in spring (or as recomemnnded by DBCA for the Claypan TEC) prior to and during construction, and for two years post construction. If after two years change to the TEC vegetation attributable to Proposal activities is detected, monitoring will continue for a further year.

Photopoint monitoring will be conducted bi-annually prior to and during construction, and for two years post construction. Additional monitoring will be conducted as a result of an event. If after two years change to the TEC vegetation attributable to Proposal activities is detected, monitoring will continue for a further year.

1.4 Monitoring type and locations

The monitoring method and parameters selected comprise a combination of quantitative and qualitative measures that will provide an overall assessment of the health of TEC vegetation and any evidence of disturbance from the Proposal.

1.5 Site locations

As detailed above, suitable monitoring Reference Site locations have been determined through desktop assessment and local knowledge of the vegetation surrounding the Proposal Area. DBCA have indicated the selected sites are suitable for use as Reference Sites in the monitoring program (pers. comm. Andrew Webb, 12/08/2019; 20/08/2019). Reference site locations are shown in Figure 1.

1.6 Monitoring methodology

Vegetation monitoring is comprised of monitoring transects and photopoints. The methodologies for each approach are detailed below. Transect start and end points (denoted by inclusion of 'T' in the site name) and photopoint locations are shown on Figure 1.

1.6.1 Banksia Woodland TEC

Two transects 30 m in length were established within Site BW-N-I-2 (Figure 1). Three reference transects, also 30 m in length, were established as follows:

- one in the Wardandi A-Class Nature Reserve (R26270) Reference Site (BW-N-R-1)
- one in Reserve 35061, on Paris Road Australind Reference Site (BW-N-R-2)
- one in vegetation along the Forrest Highway Road reserve at Old Coast Road junction at Reference Site BW-N-R-3 (Figure 1).

Transect locations were finalised during an initial site visit prior to commencing the first round of monitoring, and are located within Banksia Woodland TEC.

Photographic monitoring points were established in both Monitoring and Reference Sites, positioned at the start and end point of each monitoring transect.

Photographic monitoring only will be conducted for the Banksia TEC occurrence at Site BW-N-I-1. Photopoints to monitor this Site have been established within the adjacent road reserve.

1.6.2 Claypan TEC

One transect of 30 m in length was established at Site CP-N-I-2 (Manea Park) (Figure 1). One reference transect 30 m in length was established in Claypan vegetation at the Waterloo Nature Reserve (R46108) Reference Site (CP-N-R-1) and one at Manea Park Reference Site (CP-N-R-2) (Figure 1). Transect locations were finalised during an initial site visit prior to commencing the first round of monitoring, and are located within Claypan TEC.

Photographic monitoring points were established in both Monitoring and Reference Sites, positioned at the start and end point of each monitoring transect.

1.6.3 '*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the SCP' TEC

One transect 30 m in length was established at Site CW-N-I-1 in the South Western Highway road reserve (Figure 1). Two reference transects were established in vegetation meeting the description of this TEC; one at the Waterloo Nature Reserve (R46108) Reference Site (CW-N-R-1) and one in vegetation in the Railway Road reserve Reference Site CW-N-R-2 (Figure 1). Transect locations were finalised during an initial site visit prior to commencing the first round of monitoring, and are located within the TEC vegetation.

Photographic monitoring points were established in both Monitoring and Reference Sites, positioned at the start and end point of each monitoring transect.

1.7 Transect design

Monitoring transects 30 m in length were established within both Monitoring and Reference Sites. Along each transect, 2 x 2 m plots were established at 10 m intervals, the first at 0 m and the last at 30 m. Each plot was placed alternately left and right of the transect line. A total of 4 plots were established per transect.

Each plot was measured using a tape. Corners were marked with a galvanised steel post. The layout of a transect is shown in Figure 2.

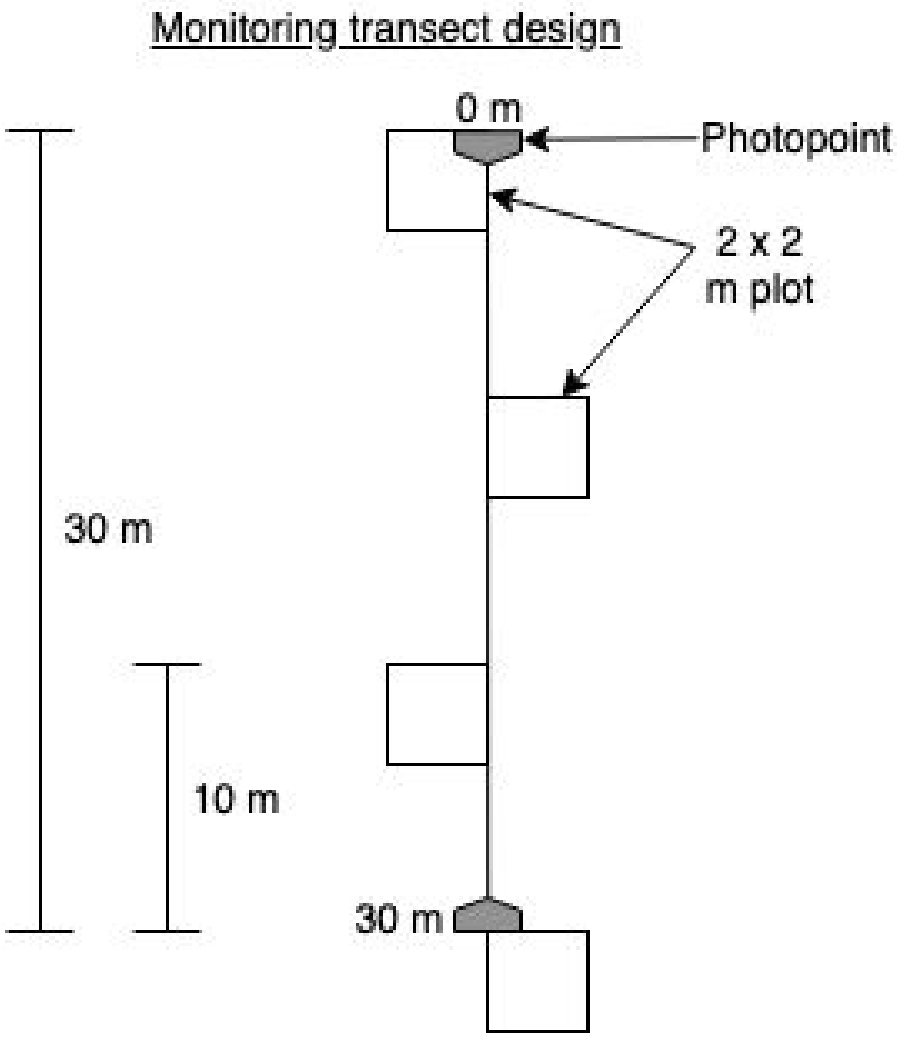
1.8 Photo monitoring point design

Photopoints were established at the following locations:

- At the start and end point of each transect
- At each plot
- In the Forrest highway road reserve to enable monitoring of vegetation in Site BW-N-I-1
- 5 m distance from the existing vegetation line at 50 m intervals around the Proposal Area boundary adjoining Sites BW-N-I-2, BW-N-I-3, BW-N-I-4, BW-N-I-5, BW-N-I-6, BW-N-I-7 and CW-N-I-1
- At the edge of the existing vegetation line on the opposite side of the road to the vegetation being photographed, at 50 m intervals along the Bell Road Claypan TEC Site CP-N-I-1.

Where allowed, photopoints were marked permanently with a stake and their locations geo-referenced (recorded using a handheld GPS). All photographs are taken from the top of the stake. Photopoint monitoring will form part of each monitoring event. Where permanent stakes cannot be installed, such as in roadside vegetation, the locations of these points was marked on the adjacent fence post, and the stake installed for each monitoring event, and removed prior to leaving the site.

Figure 2 **Layout of a monitoring transect**



Where photopoints are linked to a transect, photographs are taken facing towards the middle of the transect. For photopoints not linked to a transect, photographs are taken facing towards, and left and right of the vegetation being monitored. At independent photopoints, i.e. those not linked to transects, the following parameters are recorded:

- Site conditions including vegetation cover
- Dominant species in each structural layer
- Weed species present and overall cover
- Evidence of erosion
- Evidence of other physical disturbance such as grazing, rubbish dumping, etc.

Fewer parameters are recorded in photopoints linked to transects, because in addition to photopoints, transects contain plots at which data for numerous additional parameters is recorded, as is detailed below.

1.9 Monitoring parameters

The monitoring parameters selected comprise a combination of quantitative and qualitative vegetation measures that will provide an overall assessment of the health of the vegetation. The selected monitoring parameters are described below. Data is collected using standardised data sheets.

Within each transect plot, the following parameters are recorded:

- Species diversity and cover
- Plant deaths
- Level of plant stress
- Ground characteristics (% bare ground, leaf litter, etc).

At photopoints located at the start and end point of each transect, assessing the each transect as a whole, the following parameters are recorded:

- Site conditions
- Evidence of erosion
- Vegetation community structure.

Where required, a description of the approach used for each parameter is set out below.

1.9.1 Species diversity and cover

In each transect plot (2 x 2 m) the following information will be collected:

- Species present – identify all species present within the quadrat
- An estimate of cover and abundance of species using a slightly modified version of the Domin-Krajina scale[1], as shown in Table 3.

[1] The scale was modified for use in electronic data capture software that did not recognise a score of zero.

Table 3 Modified Domin-Krajina scale

COVER SCORE	DESCRIPTION
1	Seldom found species with insignificant cover
2	Very scattered individuals of a species with less than 1% cover
3	Scattered individuals of a species with 1-5% cover
4	Any number of individuals of a species with 5-10% cover
5	Any number of individuals of a species with 10-25% cover
6	Any number of individuals of a species with 25-33% cover
7	Any number of individuals of a species with 33-50% cover
8	Any number of individuals of a species with 50-75% cover
9	Any number of individuals of a species with greater than 75 % but less than 100%
10	Any number of individuals of a species with complete cover (100%) in the stand

1.9.2 Level of plant stress

In each transect plot, plant stress is measured on a five-point scale as detailed in Table 4.

Table 4 Plant stress scale

PLANT STRESS LEVEL	DESCRIPTION
5	No evidence of wilting of foliage. Foliage intact and healthy. Plants not stressed.
4	Plant leaves show signs of wilting at periphery. Less than 10% of plants or foliage cover affected. Plants potentially stressed.
3	Plant leaves wilting with noticeable curling of leaf periphery. 10% to 20% of plants or foliage cover affected. Plants exhibiting symptoms of stress.
2	Plant leaves wilting with noticeable curling of leaf. 20% to 30% of plants or foliage cover affected. Plants exhibiting signs of stress.
1	Plant leaves wilting with noticeable curling of leaf (approaching closure). More than 30% of plants or foliage cover affected. Plants clearly stressed.

1.9.3 Ground characteristics

In each transect plot, the percentage of bare ground, leaf litter, twig and logs are recorded in 5 % categories (i.e. 0-5 %, 5-10 % etc).

1.9.4 Site conditions

- Vegetation condition in accordance with the rating scale (EPA 2016)
- Pathogen attack – visual evidence of dieback
- Fire history – visual evidence of fire history
- Evidence of unauthorised access
- Other disturbances (e.g. rubbish dumping, access tracks, grazing).

1.9.5 Evidence of erosion or inundation

A description and photograph of erosion or inundation are recorded if present. Description includes depth and width characteristics of any erosion, and depth of any standing water.

1.9.6 Vegetation community structure

For each transect, vegetation is described based on structure, dominant taxa and cover characteristics. Vegetation unit descriptions follow the National Vegetation Information System (NVIS) and are consistent with NVIS Level V (Association). At Level V up to three taxa per stratum are used to describe the association (Executive Steering Committee for Australian Vegetation Information (ESCAVI 2003)).

1.10 Data analysis

Data collected from monitoring is to be entered into electronic spreadsheets to be analysed for trends in vegetation health. Table 5 provides a summary of the calculations to be completed for each parameter. Photographs from each transect will be appropriately labelled and stored. For the monitoring quadrats and transect plots, data analysis will include the use of parametric univariate statistical tests including a paired t-test (two sampling events) or repeated measures ANOVA (more than two sampling events) when testing for change between years at sites or between sites within a single survey event.

Table 5 Summary of analysis

PARAMETER	DESCRIPTION
Species diversity	Diversity calculated by counting the number of different species present in the quadrat / plot
Species composition	Percent composition calculated dividing the percent cover for each species by the total cover for all species
Level of plant stress	Comparison of the previous monitoring periods to note change over time
Weed species	Number and total cover calculated
Plant deaths	Total number counted and comparison of the previous monitoring periods to note change over time
Vegetation health	Visual comparison of photographs taken from each permanent photopoint. Comparison of the previous monitoring periods to note change over time
Ground characteristics	Comparison of the previous monitoring periods to note change over time

2 DRAINAGE MONITORING PLAN FOR TEC VEGETATION

Monitoring for changes to hydrology and drainage will be undertaken through a combination of visual assessments and assessment of data collected from monitoring wells (Figure 3). Analysis of data collected will determine the impact, if any, of Proposal implementation in regards to groundwater levels and quality, and any resulting effect on TEC vegetation.

2.1 Monitoring strategy – visual assessment

The purpose of visual assessment monitoring is to detect any flooding, erosion, inundation or drying of the identified TEC vegetation so that necessary remedial action can be taken. Visual assessments will be conducted by a suitably qualified and experienced environmental officer.

2.1.1 Monitoring design and frequency

Visual assessments will involve opportunistic visual inspection during construction for evidence of

- Flooding and / or inundation (primarily for Banksia Woodland TEC)
- Erosion, or
- Drying (primarily for Claypan and Floristic Community Type (FCT) 3c TECs) of TEC vegetation that is attributable to the Proposal. A field recording sheet will be prepared to capture relevant site condition data including:
    - presence / absence of standing water
    - % of TEC occurrence impacted.

Under the Vegetation Monitoring Plan, for Claypan and FCT3c vegetation, plant stress will also be assessed and recorded between late spring and late autumn, via the methodology described in the that plan.

Comparison with Reference site monitoring results will be used to determine whether any impacts are attributable to the Proposal implementation or to climatic or other conditions. Should any such impacts be present, a photograph clearly showing the site condition will be taken. Site condition and plant health information will also be recorded at the site using the photopoint monitoring and vegetation health field recording sheets prepared for the vegetation monitoring program.

Flooding, inundation and erosion are all more visually apparent than the effects of drying on vegetation. Impacts from drying will be more evident from late spring through to late autumn, and will comprise yellowing and dying off of vegetation, as well as the site drying out at a faster rate after winter than the reference sites.

Visual assessments will be conducted quarterly prior to and during construction, and for two years post construction. If after two years change to the TEC vegetation attributable to Proposal activities is detected, monitoring will continue for a further year.

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Metres

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Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
Revision No. **0**
Date **19/12/2019**

FIGURE 1

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Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

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P067869 70
P ROAD
P190350 26
R 5878
BORR_MW37
R 5878
P190350 26
P067869 70
P068088 101
P068088 100
P067869 70
P067869 77
P068088 502
P068088 501
Raymond Rd
BH9.2
P ROAD
P ROAD
P068088 100
P251812 878
Treendale Rd
BORR_MW25
P ROAD
R 47717
P035690 6211
P ROAD
COLLIE RIVER
P251812 878
P ROAD

LEGEND

- Groundwater monitoring well
- Watercourse
- Major Road
- Minor Road
- Referral Area

Paper Size ISO A3

0 50 100

Metres

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Main Roads Western Australia
Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

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Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
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Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

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Main Roads Western Australia
Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
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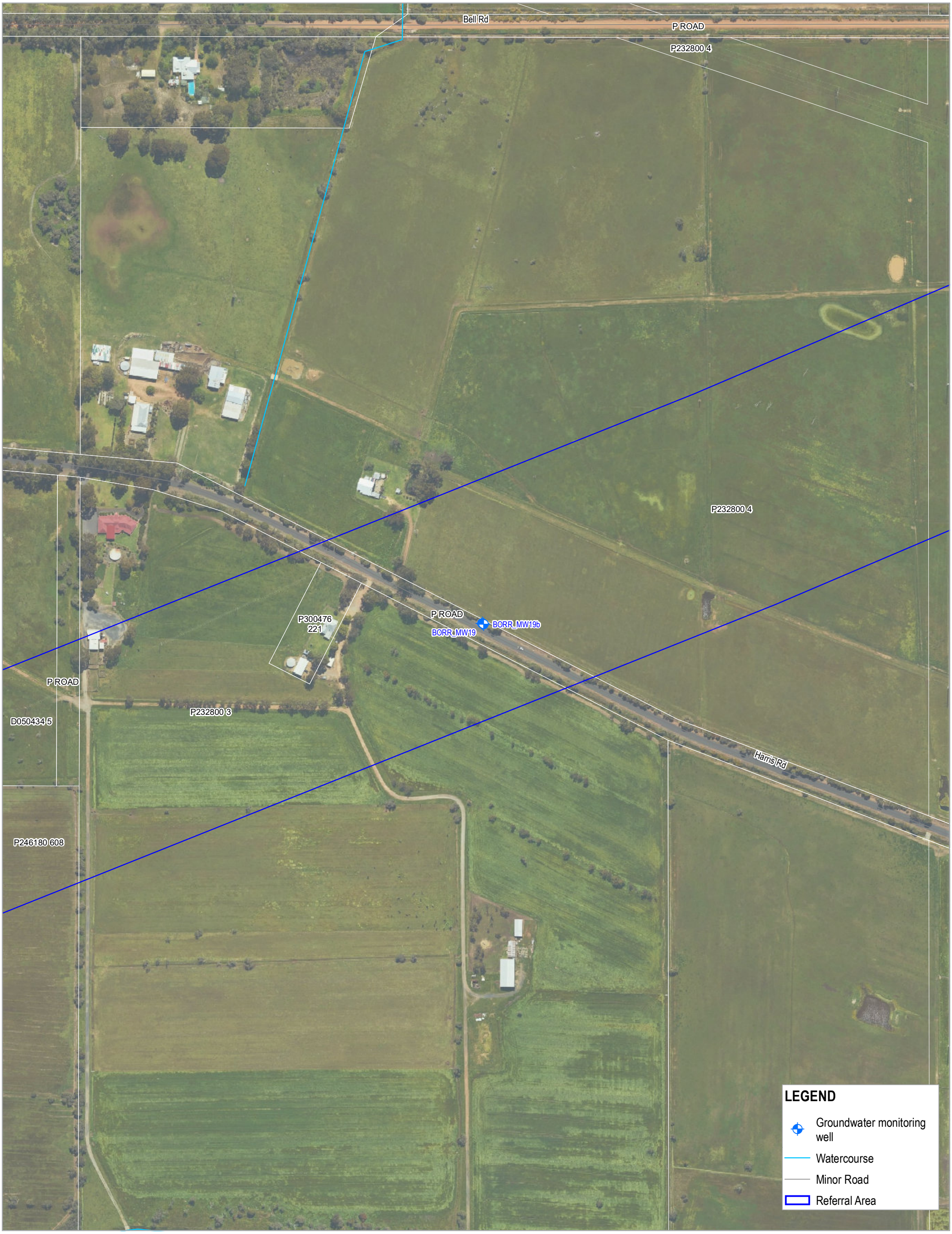

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Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
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Pedretti Rd
Andrew Foord Way
Kerr Rd
Coleman Turn
P058493 96
P058493 96
P ROAD
P ROAD
D050434 5
P ROAD
P059991 19
P059991 40
Ramsay Loop
Warrego Rd
Nicholson Rd
Golding Cr
P059991 41
P ROAD
D066013 4
BORR_MW18
FERGUSON RIVER
P ROAD
P071855 600
P071856 593
P059991 46
P ROAD
R 50660
P059991 40
P246180 608
P059991 43
P059991 45
P059991 46
D058134 50
D066013 5
P059991 42
P071856 593
P059991 46
P402909 701
R 35582
P071855 601
P ROAD
P ROAD
P301384 521
P301384 521
Boyanup-Picton Rd
P059991 42
P ROAD
P ROAD
P ROAD
Bunbury Outer Ring Rd
P ROAD
P ROAD
Martin-Pelusey Rd
Copplestone Rd

LEGEND

- Groundwater monitoring well
- Watercourse
- Major Road
- Minor Road
- Referral Area

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Main Roads Western Australia
Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
Revision No. **0**
Date **19/12/2019**

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Main Roads Western Australia
Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
Revision No. **0**
Date **19/12/2019**

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G:\61\37041\19_0_GIS\Maps\Working\BORR North EPBC Referral\6137041_APPF_GWMonitoring_Rev0.mxd
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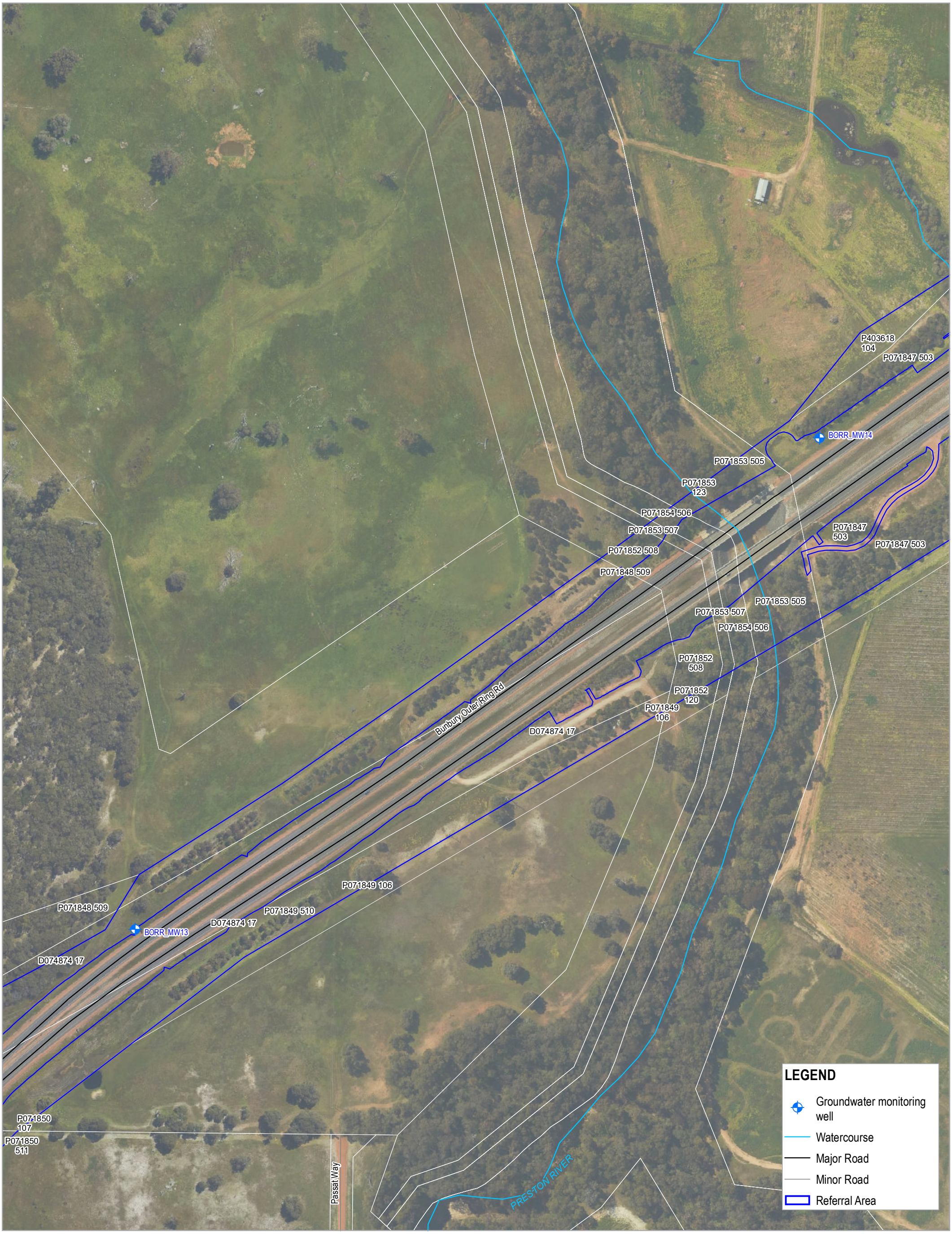

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Main Roads Western Australia
Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

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Revision No. **0**
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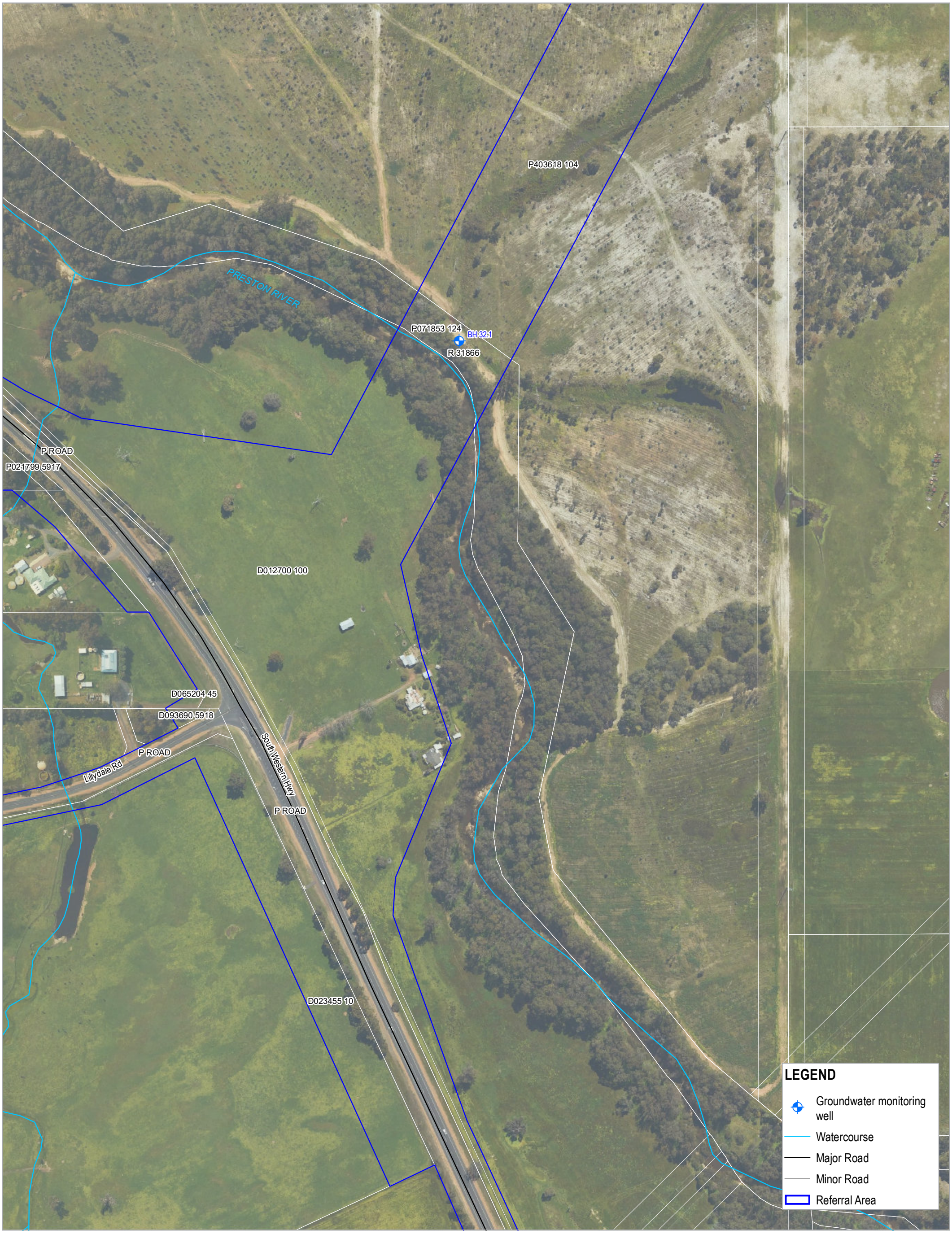

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Main Roads Western Australia
Bunbury Outer Ring Road Northern and Central Section
Drainage Monitoring Plan

Ground and surface water monitoring site and well locations

Project No. **61-37041**
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2.1.2 Data analysis

Data analysis will involve comparison of monthly site conditions between potential impact sites and reference sites, as well as between seasons, and trend analyses.

2.2 Monitoring strategy – ground and surface water wells

2.2.1 Potential impact site wells

Monthly monitoring of groundwater wells and surface water locations within or nearby the Proposal Area commenced in August 2019, to enable the collection of baseline data (Table 6). Some of these wells are located in close proximity to the TEC vegetation sites included in the Vegetation Monitoring Plan. Location and depth information is provided in Table 7.

Water levels and quality will continue to be monitored monthly to determine impacts of Proposal implementation on ground and surface water.

A new well will need to be installed to monitor groundwater levels in the vicinity of BW-N-I-5, which is not covered by any of the existing wells. Baseline data from this site will not be available, however, data from the nearby bore BORR_MW13, which is situated at a similar elevation to BW-N-I-5 (~15 m above sea level), would potentially provide suitable baseline information. BORR_MW13 is located within the Proposal Area and would need to be moved should ongoing monitoring of this well be required. The proposed new well to replace BORR_MW13 would be installed and monitored whilst monitoring is continuing at BORR_MW13. This will enable comparison of data and determination of whether baseline data from BORR_MW13 can be used as a proxy for baseline data from the new replacement well.

Table 6 Potential impact site monitoring points (TEC sites)

LOCATION	TEC SITE LOCATION	PARAMETER BEING MONITORED
North Creek 4 (surface water)	Sites CW-N-I-1, CW-N-I-2, CP-N-I-1, and BW-N-I-3	Acid Sulphate Soil GW Suite – Extended (Cl, SO_4, Alkalinity, Acidity, pH, E.C., TDS, Dissolved Ca, Mg, Na, K, Fe, Mn, Al by ICP-AES or MS. Total N, TKN, NO_x, Ammonia, Total & Reactive P; Total Al & Fe; Sulfide; Dissolved As, Cd, Co, Cu, Pb, Fe, Mn, Al, Cr, Ni, Se, Zn by ICPMS) Ammonium as N TRH/BTEXN Glyphosate OP Pesticides (41 analytes)
BORR_MW21	Sites CW-N-I-1, CW-N-I-2, CP-N-I-1, and BW-N-I-3 (note: Inside Proposal Area so needs to be moved)	Acid Sulphate Soil GW Suite – Extended (Cl, SO_4, Alkalinity, Acidity, pH, E.C., TDS, Dissolved Ca, Mg, Na, K, Fe, Mn, Al by ICP-AES or MS. Total N, TKN, NO_x, Ammonia, Total & Reactive P; Total Al & Fe; Sulfide; Dissolved As, Cd, Co, Cu, Pb, Fe, Mn, Al, Cr, Ni, Se, Zn by ICPMS) Ammonium as N TRH/BTEXN
BORR_MW22	Sites CW-N-I-1, CW-N-I-2, CP-N-I-1, and BW-N-I-3	
BORR_MW22b	Sites CW-N-I-1, CW-N-I-2, CP-N-I-1, and BW-N-I-3	

LOCATION	TEC SITE LOCATION	PARAMETER BEING MONITORED
BORR_MW28	Sites BW-N-I-1 and BW-N-I-2	
BORR_MW29	Sites BW-N-I-1 and BW-N-I-2	

Table 7 Potential impact site monitoring location and depth information

NAME	EASTING	NORTHING	DATA LOGGER TYPE	DEPTH (M)
North Creek 4 (surface water)	371362.4	6294986.2	NA	NA
BORR_MW13	378105.4	6305278.2	Telemetry	Depth to water (October 2019): 0.69m Total depth: 4.5m
BORR_MW21	385890.5	6311680.6	Telemetry	Depth to water (September 2019): 0.84m Total depth: 10.8m
BORR_MW22	385618.9	6312197.7	Telemetry	Depth to water (September 2019): 0.53m Total depth: 1.435m
BORR_MW22b	385620.1	6312198.5	Telemetry	Depth to water (September 2019): 2.391m Total depth: 13.050m
BORR_MW28	383946.6	6317809.3	Telemetry	Depth to water (October 2019): 1.73m Total depth: 4.0m
BORR_MW29	383985.2	6318169.9	Telemetry	Depth to water (September 2019): 5.499m Total depth: 8.451m

2.2.2 Reference site wells

Up to four suitable monitoring wells outside for the Proposal Area and outside of the potential zone of influence of the Proposal construction activities (dewatering) will be identified prior to commencement of construction. These monitoring wells will provide regional reference for groundwater levels and be used to compare against changes in groundwater levels in the Proposal Area.

2.2.3 Data analysis

Ground and surface water levels from monitoring sites will be compared against pre-construction baseline and trends in reference monitoring wells. Development of trigger values for ground and surface water levels will be considered at the completion of the baseline monitoring period.

Water quality parameters will be compared against ANZECC/ARMCANZ (2000) guideline values for the protection of slightly/moderately disturbed wetland ecosystems in the south west of Western Australia (development of site specific guideline values will considered once adequate baseline data

has been collected). Descriptive statistics (range, maximum, minimum, median) will also be calculated for water quality results and used to identify water quality parameters that differ between potential impact sites and reference sites. A graphical trend analysis of each analyte over each 12 month period will also be conducted.

2.3 Monitoring locations, requirements, frequency and duration

The monitoring program will be undertaken as per Table 8 during and post construction. Sample analysis will be conducted using appropriate field test equipment and laboratory samples will be tested in a NATA accredited laboratory.

Table 8 During and post construction monitoring program

SAMPLING LOCATION	REQUIREMENT	DURING CONSTRUCTION	POST CONSTRUCTION
North Creek 4 (surface water)	pH, Redox, EC & TTA, TAlk, Total nitrogen, Total phosphorus, Heavy metals, TPH, TSS, Glyphosate. If Field TTA 40-100mg/L and pH less than 6, then analyse for total acidity, total alkalinity, pH, sulfate, chloride, sodium, total iron, dissolved iron (filtered), total aluminium, dissolved aluminium (filtered), total cadmium, total manganese, total selenium, and ammoniacal nitrogen.	Monthly	Quarterly for one year
BORR_MW21 BORR_MW22 BORR_MW22 bBORR_MW28 BORR_MW29	pH, Redox, EC & TTA, TAlk, Total nitrogen, Total phosphorus, Heavy metals If Field TTA 40-100mg/L and pH less than 6, then analyse for total acidity, total alkalinity, pH, sulfate, chloride, sodium, total iron, dissolved iron (filtered), total aluminium, dissolved aluminium (filtered), total cadmium, total manganese, total selenium, and ammoniacal nitrogen.	Quarterly Monthly if Field TTA 40-100mg/L and pH less than 6	Quarterly for one year
BORR_MW13 BORR_MW21 BORR_MW22 BORR_MW22 bBORR_MW28 BORR_MW29	Water level data logging – telemetry	Monthly	Monthly for one year
Up to four monitoring wells outside	Total nitrogen, Total phosphorus, Heavy metals, Total Acidity, pH, Dissolved oxygen, Conductivity	Quarterly	Quarterly for one year

SAMPLING LOCATION	REQUIREMENT	DURING CONSTRUCTION	POST CONSTRUCTION
of the Proposal Area			

3 TRIGGERS, THRESHOLDS AND CONTINGENCY ACTIONS FOR MANAGEMENT OF TEC VEGETATION

Triggers, thresholds and contingency actions for TEC vegetation are detailed in Table 9.

The number and type of contingency actions to be implemented in the case of trigger exceedance will depend upon various factors, including the state of the natural surrounding environment, the location of the trigger and the works undertaken at the time of the exceedance. The process followed in the event of a flooding or inundation threshold breach is displayed in Figure 4.

A reportable decline is considered where monitoring shows a 20 per cent decline in the species composition and / or health attributes of the TEC Monitoring Sites against the change at Reference Sites.

Figure 4 Threshold breach response process

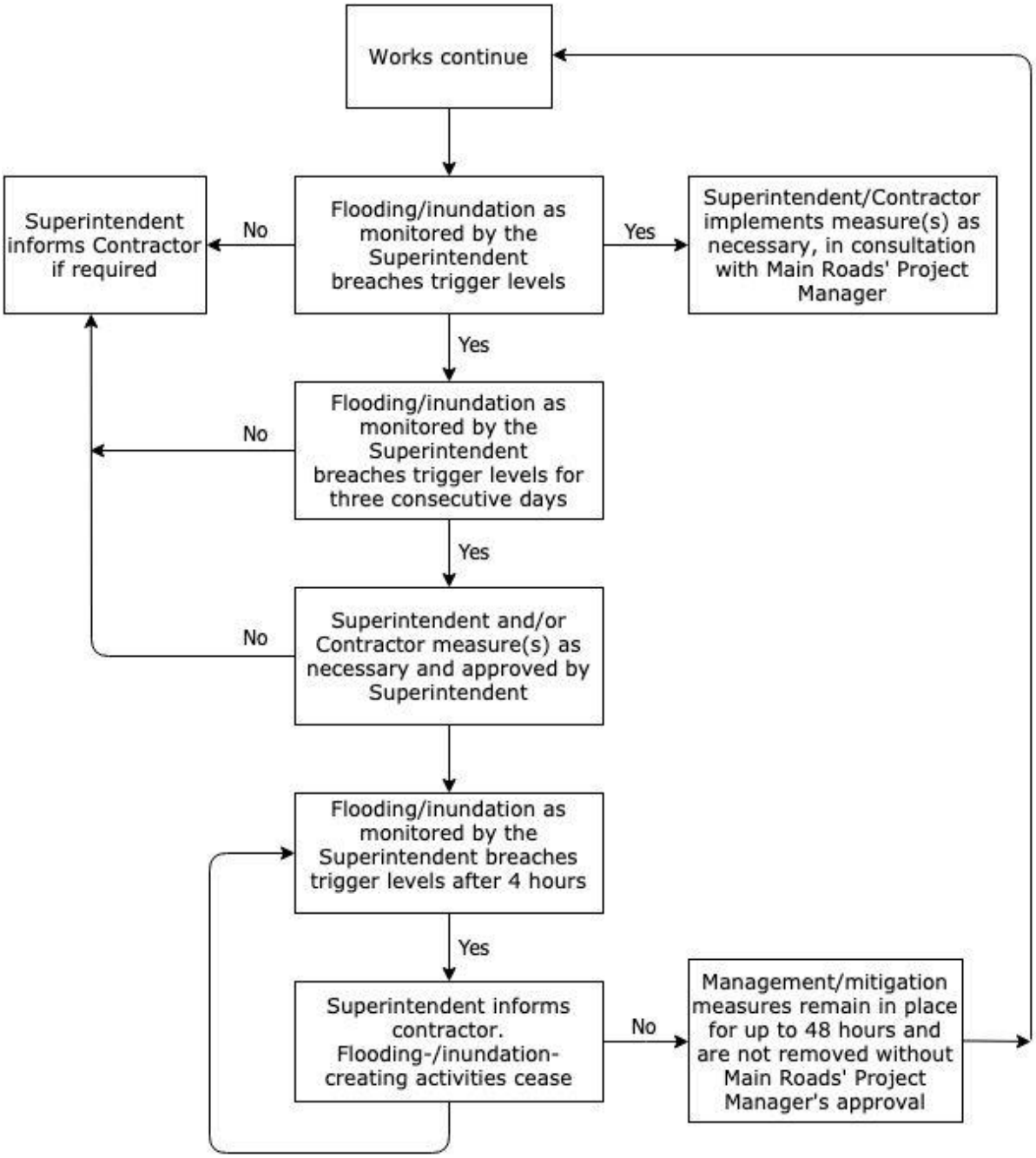

Table 9 Triggers, thresholds and contingency actions

MONITORING PARAMETER	TRIGGER	THRESHOLD	CONTINGENCY ACTION
Erosion	Evidence of new erosion in monitored TEC vegetation	Evidence of new erosion in monitored TEC vegetation	• Investigate the cause and raise an incident report if new erosion is caused by Proposal activities • Remedial action controls will be undertaken immediately to repair damage if required • Preventative actions such as modifications to infrastructure and additional engineering post-construction will be taken to prevent further non-compliance. These may include controls outside of monitored TEC vegetation to ensure no indirect impacts such as: - Application of fill/mulch - Installation of gabion cages - Installation of jute matting to secure bank. • A review will be conducted of management measures and/or further education of staff/contractors to ensure that all possible steps are taken to prevent any reoccurrence • Monitor the effectiveness of the control(s).
Flooding/inundation	TEC vegetation is inundated or flooded for 24 hours as a result of Proposal activities	TEC vegetation is inundated or flooded for three consecutive days as a result of Proposal activities	• Remedial action controls will be undertaken immediately to repair damage if required • Attempt to contain flooding if practicable (i.e. use of bunding to re-direct floodwaters away from TEC vegetation) • Determine if rehabilitation is required (i.e. if soil erosion is evident) in consultation with DBCA if within TEC areas. • Develop and implement a rehabilitation plan if necessary and consult the relevant government regulator as required • A review will be conducted of management measures and/or further education of staff/contractors to ensure that all possible steps are taken to prevent any reoccurrence • Monitor the effectiveness of the control(s).
Drying of Clay Pans TEC vegetation	Plant health scores decline by one health class relative	Drying continues to breach trigger levels two months after	• Investigate the cause and raise an incident report • Cease dewatering or other drying activities

MONITORING PARAMETER	TRIGGER	THRESHOLD	CONTINGENCY ACTION
	to control sites in two consecutive monitoring periods	management / mitigation measures are implemented	• Remedial action controls will be undertaken immediately to repair damage if required. This may include the application of water to TEC vegetation in consultation with DBCA • Preventative actions such as modifications to infrastructure and additional engineering post-construction will be taken to prevent further non-compliance • A review will be conducted of management measures and/or further education of staff/contractors to ensure that all possible steps are taken to prevent any reoccurrence • Monitor the effectiveness of the control(s).
Groundwater levels	25% variance from baseline	25% variance from baseline	• Investigate the cause and raise an incident report if necessary. Include consideration of results from baseline monitoring and comparison with reference sites for the same period • Refer to contingency actions for drainage structures (functioning of culverts etc) • A review will be conducted of management measures and/or further education of staff/contractors to ensure that all possible steps are taken to prevent any reoccurrence • Monitor the effectiveness of the control(s).
Water quality parameter(s)	Exceedance of ANZECC guideline values[2] (slightly/moderately disturbed wetlands in the SW) and/or significant difference from baseline conditions in one monitoring period	Exceedance of ANZECC guideline values (slightly/moderately disturbed wetlands in the SW) and/or significant difference from baseline conditions in two consecutive monitoring periods	• Investigate the cause and raise an incident report if necessary. Include consideration of results from baseline monitoring and comparison with reference sites for the same period • Remedial action controls will be undertaken if required – to be determined based on likely cause eg spills, sedimentation or erosion • A review will be conducted of management measures and/or further education of staff/contractors to ensure that all possible steps are taken to prevent any reoccurrence • Preventative actions such as modifications to infrastructure and additional engineering post-construction will be taken to prevent further non-compliance • Monitor the effectiveness of the control(s).
Fire	Sparks or unplanned fire	Sparks or unplanned fire detected from project	• Implement emergency evacuation and response plans • Investigate cause and raise an incident report

[2] Suitability of ANZECC guidelines as triggers will be reviewd at the end of collection of baseline and if required site specific rigger values will be developed.

MONITORING PARAMETER	TRIGGER	THRESHOLD	CONTINGENCY ACTION
	resulting from Proposal activity that have the potential to impact TEC vegetation	activity within 100 m of TEC vegetation	• Review management procedures.
Reportable decline	TEC vegetation health declined	TEC vegetation monitoring parameters have decreased greater than 20 per cent in comparison to the change at reference sites	Reportable decline: If monitoring identifies that the TEC vegetation monitoring parameters have decreased (greater than 20 per cent) in comparison to the change at reference sites (reportable decline) the following will occur: • Review hydrological monitoring to confirm whether any incidents have occurred. If incidents have occurred, review these to determine their nature and extent and whether they could have impacted the sampling sites. • If there have been no environmental incidents recorded / occurred, assess monitoring sites and their adjacent area for evidence of other impacts, such as erosion or sedimentation, dumping of waste, dust accumulation on vegetation or an increase in weed species. Assess these impacts to determine whether they are likely to be sourced from the Propopsal i.e. does the erosion extend from the Project boundary into the TEC or is there evidence of alternative pathways • Report findings to EPA / DBCA and implement management actions if impacts attributable to the Proposal are detected • Monitor effectiveness of management actions and recovery of TEC vegetation. Update / revise management measure if needed (impact persists despite management actions).

4 REFERENCES

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