APPENDIX J

Vegetation Monitoring Program

The purpose of monitoring is to inform, through the management targets detailed in this Program, whether the objectives of the *Bunbury Outer Ring Road Southern Section Environmental Assessment Referral Information s40(2)(a) Additional Information* (BORR IPT, 2020a) are being achieved or whether management actions need to be reviewed and revised.

The monitoring program comprises:

- TEC / PEC and other vegetation monitoring plan
- Drainage monitoring plan for TEC / PEC vegetation
- Triggers, thresholds and contingency actions for management of TEC / PEC vegetation

1 TEC / PEC AND OTHER VEGETATION MONITORING PLAN

The 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 Threatened and Priority Ecological Community (TEC and PEC) vegetation targeted in this monitoring plan comprises occurrences of the following Commonwealth listed TECs and State listed TECs and PECs:

- Banksia Woodlands of the Swan Coastal Plain (SCP) TEC – EPBC Act listed, also listed as a Priority 3 PEC ('Banksia Woodland TEC / PEC')
- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC, also listed as a Priority 3 PEC ('Tuart Woodland TEC / PEC')
- Southern SCP *E. gomphocephala – Agonis flexuosa* woodlands (floristic community type (FCT) 25) ('Tuart-Peppermint Woodland PEC')
- 'Herb rich shrublands in Clay Pans' FCT08 TEC, a component of the 'Clay Pans of the Swan Coastal Plain' TEC[1] (Clay Pans TEC)

Other sites that are not occurrences of TEC or PEC are also included in the vegetation monitoring program. Potential Impact (monitoring) sites as listed in Table 1, Sections 5.1.6.2, 5.1.7.2 and 5.1.8.2 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 / PEC vegetation that are located in close proximity to the Potential Impact Sites have been identified. The purpose of Reference Sites is to enable comparison of potential impact site data with data from sites located away from the Proposal Area and 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[2] have been identified for Tuart Woodland TEC and PEC, Tuart-Peppermint Woodland PEC and Claypan TEC, and three for Banksia Woodland TEC and PEC.

Monitoring Sites are listed in Table 1 and shown on Figure 1.

[1] No Claypan TEC occurrences will be impacted by the Proposal however one occurrence, situated approximately 500 m at its nearest from the Proposal Area is being included in the monitoring plan to enable the detection of any indirect impacts resulting from Proposal implementation.

[2] BTW-S-R-1 and BTW-S-R-2 meet the description of the Banksia and Tuart Woodlands TECs and PECs and FCT25 and function as Reference Sites for these community types.

Table 1 Potential Impact Site details

SITE / OCCURRENCE CODE AND TENURE	TEC / PEC TYPE	LOCATION AND LOT NUMBER
BTW-S-I-1 Private property	Tuart Woodland TEC / PEC and Tuart-Peppermint Woodland PEC; likely also meeting description for Banksia Woodland TEC / PEC	North side of Centenary Rd west of Bussell Hwy, north westernmost part of Proposal Area (P183835 / 632)
BTW-S-I-2 Road reserve and Reserve	Tuart Woodland TEC / PEC, Tuart-Peppermint Woodland PEC; likely also meeting description for Banksia Woodland TEC / PEC	Road reserve on the north side of Centenary Road east of Bussell Hwy, and extending into the adjacent reserve to the north (Road reserve, and P061603 / 9000)
BTW-S-I-3 Road reserve	Banksia Woodland TEC / PEC	Road reserve along Centenary Road east of Bussell Hwy, east of Site BTW-S-I-2 (No Lot or Location number)
BTW-S-I-4 Reserve	Banksia Woodland TEC / PEC	West of Bussell Hwy (two land parcels) (R23000 (land_id_nu: 3415480))
BW-S-I-6 Road isolation	Banksia Woodland TEC / PEC	Jilley Road north of Woods Road
BW-S-I-7 Private property	Banksia Woodland TEC / PEC	East of Yalinda Drive, west of Marchetti Road (P232768 / 156)
CP-S-I-1 Private property	Claypan TEC	South of Centenary Road, east of Bussell Hwy (P232800 / 244)
BTW-S-I-6	Not TEC / PEC	North of Ducane Road, east of Allenville Road (D042706 / 1)
BW-S-I-4 Private property	Not TEC / PEC	South of Centenary Road (P300292 / 160)
BW-S-I-5 Road reserve	Not TEC / PEC	Bussell Highway road reserve northbound, south of the alignment adjacent to the Capel Golf Course (No Lot or Location number)

Reference sites are listed in Table 2 and shown on Figure 1.

Table 2 Reference site details

REFERENCE SITE NAME	LOCATION	TEC / PEC TYPE
BW-S-R-1	Manea Park (R 32963)	Banksia Woodland TEC / PEC
BTW-S-R-1	North side of Centenary Rd west of Bussell Hwy, north westernmost part of PA (away from alignment) (P061603 9000)	Tuart Woodland TEC / PEC, Tuart-Peppermint Woodland PEC, Banksia Woodland TEC / PEC
BTW-S-R-2	North side of Centenary Rd east of Bussell Hwy (P003097 303 or 304)	Tuart Woodland TEC / PEC, Tuart-Peppermint Woodland PEC, Banksia Woodland TEC / PEC
CP-N-R-1	Waterloo Nature reserve (R46108)	Claypan TEC (FCT08)
CP-N-R-2	Manea Park (R16044)	Claypan TEC (FCT08)

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

- *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a)
- *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority 2016b)
- *Banksia Woodlands of the Swan Coastal Plain TEC Conservation Advice* (Threatened Species Scientific Community 2016)
- *Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain TEC* Conservation Advice (Threatened Species Scientific Community 2019)
- *Claypans of the Swan Coastal Plain TEC Conservation Advice* (Threatened Species Scientific Community 2012).

1.1 Personnel

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

1.2 Optimal timing

To maximise the proportion of native species recorded during the field surveys, monitoring of Banksia and Tuart Woodland 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 recommended 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 / PEC 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 / PEC 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 / PEC vegetation and any evidence of disturbance from the Proposal.

1.5 Site locations

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

The vegetation monitoring program is comprised of monitoring transects and photopoints. The methodologies for each approach are detailed below. Transect start and end points are denoted by inclusion of 'T' in the site name and photopoint locations are denoted by inclusion of 'P' in the site name.

1.6.1 Banksia Woodland TEC / PEC

One transect was established in each of the Banksia Woodland Sites BTW-S-I-3 and Site BTW-S-I-4, and one will be established in Site BW-S-I-6[3] (Figure 1). Two transects were established in Reference Site BW-S-R-1 and one each in Reference Sites BTW-S-R-1 and BTW-S-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 Banksia Woodland TEC / PEC. Transect design is described in section 1.7 and shown in Figure 2.

Photopoints were established in both Potential Impact and Reference Sites as detailed in section 1.8. Photopoint monitoring only will be conducted for the Banksia TEC occurrences at Site BW-S-I-7.

1.6.2 Tuart Woodland TEC and PEC, Tuart-Peppermint Woodland PEC

One transect was established at Tuart Woodland Site BTW-S-I-2 (Figure 1). One transect was established in each of the Reference Sites BTW-S-R-1 and BTW-S-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 Tuart TEC / PECs vegetation. Transect design is described in section 1.7 and shown in Figure 2.

Photopoint monitoring only will be conducted for the Tuart Woodland TEC / PECs occurrence at Site BTW-S-I-1. Photopoints were established in both Potential Impact and Reference Sites as detailed in section 1.8.

1.6.3 Claypan TEC

Photographic monitoring only will be conducted for the Claypan TEC Site CP-S-I-1 (Figure 1). Reference transects, including photographic monitoring points, were established in Claypan vegetation at Reference Sites CP-N-R-1 and 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.

1.6.4 Non-Tec / PEC vegetation

Photopoint monitoring only will be conducted at Sites BW-S-I-4, BW-S-I-5[4] and BTW-S-I-6.

1.7 Transect design

Monitoring transects 30 m in length were established within both potential impact 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.

[3] New Monitoring Site, not yet monitored
[4] New Monitoring Site, not yet monitored

1.8 Photo point design

Photopoints were established at the following locations:

- At the start and end point of each transect
- At each plot
- 5 m distance from the existing vegetation line at 50 m intervals around the Proposal Area boundary adjoining the Sites listed above.

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/fence post, and the stake installed for each monitoring event, and removed prior to leaving the site.

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 plant disease
- 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 (refer section 1.9).

The plant cover scale used for the photopoint monitoring (the Specht scale, a modified version of the Braun-Blanquet scale (Chytry *et al.* 2011)) is presented in Table 3.

Table 3 Photopoint plant cover scale

COVER SCORE	DESCRIPTION
1	Rare or of low cover (one or two or <2%)
2	Present but in low numbers (a few, 2% - 10%)
3	Common locally, not uniform over whole area (10% - 30%)
4	Common over whole area (30% - 70%)
5	Completely dominating overstorey or understorey (> 70%)

1.9 Transect 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[5], as shown in Table 4. The Domin-Krajina scale is appropriate for use at this fine scale.

Table 4 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 5.

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

Table 5 Plant stress scale

PLANT STRESS LEVEL	DESCRIPTION
5	Plant with >81 % of the original canopy present; healthy overall; little or no leaf yellowing. No evidence of wilting of foliage. Plants not stressed.
4	Plant with 61-80% of the original canopy present; occasional dead branches (< 20 % of canopy); small patches of leaf yellowing. Plant leaves may show signs of wilting at periphery. Plants potentially stressed.
3	Plant with 41-60 % of the original canopy present; some smaller dead branches evident (21-40 % of canopy); moderate amount of leaf yellowing (21-40 % of canopy). Plant leaves may show signs of wilting with noticeable curling of leaf periphery. Plants exhibiting symptoms of stress.
2	Plant with 21-40 % of original canopy present; some main branches dead (50 – 80 % of canopy; abundant leaf yellowing (> 41 % of canopy). Plant leaves may show signs of wilting with noticeable curling of leaf. Plants exhibiting signs of stress.
1	Plant with <20 % of original canopy; most main branches dead; remaining leaves mostly dying off. Plant leaves may show signs of wilting with noticeable curling of leaf (approaching closure). 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 (including plant disease) – visual evidence of dieback / disease
- 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 6 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 6 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 / PEC 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). The Drainage Monitoring Program will be conducted in addition to the Vegetation Monitoring Program, included above. Analysis of data collected will aim to determine the impact, if any, of Proposal implementation in regards to groundwater levels and quality, and any resulting effect on TEC and PEC vegetation.

2.1 Monitoring strategy – visual assessment

The purpose of visual assessment monitoring is to detect any flooding, erosion, inundation or drying of the TEC / PEC 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 and Tuart Woodland TEC / PEC and Tuart-Peppermint Woodland PEC)
- Erosion, or
- Drying (primarily for Claypan TEC) of TEC / PEC 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 / PEC occurrence impacted.

Should signs of plant stress be evident at any of the Potential Impact or Reference Sites, the Plant Stress Scale (Table 5) will be completed. Under the Vegetation Monitoring Program, for Claypan TEC vegetation, plant stress will also be assessed and recorded between late spring and late autumn, via the methodology described in that program.

Comparison with Reference Site monitoring results will be used to assess 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 are more likely to be evident from late spring through to late autumn, and will likely comprise yellowing, wilting and dying off of vegetation, as well as the site drying out at a faster rate after winter. Comparison with groundwater data (see section 2.2) will be used to inform the assessment and attribution of cause of vegetation response.

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 / PEC vegetation attributable to Proposal activities is detected, monitoring will continue for a further year.

2.1.2 Data analysis

Data analysis will involve comparison of 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 water quality and water levels in groundwater wells and surface water locations within or nearby the Proposal Area commenced in August 2019, to enable the collection of baseline data (Table 7). Some of these wells are located in close proximity to the TEC / PEC vegetation sites included in the Vegetation Monitoring Plan. Location and depth information is provided in Table 8.

The monitoring program will be undertaken as per Table 7 during and post construction. Water levels and quality will continue to be monitored to determine impacts of Proposal implementation on ground and surface water. Sample analysis will be conducted using appropriate field test equipment and laboratory samples will be tested in a NATA accredited laboratory.

Table 7 Potential Impact Site monitoring points (TEC / PEC sites) and monitoring design

LOCATION	TEC SITE LOCATION	MONITORING SITE TYPE	PARAMETER BEING MONITORED	MONITORING FREQUENCY	
				DURING CONSTRUCTION	POST CONSTRUCTION
Surface water					
SW10 (surface water)	BW-S-I-6	Surface water	Water depth	Monthly	Quarterly for one year
			Physical and water chemistry[6]		
Groundwater					
BORR_MW46	BTW-S-I-1, BTW-S-I-2, BTW-S-I-3	Ground water	Water level	Monthly	Monthly for one year
BH27.1	BTW-S-I-4				
MR MW05	BTW-S-I-6				
BORR_MW06	BTW-S-I-4				
BORR_MW08	BW-S-I-6		Physical and water chemistry	Quarterly Monthly if Field TTA 40-100mg/L and pH less than 6	Quarterly for one year
BORR_MW08a	BW-S-I-6				
BORR_MW09	BW-S-I-7				
Up to four monitoring wells outside of the Proposal Area	N/A	Ground water	Physical and water chemistry	Quarterly	Quarterly for one year

[6] Monitoring includes a comprehensive suite of physical and water chemistry parameters (BORR, 2020b).

Table 8 Potential Impact Site monitoring location and depth information

NAME	EASTING	NORTHING	DEPTH (M)
Surface water			
SW10	373337	6300496	NA
Groundwater			
BORR_MW46	373883	6305094	Depth to water (March 2020): 4.514 m Total depth: 5.994 m
BH27.1	-	-	TBC
MR_MW05	375313	6302189	Depth to water (March 2020): 2.867 Total depth: 4.981 m
BORR_MW06	371109	6299068	Depth to water (September 2019): 6.730 m Total depth: 7.841 m
BORR_MW08	373588	6300392	TBC
BORR_MW08a	373588	6300392	Depth to water (September 2019): 3.971 m Total depth: 5.731 m
BORR_MW09	374241	6301013	Depth to water (March 2020): 4.145 m Total depth: 5.32 m

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.

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

Triggers, thresholds and contingency actions for TEC / PEC vegetation included in this Monitoring Plan 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.

3.1 Flooding / inundation of TEC / PEC vegetation

The threshold identified for flooding / inundation of TEC / PEC vegetation is three days of inundation. In the vicinity of the Proposal Area, Banksia Woodland TEC / PEC, Tuart Woodland TEC / PEC and tuart-Peppermint Woodland PEC vegetation occurs in upland areas on free draining sandy soil. Inundation or flooding of these areas would therefore naturally occur infrequently and for short duration, and as such, it is in these communities where inundation would be expected to have the most significant impact. Inundation or flooding of these areas as a result of Proposal implementation to the extent that inundation for three consecutive days occurs is highly unlikely.

No published information regarding the tolerance of Tuart or Banksia Woodlands to inundation is available however one study (Groom, 2004) has shown that *Banksia prionotes*, a species common to the Banksia Woodland community in the Perth region is impacted by inundation after 28 days, with 22 % mortality of seedlings recorded, and another (Heliyanto, 2006) indicates that *B. ilicifolia*, which occurs in Banksia Woodlands adjacent to the Proposal Area, shows reduced seedling growth and root development as well as leaf senescence after 42 days of waterlogging. These results, and the fact that this community occurs on uplands not frequently subject to inundation leads to the assumption that the community's inundation tolerance is low.

Cognisant of these factors and the low risk of this impact occurring, the requirement of a response after three consecutive days of inundation is considered a reasonable amount of time with regard to organising the response and mitigating the impact

3.2 Reportable decline

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

Table 9 Triggers, thresholds and contingency actions

MONITORING PARAMETER	MONITORING TIMING, METHODOLOGY AND FREQUENCY	TRIGGER	THRESHOLD	CONTINGENCY ACTION
Erosion	During construction: Visual inspection opportunistically and weekly Prior to, during and post construction: Visual assessment biannually and plant health assessment annually	Evidence of new erosion in monitored TEC / PEC vegetation	Evidence of new erosion in monitored TEC / PEC 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 / PEC 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	During construction: Visual inspection opportunistically and weekly Prior to, during and post construction: Visual assessment biannually and plant health assessment annually	TEC / PEC vegetation is inundated or flooded for 24 hours as a result of Proposal activities	TEC / PEC 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 /PEC vegetation) • Determine if rehabilitation is required (i.e. if soil erosion is evident) in consultation with DBCA if within TEC / PEC 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

MONITORING PARAMETER	MONITORING TIMING, METHODOLOGY AND FREQUENCY	TRIGGER	THRESHOLD	CONTINGENCY ACTION
				• Monitor the effectiveness of the control(s).
Drying of Claypan TEC vegetation	During construction: Visual inspection opportunistically and weekly Prior to, during and post construction: Plant health assessment biannually or as recommended by DBCA	Plant health scores decline by one health class relative to Reference Sites in two consecutive monitoring periods	Drying continues to breach trigger levels two months after management / mitigation measures are implemented	• Investigate the cause and raise an incident report • Cease dewatering or other drying activities • 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	Prior to, during and post construction: Monthly	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)	During construction: South Creek 4 (surface water) monthly	Exceedance of ANZECC guideline values[7] (slightly/ moderately	Exceedance of ANZECC guideline values (slightly/ moderately	• 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

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

MONITORING PARAMETER	MONITORING TIMING, METHODOLOGY AND FREQUENCY	TRIGGER	THRESHOLD	CONTINGENCY ACTION
	Ground water wells quarterly Post construction: Both surface and ground water quarterly	disturbed wetlands in the SW) and/or significant difference from baseline conditions in one monitoring period	disturbed wetlands in the SW) and/or significant difference from baseline conditions in two consecutive monitoring periods	• Remedial action controls will be undertaken if required – to be determined based on likely cause e.g. 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	During construction: Visual inspection opportunistically and weekly Prior to and post construction: N/A	Sparks or unplanned fire resulting from Proposal activity that have the potential to impact TEC / PEC vegetation	Sparks or unplanned fire detected from project activity within 100 m of TEC / PEC vegetation	• Implement emergency evacuation and response plans • Investigate cause and raise an incident report • Review management procedures.
Reportable decline	During construction: Visual inspection opportunistically and weekly Prior to and post construction: Plant health assessment biannually (or as recommended by DBCA for Claypan TEC)	TEC / PEC vegetation health shows a decline on baseline levels	TEC / PEC 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 / PEC 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. Implement Hydrological contingency actions as detailed in Section 2.4.2

MONITORING PARAMETER	MONITORING TIMING, METHODOLOGY AND FREQUENCY	TRIGGER	THRESHOLD	CONTINGENCY ACTION
				• 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 Project 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 / PEC vegetation. Update / revise management measure if needed (impact persists despite management actions).

4 REFERENCES

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Threatened Species Scientific Committee (TSSC). (2019). *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community*. Canberra: Threatened Species Scientific Committee via the Department of the Environment and Energy.

APPENDIX A

Figures

Paper Size ISO A3

0 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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LEGEND

- BORR Southern Section Referral Boundary
- Cadastre

TEC/PEC monitoring and reference sites

- Banksia Woodlands TEC / PEC
- Claypan TEC (FCT08)
- Tuart Woodlands TEC / PEC and Tuart-Peppermint Woodland PEC
- Tuart Woodland TEC and PEC, Banksia Woodland TEC and PEC

Hildas Cl
Winthrop Av
Oriel Ct
Hertford Elb
Oriel Ct
Christchurch Pl
St Peters Grn
St Peters Grn
St Peters Grn
Magdalen Pl
Darwin Way
Somerville Dr
Hall Cl
Somerville Dr
Cavendish Grn
Pembroke St
Clare Row
St Annes Dr
Possum Way
Peppermint Bvd
Peppermint Bvd
Lakeside Dr
Peppermint Bvd
Merton Av
Lakeside Dr
Lakeside Dr
Melaleuca Dr
BW-S-R-1
BW-S-R-1
BTW-S-R-1
COLLEGE GROVE
CP-R-2
TW-S-I-2
BW-S-I-3
BW-S-I-3
Centenary Rd
CP-S-I-1
NORTH BOYANUP
1
2
3
4
5
6
7
8
9
10
SLIP
POWERED BY LANDGATE

Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
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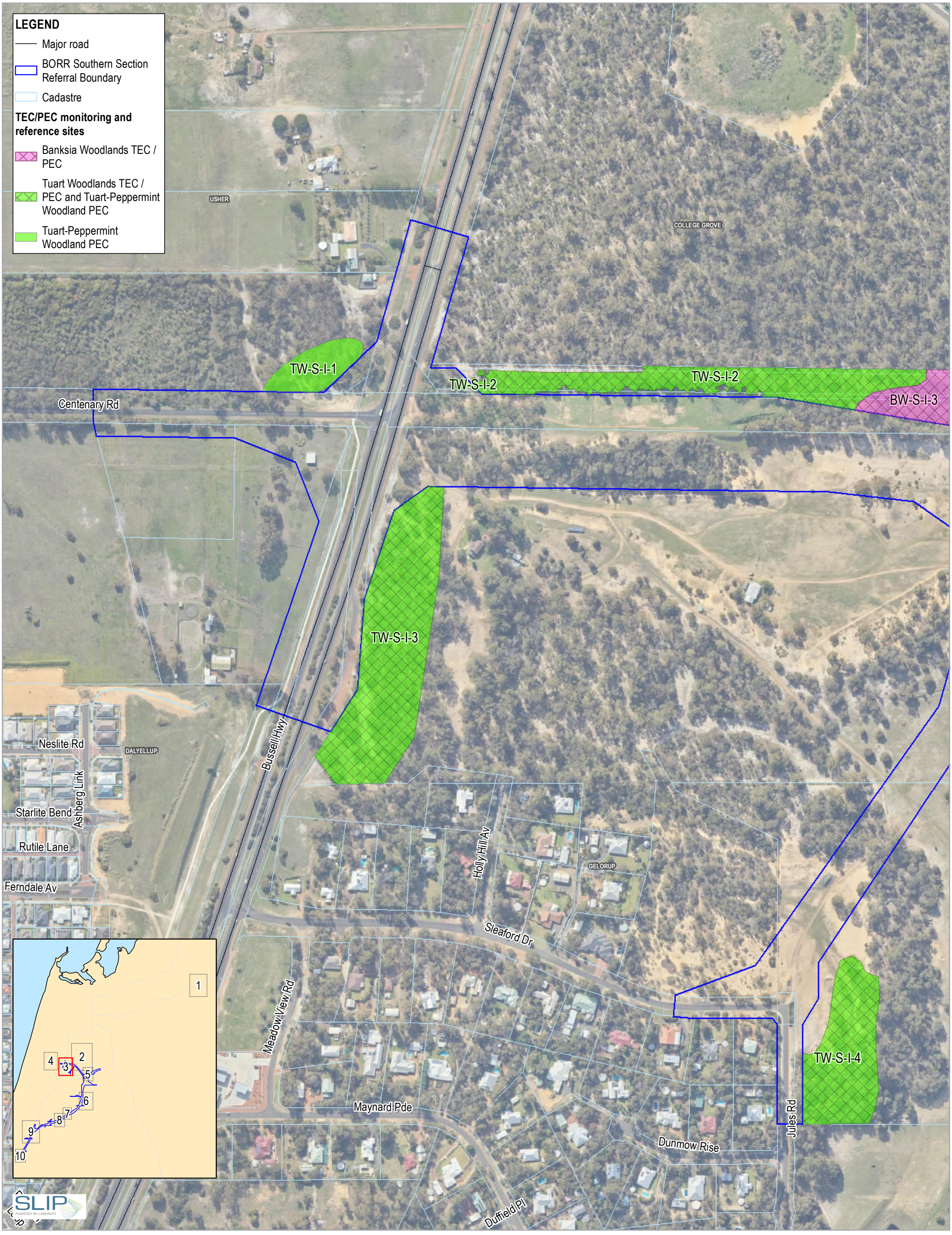

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LEGEND

Cadastre

TEC/PEC monitoring and reference sites

Tuart Woodland TEC and PEC, Banksia Woodland TEC and PEC

Carlson Pl
Coote Pl
Foreman Dr
Honey Lane
Payton Way
Nowland Ct
Liam St
Dudley Dr
O'Meehan Grn
Carr Pl
Brand Av
Thunder Way
Gillman Lane
Pritchard Crss
Griffin Lane
Lloyd Way
Monger Ct
Meredith Way
Yardley Ct
USHER
Serpentine Way
Mosedale Av
BTW-S-R-2
Parade Rd
Centenary Rd
Karnet Link
DALYELLUP
Beraking Loop
Quilben Rd
Barton Link
Wuraming Bend
Mooralup Turn
Lewana App
Gorrie Lane
Ferndale Av
McLeod Lane
Jacob St
Jacinth Rd
Pyrite Way
Flint Lane
Neslite Rd
Jargoon App
Chalk Lane
Starlite Bend

1 2 3 4 5 6 7 8 9 10

SLIP POWERED BY LANDGATE

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Metres

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LEGEND

BORR Southern Section Referral Boundary

Cadastre

TEC/PEC monitoring and reference sites

Not TEC/PEC

BW-S-I-4

NORTH BOYANUP

1 2 3 4 5 6 7 8 9 10

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Paper Size ISO A3

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LEGEND

- BORR Southern Section Referral Boundary
- Cadastre

TEC/PEC monitoring and reference sites

- Not TEC/PEC

Allenville Rd

Hasties Rd

NORTH BOYANUP

GELORUP

BW-S-I-1

BW-S-I-1

BW-S-I-1

BW-S-I-1

Ducane Rd

Ken Bell Rd

1 2 3 4 5 6 7 8 9 10

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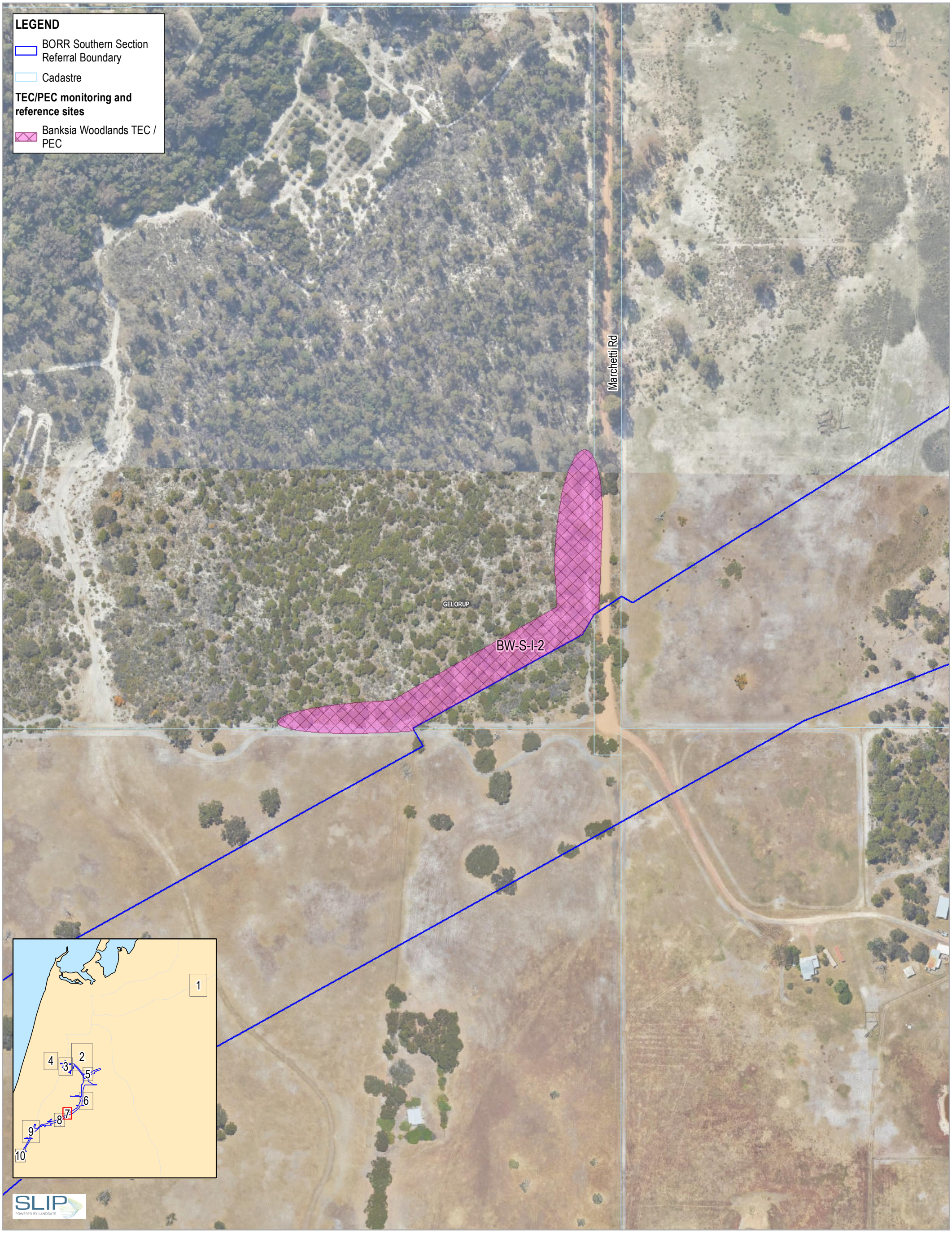

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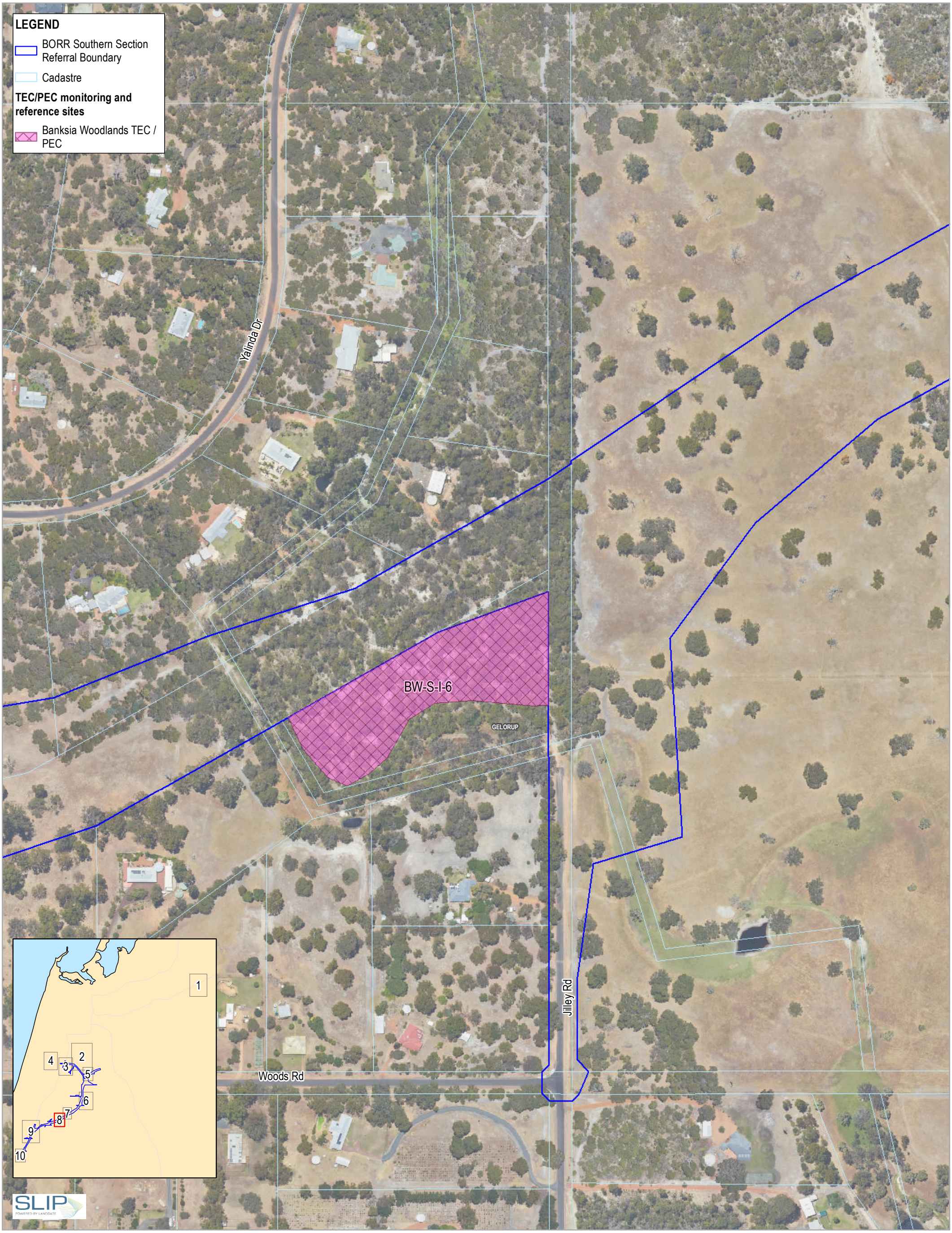

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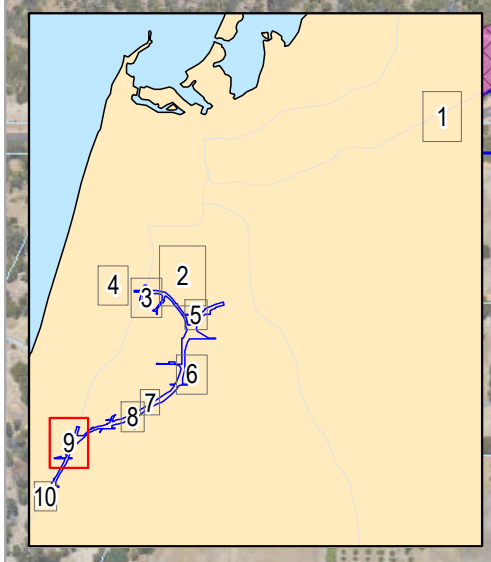
LEGEND

- Major road
- BORR Southern Section Referral Boundary
- Cadastre

TEC/PEC monitoring and reference sites

- Banksia Woodlands TEC / PEC

Bussell Hwy
Woods Rd
DALYELLUP
BW-S-I-4
STRATHAM
GELORUP
Brockway Dr
Manea Dr
Lakes Rd
BW-S-I-4
Tamra Cl
Calinup Rd
STRATHAM



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Metres

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Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
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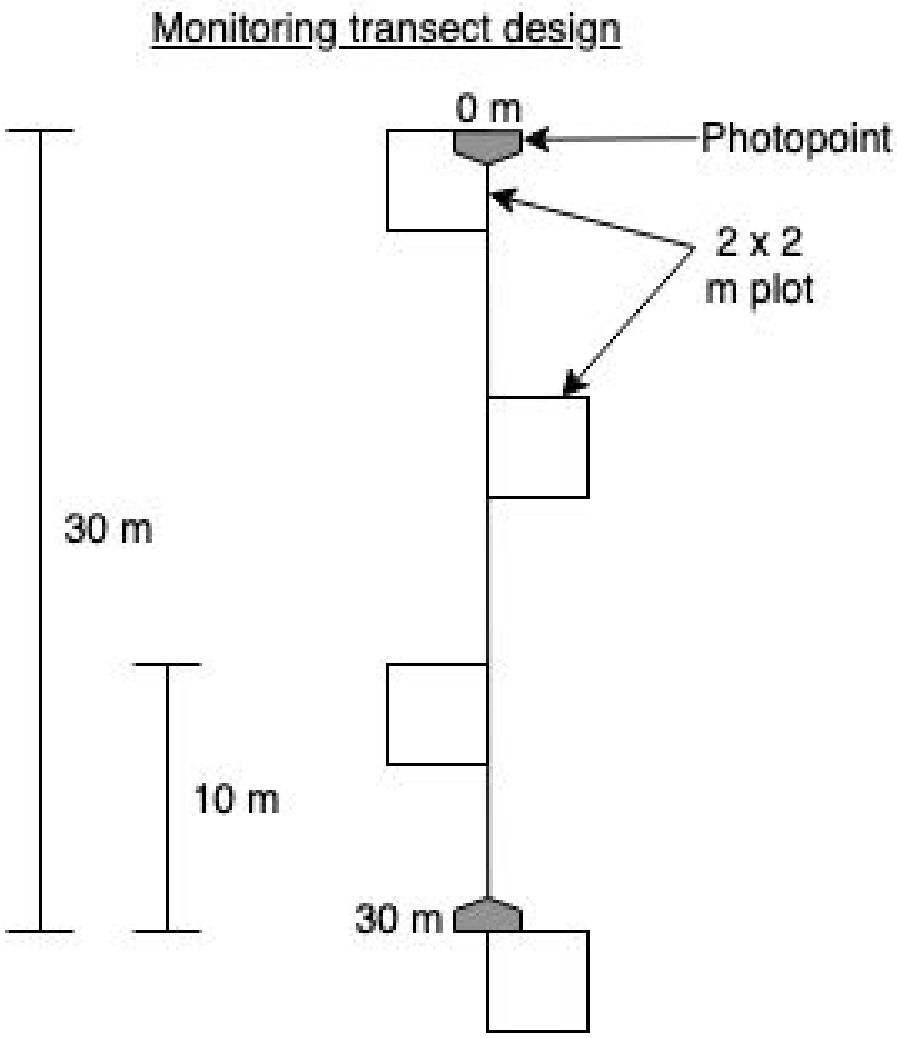
Figure 2 **Layout of a monitoring transect**



BORR_MW46

Centenary Rd

Bussell Hwy

Neslite Rd

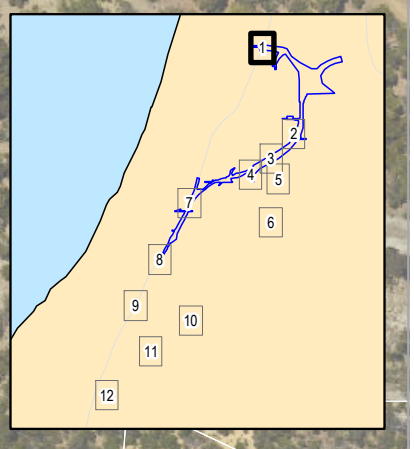
Ashberg Link

Starlite Bend

Rutile Lane

Holly Hill Av

SLIP POWERED BY LANDGATE



LEGEND

- Ground water monitoring well
- Main Road
- Minor Road
- Track

Paper Size ISO A3

0 25 50 75 100

Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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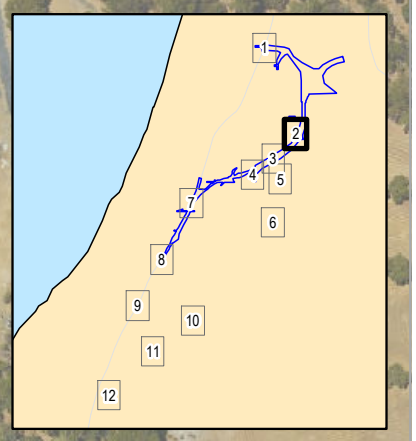
MR_MW05

BORR_MW10

Ducane Rd



LEGEND

- Ground water monitoring well
- Watercourse
- Minor Road

SLIP POWERED BY LANDGATE

Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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5 MILE BROOK

Marchetti Rd

BORR_MW09

LEGEND

Ground water monitoring well

Watercourse

Minor Road

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Yalinda Dr

SW10

5 MILE BROOK

BORR_MW08a

BORR_MW08

Jilley Rd

Woods Rd

LEGEND

- Ground water monitoring well
- Surface water monitoring well
- Watercourse
- Minor Road

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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BORR_S_10

LEGEND

Surface water monitoring well

Watercourse

SLIP POWERED BY LANDGATE

Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
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Ground and surface water monitoring site and well locations

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Revision No. **0**
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Print date: 27 Jul 2020 - 12:55

Data source: Geoscience Australia: GeoData Topo 250k Series III - 2006; Landgate: Roads, Watercourses - 20180501, Imagery - WA Now accessed 20200727t; BORR: Proposal Area - 20191212, Sampling locations - 2018-19. Created by: slei

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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BH 27.1

BORR_MW06

Bussell Hwy

Brockway Dr

Lakes Rd

Tamra Cl

Calinup Rd

LEGEND

- Ground water monitoring well
- Main Road
- Minor Road

Paper Size ISO A3

0 25 50 75 100

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BORR_MW04

SW11

Bussell Hwy

LEGEND

- Ground water monitoring well
- Surface water monitoring well
- Main Road
- Minor Road

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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0 25 50 75 100

Metres

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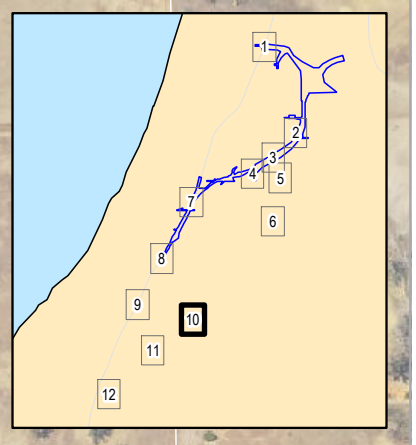
BORR_S_04

Boyanup Rd



LEGEND

- Surface water monitoring well
- Watercourse
- Main Road

SLIP POWERED BY LANDGATE

Paper Size ISO A3

0 25 50 75 100

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BORR_S_02

GYNUDUP BROOK

LEGEND

Surface water monitoring well

Watercourse

Track

Paper Size ISO A3

0 25 50 75 100

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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0 25 50 75 100

Metres

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Data source: Geoscience Australia: GeoData Topo 250k Series III - 2006; Landgate: Roads, Watercourses - 20180501, Imagery - WA Now accessed 20200727t; BORR: Proposal Area - 20191212, Sampling locations - 2018-19. Created by: slei

Figure 4 Threshold breach response process