

APPENDIX F

DRAINAGE MONITORING PROGRAM FOR TEC / PEC VEGETATION

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Monitoring for changes to hydrology and drainage will be undertaken through a combination of visual assessments and assessment of data collected from monitoring wells.

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 Threatened and Priority Ecological Community (TEC and PEC) vegetation.

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.

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 Woodlands TEC / PEC)
- Erosion, or
- Drying (primarily for Claypan and Floristic Community Type (FCT) 3c TECs) 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.

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

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 MONITORING STRATEGY – GROUND AND SURFACE WATER WELLS

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 1). 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 2.

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 Site 9, 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 Site 9 (~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 1 Potential impact site monitoring points (TEC/PEC sites)

Location	TEC / PEC site location	Parameter being monitored
North Creek 4 (surface water)	Sites 3a, 3b, 4, 5, 6, and 7	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 3a, 3b, 4, 5, 6, and 7 (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 3a, 3b, 4, 5, 6, and 7	
BORR_MW22b	Sites 3a, 3b, 4, 5, 6, and 7	
BORR_MW28	Sites 1 and 2	
BORR_MW29	Sites 1 and 2	

Table 2 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 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.

3 MONITORING LOCATIONS, REQUIREMENTS, FREQUENCY AND DURATION

The monitoring program will be undertaken as per Table 3 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 3 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

Sampling location	Requirement	During construction	Post construction
BORR_MW21, BORR_MW22, BORR_MW22b, BORR_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_MW22b, BORR_MW28, BORR_MW29	Water level data logging – telemetry	Monthly	Monthly for one year
Up to four monitoring wells outside of the Proposal Area	Total nitrogen, Total phosphorus, Heavy metals, Total Acidity, pH, Dissolved oxygen, Conductivity	Quarterly	Quarterly for one year

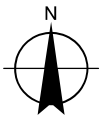
4 DATA ANALYSIS

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 be 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.



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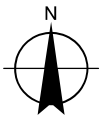
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Monitoring sites

FIGURE 1



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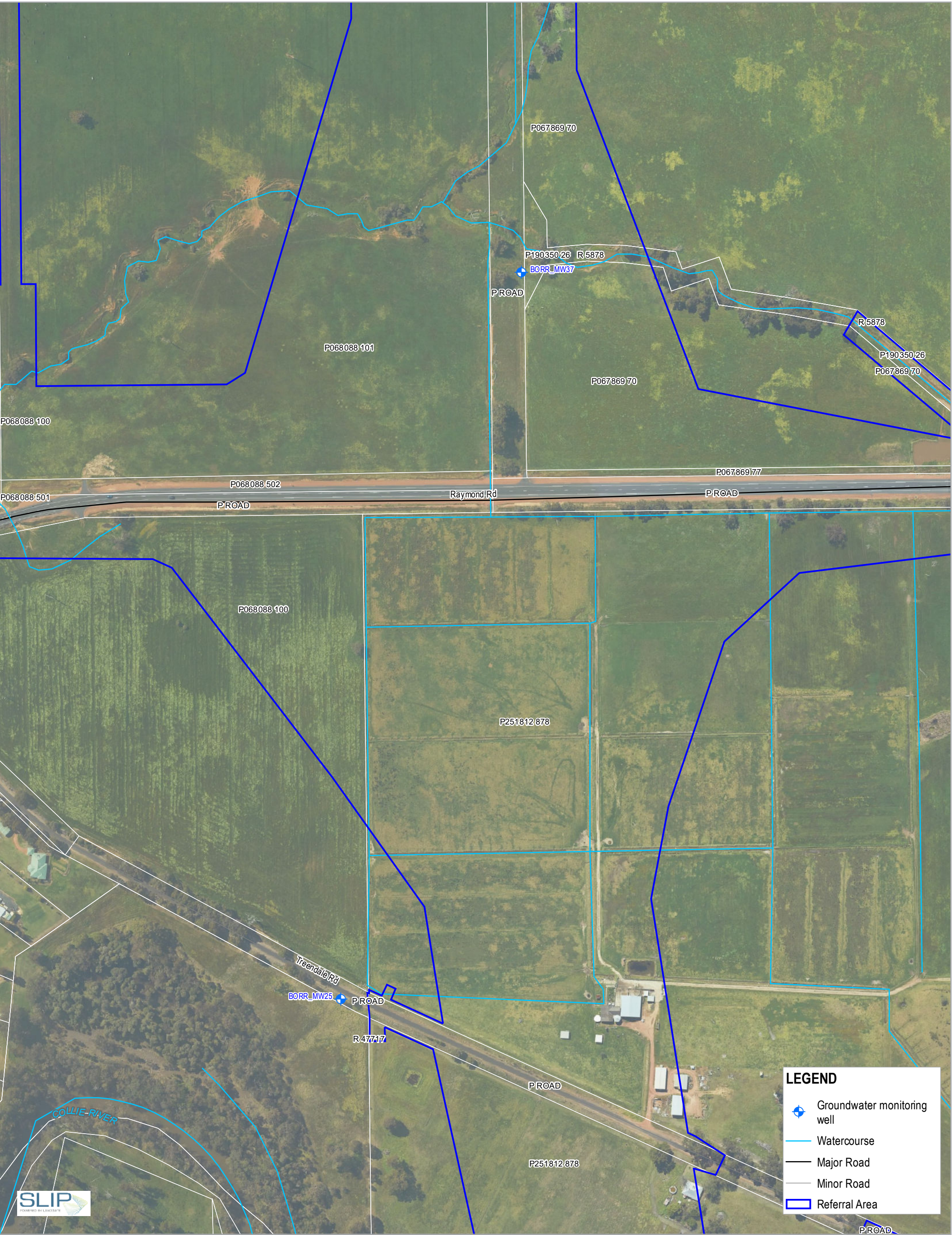
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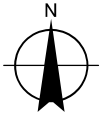
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FIGURE 1



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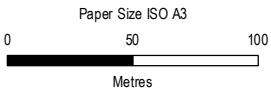
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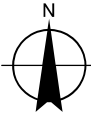
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FIGURE 1



Map Projection: Transverse Mercator
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FIGURE 1



LEGEND

Groundwater monitoring well

Surface water monitoring location

Watercourse

Major Road

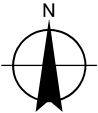
Minor Road

Referral Area

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Metres

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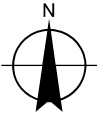
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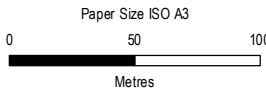
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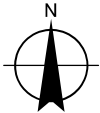


LEGEND

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



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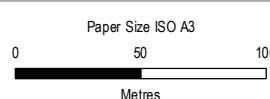
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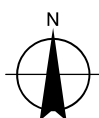
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FIGURE 1



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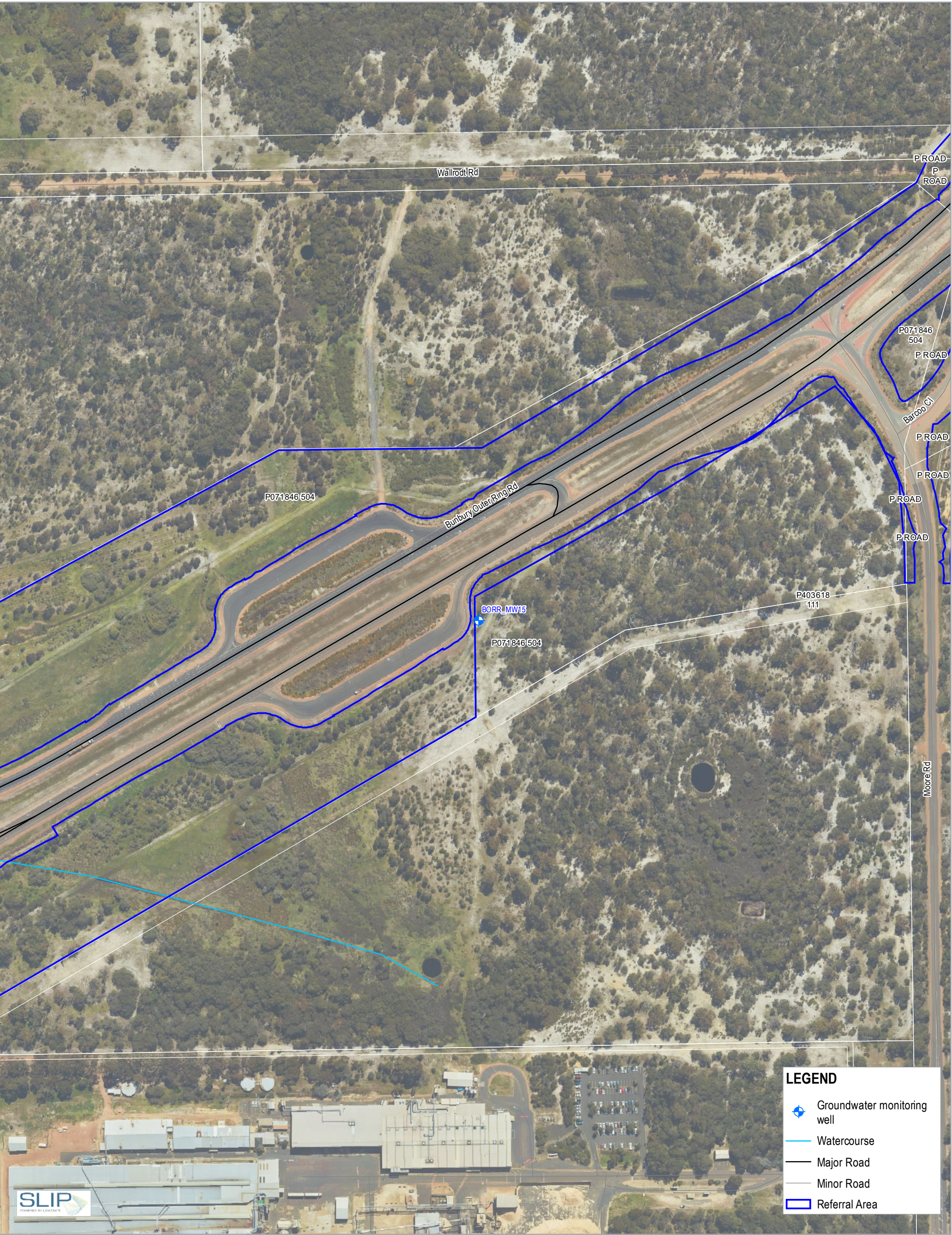
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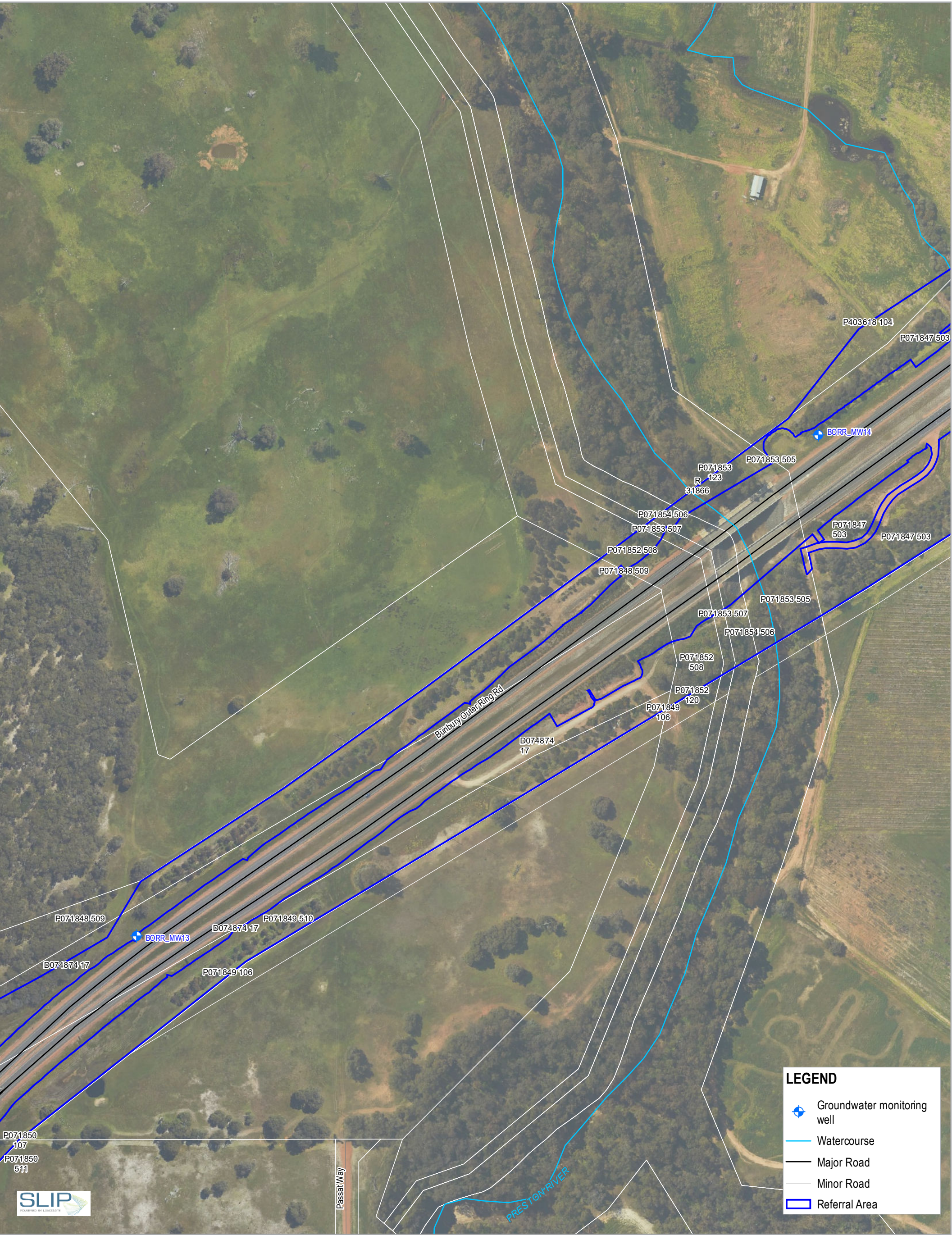
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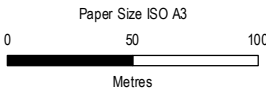
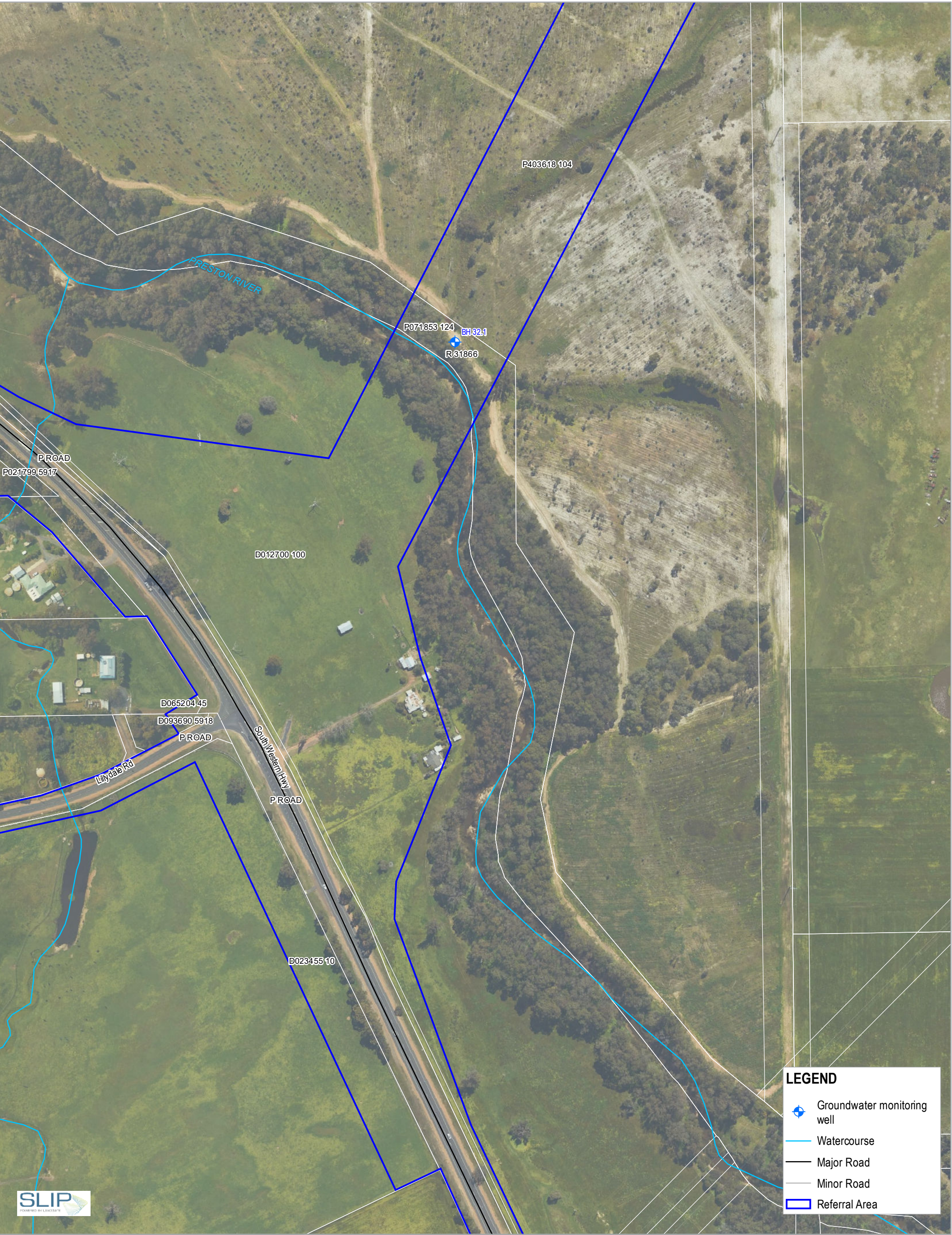
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Monitoring sites

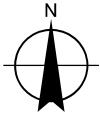
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FIGURE 1